considerably across the state and is correlated approximately with elevation. Annual average wind speed in most areas is within the range of 4-7 meters/second. Wind potential is typically higher offshore than onshore.

Detailed maps of solar and wind potential in Oregon are included in the ORESA Mapping and Reporting tool, available at: **https://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=renewable**

Site Characteristic 2: Access to Existing Transmission and Distribution Networks with Available Capacity and Interconnection

The REIMA portion of the ORESA process found that access to available transmission with injection capacity is a significant challenge for renewable energy development: "Transmission access will be key to the future of renewable energy development in the state. Many areas of Oregon with high renewable energy potential have limited transmission capacity—there is less transmission infrastructure to access Oregon's best solar resources in central and southeastern Oregon, and where more significant transmission infrastructure does exist, such as along the Columbia Gorge, there is limited available capacity for new additions of generation. Without additional transmission infrastructure, Oregon will face challenges accessing its renewable energy potential" (ODOE 2022a). Three of the four large-scale solar projects that are currently operating in Oregon are located near Prineville, which is also home to several large technology data centers (Rogoway 2018). As major consumers of electricity, these entities provide a ready offtaker with substantial infrastructure capacity, circumventing the issue of transmission availability.

Maps of existing transmission lines and substations are available at: **https://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=renewable**

Pronghorn buck at Hart Mountain National Antelope Refuge in southeast Oregon.

Site Characteristic 3: Areas with Low Biodiversity Conflicts

Climate change is one of the top threats to biodiversity worldwide and its impacts are accelerating, although other threats like habitat loss, pollution and over-exploitation remain important and must not be ignored (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2019). Expanding the production and use of renewable energy is one of our most important tools to combat climate change (Intergovernmental Panel on Climate Change [IPCC] 2022), but it too can have local, regional or population-level impacts on wildlife and habitat. One example of this in the Northwest is the detrimental effect of hydropower on salmon populations (NWPCC n.d.).

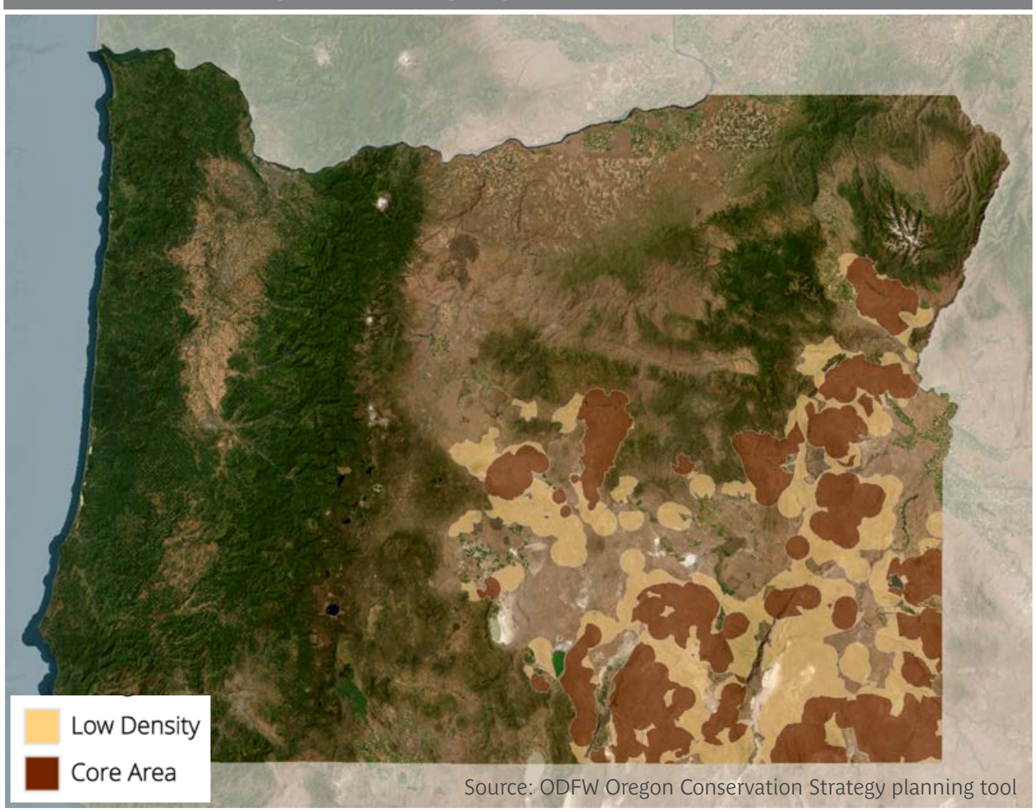
Concerns about wildlife impacts from wind turbines date nearly to the first large-scale wind power installations in the 1980s. The facility at Altamont Pass, California, was found to kill a surprising number of eagles and other raptors due to a combination of siting, land management and an early turbine design with lattice supports that encouraged perching near the rotor-swept area (Smallwood and Thelander 2005). Wind power has also been linked to potential direct impacts to other bird species and bats and to habitat effects for species like sage-grouse. However, a large body of information and practice has emerged to help understand, avoid and minimize both collision risk and habitat impacts (see https://rewi.org/results-catalog/). Concerns have been raised about the effects of solar power development on birds (Walston et al. 2016), migrating ungulates (Sawyer et al. 2022) and other species. The first-ever joint report of the global scientific consortia working on climate change (IPCC) and on biodiversity loss (IPBES), warned that solutions to climate change, including renewable energy development, "can pose serious threats to biodiversity" and that "to be holistically effective, renewable energy development will benefit from consideration of a circular economy and, ultimately, biodiversity" (Pörtner et al. 2021, Finding 20).

Siting in areas with low biodiversity value would avoid these negative impacts as well as reduce time and cost to the developers. In a study of the sources of opposition to renewable energy projects, Susskind and colleagues (2022) found that environmental conflicts played a role in 60% of the case studies that they investigated. Specific biodiversity concerns that they highlighted include impacts to eagles, sage-grouse and other bird species, bats, mammal migrations, sensitive aquatic habitats and ecosystem services. A study in California compared large-scale solar development on eight parcels with low biodiversity value and eight parcels with high biodiversity value. The authors found that developments in low-biodiversity areas were permitted much more quickly (13 months on average) than those in areas of high biodiversity value (35 months on average). Furthermore, costs associated with mitigation, reclamation and species management averaged $0.14/watt or $9,000/acre less expensive on low-biodiversity-value lands than on high-biodiversity-value lands (Dashiell et al. 2019).

The EFSC standards that govern utility-scale renewable energy siting in Oregon require that proposed projects avoid, minimize or mitigate impacts to species listed as threatened or endangered and to high value habitats identified by the Oregon Department of Fish and Wildlife (ODFW). The ORESA map depicts some of these high value habitats, including wetlands and deer and elk winter range. In addition to the listed species and habitats that must be considered by EFSC, ODFW has produced the Oregon Conservation Strategy, which identifies "strategy habitats" and "strategy species" as key conservation targets (ODFW 2016). The strategy habitats include sagebrush ecosystems, grasslands, and several forest and woodland types including oak and aspen woodlands, ponderosa pine forests and late successional conifer forest. The 294 strategy species[6] were determined to be "Species of Greatest Conservation Need" on the basis of small or declining populations, at-risk status or other management concerns. Greater sage-grouse (Figure 4), northern spotted owl and Columbian white-tailed deer are a few examples of such species. The Conservation Strategy habitats and species can be viewed in an online map here: https://compass.dfw.state.or.us/visualize.

The Oregon Biodi-

Figure 4. ODFW greater sage-grouse core habitat areas



Source: ODFW Oregon Conservation Strategy planning tool

6 The strategy species include 17 amphibians, 58 birds, 29 mammals, five reptiles, 60 fish, 62 invertebrates, and 63 plants and algae.

versity Information Center (ORBIC)—part of the Institute for Natural Resources, a cooperative venture of Oregon's public universities—catalogs the recorded locations of rare plants and wildlife and maintains lists of all species in the state ranked by rarity and risk of extirpation. In addition to these lists, ORBIC provides an online wildlife viewer (**https://oe.oregonexplorer.info/Wildlife/WildlifeViewer**) that can be used to generate statewide maps of modeled habitat for any wildlife species, as well as lists of all species present in a given county, ecoregion, basin or watershed. ORBIC also manages the Oregon Explorer map viewer (**https://tools.oregonexplorer.info**), an interactive map with various natural resource layers including a detailed depiction of all habitat types in the state.

There are many examples of processes, guidelines and datasets for determining the habitat and biodiversity value of a site and for avoiding sites where large effects may occur. Different sets of existing guidelines have taken various approaches to identifying and reducing environmental impacts. The following examples illustrate some of these approaches, with each generally focused on different aspects of environmental impact.

Sage-grouse in snow.

Habitat Avoidance Approaches

Several guidance documents outline habitat types that are of concern for a particular state or region and recommend avoiding development in those key habitats. For instance, the Maine Department of Inland Fisheries and Wildlife's (MDIFW) *Solar Energy Project Resource Guidance and Recommendations* (MDIFW 2020) recommends avoiding the habitats of rare, threatened and endangered species identified by the Maine Endangered Species Act. Other areas to be avoided are Significant Wildlife Habitats and Protected Natural Resources identified by state law. Significant Wildlife Habitats include deer wintering areas, seabird nesting islands, salmon areas, vernal pools, and waterfowl/waterbird habitat. Protected Natural Resources include coastal dunes, rivers, wetlands and fragile mountain areas.

Scenic Hudson's *Guide to Siting Renewable Energy in the Hudson Valley* (Friedrichsen 2018) also recommends avoiding certain types of resources: "wildlife and other critical habitat, including intact and connected wildlife corridors and migratory bird flyways; streams and stream corridors; wetlands and wetland buffer areas; river corridors and floodplains; ridgelines, steep slopes and other sensitive geological and hydrogeological formations; and valuable contiguous forests, such as those that serve as critical wildlife habitat and migration corridors, serve as carbon sinks or provide climate change resiliency."

The Wyoming Game and Fish Department's (WGFD) *Guidelines for Wind and Solar Energy Development* (WGFD 2021) emphasizes assessing habitat value and avoiding the highest value areas, selecting previously disturbed sites and communicating with the WGFD: "The selection of a project location and siting of infrastructure within the project area are the most critical choices in avoiding impacts to fish and wildlife from renewable energy development. Proponents should avoid high-value or sensitive fisheries and wildlife resources and large areas of unfragmented habitat, which can be identified through coordination with the Department and using geospatial data provided on the Department's website." While acknowledging that resource considerations may vary by region and renewable energy technology, the guidelines provide a framework for avoiding impacts to aquatic resources, federally threatened and endangered species, greater sage-grouse and several other bird species, bats, big game, and special fish and wildlife habitat features such as rock outcroppings, cliffs, caves, unique vegetation communities, riparian areas, springs, wetlands, water, nearby fish spawning locations, migration stopover habitat and food resources.

In Oregon, the EFSC siting standards require avoidance, minimization and mitigation of impacts to high value habitats, in accordance with the ODFW Habitat Mitigation Policy, which is broadly applicable to development activities (Oregon Secretary of State 2022b).

Use of the previously described Oregon natural resources mapping tools early in the planning process may facilitate selection of less biologically sensitive areas and minimize the need for potentially expensive mitigation. The tools may also be used to identify and avoid habitats outside the scope of the EFSC requirements, such as strategy habitats and areas occupied by strategy species, a voluntary approach that would highlight a proposed project's commitment to avoiding biodiversity conflicts.

Tiered Approach: *U.S. Fish and Wildlife Service (FWS) Land-Based Wind Energy Guidelines* (FWS 2012) and the Oregon Columbia Plateau Guidelines (2008)

The voluntary Wind Energy Guidelines (WEGs) were developed following a several-year process in which a Federal Advisory Committee was convened by FWS that included conservation organizations, clean energy advocates, federal and state agencies, a tribal representative, wind industry representatives and academia. The WEGs are intended to help wind developers assess, avoid, minimize and compensate for impacts to species of concern, including migratory birds, bats, eagle and grouse species, and federally or state protected species. Although the WEGs are voluntary, FWS takes adherence to their methodology and communication protocol into account in the event of a violation of federal wildlife laws.

The tiered approach of the WEGs is intended to work in parallel with the site selection and evaluation process, wherein the developer assesses wind energy potential, transmission infrastructure, realty concerns and potential conflicts. The WEGs are specifically geared toward wildlife concerns and do not evaluate other sources of potential conflicts such as prime farmland, cultural resources or visual impacts. However, the preconstruction evaluation process encompassed by Tiers 1 through 3 (described below) could be adapted as a framework to gather increasingly specific information about these type of resource concerns as well.

Tier 1, the preliminary site evaluation, uses publicly available information and databases to identify places where wind energy development "poses significant risks to species of concern" or to screen a landscape or one or more potential sites to gain preliminary information about risks to wildlife and habitat. In the years since the publication of the WEGs, the amount and quality of publicly available information that a developer can draw on has increased significantly. The ORESA Mapping and Reporting Tool is an excellent example of the type of information that could inform a Tier 1 assessment for wildlife and other resources. It could be applied to either wind or solar energy. However, given the possibility that sensitive information about species, cultural resources or other potential sources of conflict might not be publicly available, communication with appropriate federal, state and tribal entities can help ensure that a full suite of information is considered.

Tier 2 is the site characterization, applicable when the developer is considering one or a few specific sites. It entails one or more site visits at appropriate times of the year to determine if known species of concern or their habitats are present on the site or if the site contains areas that are sensitive or precluded from development. This tier represents a more formal ground-truthing of site conditions. In some cases, Tier 2 information may clearly indicate that a site is of sufficiently low risk that the developer can proceed to permitting and development or of such high risk that the site should be abandoned. If uncertainty remains, the developer can move to Tier 3, which entails more detailed field surveys to characterize risk and identify potential mitigation options.

Another resource that offers a form of tiered approach that predates the WEGs is the 2008 Oregon *Columbia Plateau Ecoregion Siting and Permitting Guidelines*. This document, which has informed the siting practices of the ODFW and EFSC and was one of the resources consulted in the development of the WEGs, describes a siting process that includes 1) Macrositing, an early assessment that involves a literature review and initial scoping with agencies; 2) Pre-project Assessment that is analogous to Tier 2 and 3 of the WEGs; and 3) Micrositing after project approval to minimize impacts to wildlife and habitats.

Prioritization Approach: Bureau of Land Management's Designated Leasing Areas

The BLM has developed a system to prioritize the processing of renewable energy applications in the lands it manages based on site characteristics. Top priority is given to lease applications submitted for areas identified in a BLM Resource Management Plan as designated leasing areas (DLAs), in accordance with 43 CFR [Code of Federal Regulations] 2809. These DLAs include 19 Solar Energy Zones (SEZs) that were designated across six southwestern states in the Western Solar Plan (BLM n.d.). Oregon was not covered by the Western Solar Plan when it was finalized in 2012, and no SEZs or other DLAs are located in the state. However, at the time of the publication of this document in March 2023, BLM was preparing to undertake a new solar Programmatic Environmental Assessment (PEIS) that could result in an expansion of the plan area to include all 11 western states. In that event, BLM might choose to designate one or more SEZs in the 15.7 million acres of land managed by the agency in Oregon.

For lands outside of DLAs, BLM operates a three-tier system governed by 43 CFR 2804.35, finalized in December 2016. Lands designated as "high priority" for leasing generally avoid conflicts with wildlife and habitat (see examples of suitable sites below). Medium-priority applications may be located on lands that contain some sensitive resources. Per the prioritization checklist, the presence of "sensitive habitat areas, including important species use areas, riparian areas, or areas of importance for Federal or State sensitive species" is sufficient to merit a decrease in priority to "medium." Low-priority applications are those that may not be feasible to authorize, and therefore may not even be processed, because of the presence of one or more significant conflicts, including "designated critical habitat for federally threatened or endangered species, if project development may result in the destruction or adverse modification of that critical habitat."

In addition, some BLM districts also have local considerations that can change a project's priority. Local considerations in the Southern Nevada district, for instance, include sensitive wildlife or plant species (particularly desert tortoise), noxious weeds, documented archeological or Native American sites within a kilometer of the project area, the level or recreational activity and grazing allotments.

Site Characteristic 4: Areas That Do Not Conflict with Agricultural Production

It is preferable, and in some cases required by law, for renewable energy facilities to be sited in a way that reduces conflicts with agricultural production. This is particularly relevant to utility-scale solar, transmission and storage facilities, given their larger footprint relative to wind turbines. Working farmland, which is important to local and regional economies and food security, is increasingly under threat of conversion to residential development and other land uses (Freedgood et al. 2020). Multiple organizations have released guidance to help direct solar

Aerial view of wind turbines in Oregon.