Appendix C: Air Quality and Greenhouse Gases Resource Report

For Programmatic Environmental Impact Statement on Utility-Scale Wind Energy Facilities in Washington State

By

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For the

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Acronyms and Abbreviations List

BESS	battery energy storage system
BMP	best management practice
CalEEMod	California Emissions Estimator Model
CETA	Clean Energy Transformation Act
CFR	*Code of Federal Regulations*
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e/kWh	carbon dioxide equivalents per kilowatt hour
Ecology	Washington State Department of Ecology
g CO_2e/kWh	gram of carbon dioxide equivalents per kilowatt hour
GHG	greenhouse gas(es)
GWP	global warming potential
HFCs	hydrofluorocarbons
kg CO_2e/MWh	kilogram of carbon dioxide equivalents per megawatt hour
LCA	life-cycle assessments
MACT	Maximum Achievable Control Technology
MMBtu/hr	million British thermal units per hour
MOVES	Motor Vehicle Emission Simulator
MT CO_2e	metric tons of carbon dioxide equivalents
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NO_2	nitrogen dioxide
NOC	Notice of Construction
NOx	nitrogen oxide
NREL	National Renewable Energy Laboratory
NSPS	New Source Performance Standards
PEIS	Programmatic Environmental Impact Statement
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	fine particulate matter smaller than 2.5 microns in diameter
PSD	Prevention of Significant Deterioration
SEPA	State Environmental Policy Act
SO_2	sulfur dioxide
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WAAQS	Washington Ambient Air Quality Standards
WAC	Washington Administrative Code
$\mu m/m^3$	micrograms per cubic meter

Executive Summary

This resource report describes the air quality and greenhouse gas (GHG) conditions in the study area. It also describes the regulatory context, outlines methods for assessing potential air quality and GHG impacts of facilities, presents air quality conditions in the study area, and assesses the potential impacts of the facilities and actions that could avoid or reduce impacts.

The operation of onshore wind energy facilities would reduce overall GHG emissions compared to a fossil fuel power plant that would otherwise be in operation to supply the same amount of electricity. Overall, GHG emissions would be reduced if onshore wind energy production replaces fossil fuel energy production over the next 20 years. Washington state law requires utilities to have net-zero GHG emissions by 2045.

Findings for air quality and GHG impacts described in this resource report are summarized as follows:

- Facility GHG life-cycle emissions could be up to 11,866 metric tons of carbon dioxide equivalents (MT CO_2e) a year. Facilities with a battery energy storage system could have total GHG emissions up to 21,711 MT CO_2e a year. These impacts are **less than significant** and offsets could be used to reduce the amount of GHGs in the atmosphere.
- Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction, operation, and decommissioning of facilities would likely result in **less than significant impacts** on air quality.

Compliance with existing laws is sufficient for there to be **no significant and unavoidable adverse impacts** to air quality and GHGs expected for any of the facilities evaluated. Site selection considerations could be used to reduce the air pollutants and GHG emitted from the transport of materials and personnel. Measures that minimize the emissions from vehicle and equipment engines, such as using newer engines with the most up-to-date emissions performance technology and limiting engine idling time, would also reduce air quality and GHG impacts. Paving of roads and parking areas could also reduce air pollution from fugitive dust generated by vehicle traffic.

Crosswalk with Air Quality and Greenhouse Gases Resource Report for Utility-Scale Solar Energy

Two PEISs are being released at the same time, one for utility-scale solar energy facilities and one for utility-scale onshore wind energy facilities. This crosswalk identifies the areas with substantial differences between the air quality and greenhouse gases resource reports for each PEIS.

Utility-Scale Solar Energy PEIS	Utility-Scale Onshore Wind Energy PEIS (this document)
• Different specific air emission estimates • Differences in the estimates for GHG life-cycle assessments	• Different specific air emission estimates • Includes evaluation of air quality for repowering facilities instead of decommissioning • Differences in the estimates for GHG life-cycle assessments

1 Introduction

This resource report describes air quality and greenhouse gases (GHGs) within the study area and assesses potential impacts associated with the types of facilities evaluated (alternatives), including a No Action Alternative. Chapter 2 of the State Environmental Policy Act (SEPA) Programmatic Environmental Impact Statement (PEIS) provides a description of the types of facilities evaluated.

1.1 Resource description

1.1.1 Fundamentals of air quality

Air quality is a measure of how clean or polluted the air is. When air quality is good, the air appears clear and contains little to no chemical pollutants or particles. Poor air quality occurs when the air contains high levels of pollutants, which can be dangerous to both human health and the environment.

Air pollution arises from various sources, both human-made and natural. Although natural sources like wind-blown dust, wildfires, and volcanoes can be substantial contributors to poor air quality, they usually do not create long-term problems. Human-made mobile sources of air pollution include cars, buses, planes, trucks, and trains. Stationary sources of human-made air pollution include power plants, oil refineries, and other industrial facilities. Area sources of human-made air pollution are localized activities or processes that emit air pollutants that can collectively contribute to poor air quality such as agricultural activities, urban areas, and wood-burning fireplaces.

1.1.2 Fundamentals of greenhouse gases

“Global warming” and “climate change” are common terms used to describe the increase in the average temperature of the Earth’s near-surface air and oceans since the mid-20th century. Natural processes and human actions have been identified as impacting climate. Since the 19th century, increasing GHG concentrations resulting from human activity (such as fossil fuel combustion, deforestation, and other activities) have unequivocally caused global warming (IPCC 2023). GHGs in the atmosphere naturally trap heat by impeding the exit of solar radiation—a phenomenon sometimes referred to as the “greenhouse effect.” Some GHGs occur naturally and are necessary for keeping the Earth’s surface inhabitable. However, increases in the concentrations of these gases in the atmosphere during the last 100 years have trapped solar radiation and decreased the amount that is reflected back into space, intensifying the greenhouse effect and resulting in the increase of global average temperature and climate change.

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the principal GHGs. When concentrations of these gases exceed historical concentrations in the atmosphere, the greenhouse effect is intensified. CO_2 is the reference gas for climate change, because it is the GHG emitted in the highest volume. The effect that each of the GHGs has on global warming is the product of the mass of their emissions and their global warming potential (GWP). GWP indicates how much a gas is predicted to contribute to global warming relative to how much warming would be predicted to be caused by the same mass of CO_2. For example, CH4 and N2O are substantially more potent GHGs than CO_2, with GWPs of approximately 25 and approximately 298 times that of CO_2, which has a GWP of 1.

In emissions inventories, GHG emissions are typically reported as metric tons of carbon dioxide equivalents (MT CO_2e). CO_2e is calculated as the product of the mass emitted of a given GHG and its specific GWP. While CH_4 and N_2O have much higher GWPs than CO_2, CO_2 is emitted in higher quantities and it accounts for the majority of GHG emissions in CO_2e, both from developments and human activity in general.

1.2 Regulatory context

1.2.1 Air quality

To protect public health and welfare nationwide, the federal Clean Air Act requires that the U.S. Environmental Protection Agency (USEPA) establish National Ambient Air Quality Standards (NAAQS) for certain common and widespread pollutants based on the latest science. USEPA has set NAAQS for six common "criteria pollutants":

- Particulate matter smaller than 10 microns in diameter (PM_{10})
- Particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$)
- Ozone
- Sulfur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Lead

Most of the criteria pollutants are directly emitted. Ozone, however, is a secondary pollutant that is formed in the atmosphere by chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs). These primary NAAQS represent maximum ambient (outdoor air) concentration levels of the criteria pollutants with the aim of protecting public health with an adequate margin of safety. The NAAQS specify different averaging times as well as maximum concentrations. Washington State has adopted its own set of Washington Ambient Air Quality Standards (WAAQS), which are equal to the NAAQS for nearly all the criteria pollutants. The exception is for the primary annual $PM_{2.5}$ NAAQS, which USEPA recently lowered on February 7, 2024, from 12 micrograms per cubic meter ($\mu m/m^3$) to 9 $\mu m/m^3$. The primary annual $PM_{2.5}$ WAAQS remains at the former NAAQS level as of the time of authoring this resource report; therefore, the more-stringent NAAQS is the maximum allowable concentration level for $PM_{2.5}$. When an area is achieving an ambient air quality standard, it is referred to as an "attainment area" with respect to that pollutant.

If an area is exceeding the NAAQS, the area is designated as a "nonattainment area." When this occurs, the regulatory agency must develop and implement a plan that outlines specific measures to reduce ambient levels of that pollutant. This can involve stricter vehicle emissions standards, improved fuel economy requirements, and additional regulations on industrial sources of pollutants. Overall, the goal is to improve air quality, protect public health, and bring pollutant levels into compliance with the ambient air quality standards.

A new emissions source must demonstrate that it will operate in compliance with all applicable federal and state air quality requirements, including emissions standards and NAAQS/WAAQS. The State of Washington has established rules through the Washington State Department of Ecology (Ecology) for permitting new sources in both attainment and nonattainment areas of the state, and additional requirements may be imposed by local air authorities. Local clean air agencies with jurisdiction within the study area include the Puget Sound Clean Air Agency, Southwest Clean Air Agency, Yakima Regional Clean Air Agency, Benton Clean Air Agency, and Spokane Regional Clean Air Agency. Washington Administrative Code (WAC) 463-62-070 requires that energy facilities meet all federal and state air quality laws and regulations mentioned previously. In general, if potential emissions from stationary sources exceed certain thresholds, approval from the applicable permitting authority is required before beginning construction. In Washington, these permits are called Notice of Construction (NOC). New sources of air emissions in nonattainment areas must undergo more rigorous permitting than equivalently sized sources in attainment areas. Chapter 173-400 WAC establishes the requirements for review and issuance of NOC approvals for sources of air emissions.

While the ambient air quality standards place upper limits on levels of air pollution, the Prevention of Significant Deterioration (PSD) permitting regulations administered by Ecology place limits on the total increase in ambient pollution levels above baseline levels in attainment areas from the operation of large stationary sources. By only allowing ambient concentration levels to increase by a limited amount, it prevents “polluting up to the standard” from new and modified stationary sources and the deterioration of air quality in an area. These allowable increases are called “increments” and are smallest in Class I areas, such as national parks or wilderness areas. The rest of the country is subject to larger Class II increments. The federal Clean Air Act established mandatory Class I areas for national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres. States can choose a less stringent set of Class III increments; however, none have done so. Major (larger than a certain threshold) new stationary sources and large modifications at existing major stationary sources must meet the requirements of the PSD regulations and be issued a permit from Ecology before construction can begin. The PSD regulations also require the use of best-performing pollution control technology and practices, a quantitative demonstration that a stationary source would not cause or contribute to a violation of the NAAQS, and coordination with Federal Land Managers of Class I areas located near a stationary source to evaluate whether there would be an adverse impact on any air quality related values of those areas such as scenic, cultural, biological, and recreational resources.

Stationary emissions sources that are not major (larger than a certain threshold) are considered minor sources. Minor sources would not trigger the requirements of PSD permitting; however, air permits or other forms of registration may still be required. Local clean air agencies would administer the minor source permitting programs within their jurisdictions. Ecology would manage these programs in all other areas. The jurisdictional areas of the local clean air agencies are as follows (Ecology 2024):

- Benton Clean Air Agency—Benton County
- USEPA Region 10—Tribal lands
- Northwest Clean Air Agency—Island, Skagit, and Whatcom counties
- Olympic Region Clean Air Agency—Clallam, Grays Harbor, Jefferson, Mason, Pacific, and Thurston counties
- Puget Sound Clean Air Agency—King, Kitsap, Pierce, and Snohomish counties
- Southwest Clean Air Agency—Clark, Cowlitz, Lewis, Skamania, and Wahkiakum counties
- Spokane Regional Clean Air Agency—Spokane County
- Yakima Regional Clean Air Agency—Yakima County

Construction-related emissions are regulated separately under the federal Clean Air Act. WAC 173-400-110(4) exempts construction activities from permitting review when the activities do not result in new or modified stationary sources. Washington State regulates what are known as “fugitive” air emissions, which consist of any pollutants that are not emitted through a chimney, smokestack, or similar facility. For example, blowing dust from construction sites, unpaved roads, and tilled agricultural fields are common sources of fugitive particulate matter emissions, referred to as fugitive dust. Wind energy plants are not included among the facilities for which review and permitting of fugitive emissions are required (WAC 173-400-040). Nevertheless, WAC 173-400-040(9)(a) requires owners and operators of fugitive dust sources to take reasonable measures to prevent dust from becoming airborne and to minimize emissions.

Other Washington state regulations that apply to nuisance emissions, including fugitive dust and various equipment used during construction, include the following:

- **WAC 173-400-040(3), Fallout.** No person shall cause or allow the emission of particulate matter from any source to be deposited beyond the property under direct control of the owner or operator of the source in sufficient quantity to interfere unreasonably with the use and enjoyment of the property upon which the material is deposited.
- **WAC 173-400-040(4)(a), Fugitive Emissions.** The owner or operator of any emissions unit engaging in materials handling, construction, demolition, or other operation that is a source of fugitive emissions, if located in an attainment area and not impacting any nonattainment area, shall take reasonable precautions to prevent the release of air contaminants from the operation.
- **WAC 173-400-040(5), Odors.** Any person who causes or allows the generation of any odor from any source that may unreasonably interfere with any other property owner’s use and enjoyment of their property must use recognized good practices and procedures to reduce the odor to a reasonable minimum.
- **WAC 173-400-040(9), Fugitive Dust**. The owner or operator of a source or activity that generates fugitive dust must take reasonable precautions to prevent that fugitive dust from becoming airborne and must maintain and operate the source to minimize emissions.

1.2.2 Greenhouse gases

In March 2008, the Washington Legislature enacted House Bill 2815, which directed Ecology to develop rules for the mandatory reporting of GHG emissions by sources that emit more than certain specified threshold amounts. These rules are codified in Chapter 173-441 WAC. According to WAC 173-441-030 (1)(a), any source that emits 10,000 MT CO_2e per calendar year is required to report its GHG emissions to Ecology. For facilities emitting more than 25,000 metric tons per year, a quantitative disclosure of GHGs is required.

In 2020, the Washington Legislature set new GHG emission limits (Revised Code of Washington 70A.45.020) to combat climate change. Under the law, the state is required to reduce emissions levels as follows:

- 2020—reduce to 1990 levels
- 2030—45% below 1990 levels
- 2040—70% below 1990 levels
- 2050—95% below 1990 levels and achieve net zero emissions

The 2019 Clean Energy Transformation Act (CETA) requires all electric utilities in Washington to transition to carbon-neutral electricity by 2030 and to 100% carbon-free electricity by 2045. The Washington Department of Commerce and the Washington Utilities and Transportation Commission are leading the implementation efforts.

Table 1. Applicable laws, plans, and policies

Regulation, statute, guideline	Description
Federal	
42 *United States Code* 7401 et seq., Clean Air Act	The Federal Clean Air Act is the law that defines the U.S. Environmental Protection Agency's (USEPA's) responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.
40 *Code of Federal Regulations* (CFR) 50, National Ambient Air Quality Standards (NAAQS)	These are national primary and secondary ambient air quality standards. The primary standards define levels of air quality that USEPA judges are necessary, with an adequate margin of safety, to protect public health. The secondary air quality standards define levels that USEPA judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
40 CFR 52.21, Prevention of Significant Deterioration (PSD) of Air Quality	If a facility would be a major source of air pollutant emissions, a PSD air permit would be required prior to construction. The Washington State Department of Ecology (Ecology) administers the PSD program in Washington, except for on Tribal lands or for sources under the jurisdiction of the Energy Facility Site Evaluation Council. Although this program is administered by Ecology, it requires coordination with federal partners such as USEPA.

Regulation, statute, guideline	Description
40 CFR 60, New Source Performance Standards (NSPS)	These are federal emissions standards that apply to specific categories of stationary sources. The NSPS represent the minimum level of control that is required on a new or modified source. Generator engines or combustion heating equipment may be subject to the NSPS. Ecology and often local clean air agencies administer the NSPS.
40 CFR 63, National Emissions Standards for Hazardous Air Pollutants (NESHAP)	These are federal emissions standards for hazardous air pollutants from specific source categories. They generally specify the Maximum Achievable Control Technology (MACT) that must be applied for a given source category; therefore, they are also referred to as MACT standards. Generator engines or combustion heating equipment may be subject to NESHAP. Ecology and often local clean air agencies administer the NESHAP.
40 CFR 98, Mandatory Greenhouse Gas (GHG) Reporting	Facilities with an aggregated max rated heat input capacity ≥30 million British thermal units per hour (MMBtu/hr) of stationary fuel combustion units emitting ≥25,000 metric tons of carbon dioxide equivalents (MT CO_2e) per year must report GHG emissions.
40 CFR 51(W) and 40 CFR 93, General Conformity Analysis	General Conformity requires that federal agencies not take actions that cause or contribute to violations of ambient air quality standards or interfere with goals outlined in a state or Tribal implementation plan for achieving attainment.
State	
Chapter 173.400 Washington Administrative Code (WAC), General Regulations for Air Pollution Sources	This chapter establishes technically feasible and reasonably attainable emissions standards and establishes rules generally applicable to the control and/or prevention of the emission of air contaminants.
WAC 173.400.040, General Standards for Maximum Emissions	This chapter outlines some general emissions standards that apply to all sources and emissions units.
WAC 173.400.110, New Source Review for Sources and Portable Sources	A source must apply for and be issued a Notice of Construction (NOC) for sources of air emissions unless exempted. Exemptions are described in the rule. A local clean air agency often implements their own approved version of this program.
WAC 173.400.99 through 173.400.105, Registration Program	Many sources of air emissions that do not require an NOC instead require registration. A local clean air agency often implements their own approved version of this program.
WAC 173.400.720, PSD	These are the state rules for administering the PSD permitting program. If a facility would be a major source of air pollutant emissions, a PSD air permit would be required prior to construction.
Chapter 173.401 WAC, Operating Permit Regulation	Title V major sources require an Air Operating Permit.
Chapter 173.460 WAC, Controls for New Sources of Toxic Air Pollutants	Sources of toxic air pollutants must comply with these regulations.
Chapter 173.441 WAC, Mandatory GHG Reporting	Facilities with stationary fuel combustion units emitting ≥10,000 MT CO_2e per year must report GHG emissions.

Regulation, statute, guideline	Description
Chapter 173.446 WAC, Washington Climate Commitment Act	Implements the provisions of the GHG emissions cap and invest program.
Chapter 173.444 WAC, Washington Clean Energy Transformation Act (CETA)	Establishes rules that electric utilities shall use to comply with parts of the Washington CETA.
Local	
Local New Source Review/Air Permitting program	An NOC may be required for sources of air emissions. Local clean air agencies often have their own approved programs rather than being administered by Ecology. The Puget Sound Clean Air Agency, Southwest Clean Air Agency, Yakima Regional Clean Air Agency, Benton Clean Air Agency, and Spokane Regional Clean Air Agency are located within the study area.
Local Registration Program	Sources of air emissions that do not require an NOC may instead require registration. Local clean air agencies often have their own approved programs rather than being administered by Ecology.

2 Methodology

2.1 Study area

The study area for air quality resources encompasses the overall wind geographic study area (Figure 1), which covers large areas of land spread across Washington. The study area accounts for air resources that have the potential to be affected by the following:

- Short-term construction impacts on localized ambient air quality concentrations and contributions to global emissions of GHGs
- Long-term impacts from operations, maintenance, and decommissioning on localized ambient air quality concentrations and contributions to global emissions of GHGs over the lifespan of a proposed development

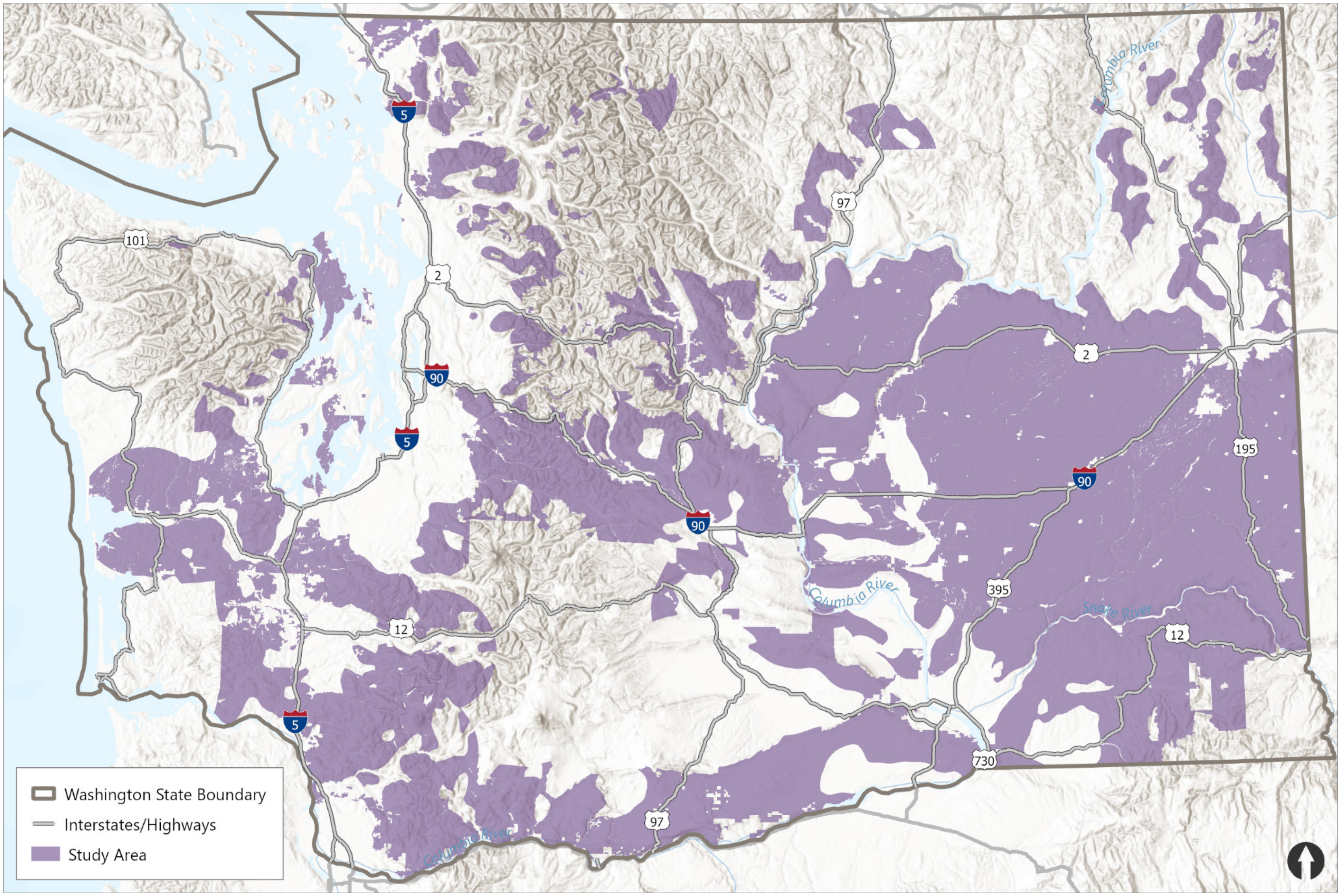

Figure 1. Onshore Wind Energy Facilities PEIS – geographic scope of study

2.2 Technical approach

This section describes the key sources of air pollution and GHG that are analyzed in the potential impacts and mitigation measures discussion:

- Construction and decommissioning of wind energy generation facilities would result in air pollutant and GHG emissions. Typical construction activities include the operation of non-road equipment (equipment that does not regularly use roads such as construction machinery and generators) and on-road vehicle traffic, which would emit gaseous air pollutants and GHG from the combustion of fuel in internal combustion engines, as well as particulate dust emissions from land-clearing activities and vehicle travel on paved and unpaved roadways. If required, blasting would also generate air emissions and GHGs.
- Operational use of generators and vehicle use associated with maintenance activities would result in air pollutant and GHG emissions. The wind turbines are not sources of air emissions or GHG during operation; however, installations may use backup generator engines to supply power when normal sources of electricity are unavailable. The facilities are typically not staffed and therefore would not experience daily worker commutes by vehicle. Periodic site visits would be required for maintenance activities.

2.3 Impact assessment

The primary drivers of air quality and GHG emissions are from fuel combustion by non-road equipment and on-road vehicle traffic during construction and decommissioning. Disturbed soils from land-clearing activities could also result in airborne fugitive dust. Although wind turbines are not sources of air emissions or GHG during operation, combustion emissions and fugitive dust would be generated by vehicles traveling on facility access roads to perform operation and maintenance functions. Air pollutant and GHG emissions level ranges have been estimated for the types of facilities based on the predicted level of non-road equipment and on-road vehicle use required during construction and operation. This analysis evaluates impacts relative to the effects of site characterization, construction, operation, and decommissioning of facilities. Significant air quality impacts would occur if a facility would result in the following:

- Emissions that may trigger air permitting requirements (100 tons per year of VOCs, NOx, SO_2, CO, PM_{10}, or $PM_{2.5}$ within a calendar year unless the area is in a nonattainment area; if within a nonattainment area, then use the matching general conformity de minimis limits for that region)
- Fugitive dust that may impact biological resources or water quality

Although GHG concentrations are global and not localized, all of the types of facilities evaluated would result in GHG emissions. Life-cycle GHG emissions ranges for the facilities were derived from GHG life-cycle assessments (LCAs) developed by the National Renewable Energy Laboratory (NREL; NREL 2013). An LCA is a method used to assess the overall GHG impacts of a fuel or energy resource throughout its entire life cycle, from production to use to disposal. It considers each stage of the life cycle, including extraction, manufacturing, transportation, use and end-of-life management. An LCA does not consider any offsetting of impacts from replacing one energy source with another, i.e., it does not account for CO_2e emissions reduced by replacing fossil fuel energy generation with a clean energy source. The life-cycle GHG emissions and state GHG requirements for utilities were considered in determining significance. Future proposals will need to complete a project-specific LCA.

3 Technical Analysis and Results

3.1 Overview

This section describes the potential significant adverse air quality and GHG impacts that might occur for a given wind energy facility type. In general, the extent of the impact depends on the size of the power range and size of the facility. This section also evaluates actions that could avoid, minimize, or reduce the identified impacts, and potential unavoidable significant adverse impacts.

3.2 Affected environment

The affected environment represents the conditions before any construction begins at an onshore wind energy facility site. Given the substantial geographic extent of the wind study area, the existing air pollutant concentration levels can vary from one site to another. All portions of the study area currently meet all ambient air quality standards. There are some areas of concern for particulate matter and ozone within the study area. The Tri-Cities area (Kennewick, Pasco, and Richland) is an area of concern for ozone. Sunnyside, Toppenish, and Yakima to the west are areas of concern for particulate matter, along with Omak in the north and Colville in the northeast. To make sure the air continues to meet air quality standards, Ecology and its partners monitor the air using Washington's Air Monitoring Network.

As previously described, regulatory programs such as PSD and Chapter 173-400 WAC are in place to ensure that air pollution levels do not increase to concentrations that threaten ambient air quality standards. Any new industrial sources of air pollution must receive an air quality permit prior to operation. The permitting programs are designed to ensure that not only are ambient air quality standards protected, but that the current levels of air quality are not substantially degraded by industrial growth.

In 2021, the United States generated roughly 6,340 million MT CO_2e (USEPA 2023). Ecology estimates that in 2019, Washington produced about 102.1 million MT CO_2e (Ecology 2022). Ecology found that transportation is the largest source, at 40% of the state's GHG emissions, followed by residential, commercial, and industrial energy use at 31%, and electricity consumption (both in-state and out-of-state) at 21%.[1] The sources of the remaining 8% of emissions are agriculture, waste management, and industrial processes.[2]

[1] Transportation sources include on-road vehicles, marine vessels, jet fuel and aviation gasoline, rail operations, and natural gas for transportation. Washington GHG emissions from the transportation sector have been fairly constant for several years, with on-road gasoline continuing to contribute over 50% of transportation sector emissions. Marine vessel emissions include emissions from recreational, commercial, and ocean-going vessels, but exclude marine bunker fuels consumed in international waters.
[2] The industrial sector includes fugitive GHG emissions that are released during the production, processing, transmission, and distribution of fossil fuels. These emissions are typically fugitive methane due to leakage and venting from natural gas pipelines, and petroleum systems.

3.3 Potentially required permits

New industrial stationary sources of pollution must receive an air quality permit (NOC) prior to operation. Chapter 173-400 WAC establishes the requirements for review and issuance of NOC approvals for new sources of air emissions. When there are no permanent sources of regulated pollutants, an NOC would not be required. Stationary emergency generator engines that do not exceed 500 brake-horsepower are exempt from permitting review, along with associated fuel tanks. Construction activities are considered to be temporary sources and are exempt from permitting review. No air quality permits are expected to be required for the construction or operation of any of the facility types. Construction may require the temporary use of portable concrete batch plants, which would already be permitted using general orders by the owners/operators of the plants.

3.4 Small to medium utility-scale facilities of 10 MW to 250 MW (Alternative 1)

3.4.1 Air quality impacts from construction

Site characterization and construction of small to medium utility-scale wind energy facility (Alternative 1) would generate air and GHG emissions from the following:

- Non-road equipment used for site characterization, site preparation, and construction
- On-road vehicle traffic associated with site characterization and construction activities

Site characterization and construction-related air emissions would be generated by non-road construction equipment, haul-truck trips, on-road worker trips, vehicle travel on paved and unpaved surfaces, and fugitive dust from material handling activities. Construction emissions were estimated by reviewing emissions data from similar wind facilities both in Washington and California and deriving a scaled emissions rate in tons per megawatt (MW) to apply to this analysis. Emissions from the reviewed facilities were calculated using both the USEPA's Motor Vehicle Emission Simulator (MOVES; USEPA 2024) emissions factor modeling system and the California Emissions Estimator Model (CalEEMod; CAPCOA 2022). The pollutant rates were applied to this programmatic analysis to calculate construction emissions using the most conservative proposed wattage of the facility. Emissions shown in Table 2 were estimated for the construction of a 250-MW onshore wind energy facility.

Table 2. Construction emissions for a 250-MW onshore wind energy facility

	Estimated emissions (tons)					
	VOC	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
Construction	0.7	9.1	10.5	8.3	1.4	<0.01
Threshold (tons per year)	100	100	100	100	100	100
Exceed threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Prepared by ESA based on emissions per MW of development from published Environmental Impact Statements produced at the project-specific level. Evaluated projects were: Fountain Wind Project (ESA 2021), Horse Heaven Wind Farm (EFSEC 2023), and Humboldt Wind Energy Project (Humboldt County 2019).

A significant air quality impact would occur if emissions generated exceeded the annual threshold presented in Table 2. As shown in Table 2, construction emissions from a 250-MW wind energy facility are not anticipated to be exceeded for any criteria pollutant. Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction of a small to medium facility would likely result in **less than significant impacts** on air quality.

3.4.2 Air quality impacts from operation

Operation of a small to medium onshore wind energy facility would generate air and GHG emissions from:

- On-road vehicle traffic associated with maintenance activities

Operations of a small to medium onshore wind energy facility would generate exhaust and fugitive dust emissions from on-road vehicles required for turbine maintenance. This would involve both light- and heavy-duty vehicles. Operational emissions were estimated by reviewing emissions data from similar wind projects both in Washington and California and deriving a scaled emissions rate in tons per MW to apply to this programmatic analysis. Emissions from the reviewed projects were calculated using the USEPA's MOVES emissions factor modeling system. The pollutant rates were applied to this programmatic analysis to calculate operational emissions using the most conservative proposed wattage of the facility. Emissions shown in Table 3 were estimated for the operations of a 250-MW wind energy facility.

Table 3. Annual operational emissions for a 250-MW onshore wind energy facility

	Estimated annual emissions (tons per year)					
	VOC	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
Operations	0.2	0.9	0.6	5.8	0.6	<0.01
Threshold (tons per year)	100	100	100	100	100	100
Exceed threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Prepared by ESA based on emissions per MW of development from published Environmental Impact Statements produced at the project-specific level. Evaluated projects were: Fountain Wind Project (ESA 2021), Horse Heaven Wind Farm (EFSEC 2023), and Humboldt Wind Energy Project (Humboldt County 2019).

A significant air quality impact would occur if emissions generated exceeded the annual threshold presented in Table 3. As shown in Table 3, operations of a 250-MW wind energy facility are not anticipated to produce emissions at a level that exceeds any criteria pollutant thresholds. Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the operation of small to medium facilities would likely result in **less than significant impacts** on air quality.

3.4.3 Air quality impacts from decommissioning

Decommissioning of an onshore wind energy facility would generate air emissions from:

- Non-road equipment used for take-down and site clearance activities
- On-road vehicle traffic associated with off-haul trucks, vendors, and workers

Decommissioning impacts from air emissions are expected to be similar to those determined for the construction phase of the facility, as described previously.

According to the U.S. Energy Administration, repowering older wind turbines—replacing aging turbines or components—is becoming more common. Fully repowering wind turbines involves decommissioning and removing existing turbines and replacing them with newer turbines at the same facility site. If a small to medium utility-scale facility was repowered after decommissioning, this would result in similar or fewer emissions as identified during facility construction.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the decommissioning or repowering of small to medium facilities would likely result in **less than significant impacts** on air quality.

3.4.4 GHG emissions over the lifetime of the wind energy facility

NREL has developed LCAs for various electricity generation technologies. The LCA covers the full lifespan of the product from raw material extraction to construction and operation, and ultimately decommissioning and disposal. According to the NREL LCA, wind energy technology has life-cycle GHG emissions equal to approximately 10 grams of carbon dioxide equivalents per kilowatt hour (g CO_2e/kWh) with a system lifetime of 20 years (NREL 2013). Table 4 summarizes where the GHG emissions are generated during the lifespan of an onshore wind installation and compares them to LCA values for coal-fired and natural gas electricity generation facilities.

Table 4. LCA comparison for utility-scale facilities

Facility type and energy comparison	Upstream processes	Operational processes	Downstream processes
Wind	• Raw materials extraction • Module manufacture • Parts manufacture • Wind/turbine/farm construction	• Power generation • Plant operation and maintenance	• Wind turbine/farm decommissioning
10 g CO_2e/kWh	86%	9%	5%
Coal	• Raw materials extraction • Construction materials manufacture • Power plant construction	• Coal mining • Coal preparation • Coal transport • Coal combustion • Power plant operation and maintenance	• Power plant decommissioning • Waste disposal • Coal mine land rehabilitation
1,000 g CO_2e/kWh	<1%	>98%	<1%
Natural Gas	• Raw materials extraction • Gas processing • Pipeline transport	• Combustion of fuels • Maintenance • Operation	• Decommissioning • Disposal and recycling
460 g CO_2e/kWh	<1%	>99%	<1%

Source: NREL 2013.

The NREL LCA information provides the proportion of the GHG emissions produced from a technology's life cycle during upstream processes, operational processes, and downstream processes. Upstream processes include the raw material extraction and construction of modules and associated components, along with the construction of the wind facility. Operational processes are addressed in Section 3.4.2 for turbine maintenance and involve mostly vehicle exhaust emissions from the maintenance activities. Downstream processes are the decommissioning of the wind installation. The estimates for annual operational GHG emissions for a 250-MW facility have been used to determine the total operational GHG emissions for a 30-year life cycle, scaled with the LCA performed by NREL, which is based on a 20-year life cycle for wind. Table 5 summarizes the life-cycle GHG emissions for a 250-MW onshore wind energy facility, as well as an amortized GHG estimate based on the life-cycle GHG emissions, and compares them to those for coal-fired and natural gas electricity generation facilities.

Table 5. Life-cycle GHG emissions comparison for 250-MW facilities

Life-cycle GHG emissions	Upstream processes (MT CO_2e)	Operational processes (MT CO_2e)	Downstream processes (MT CO_2e)	Total life-cycle emissions (MT CO_2e)	Amortized GHG emissions (MT CO_2e/year)
Wind					
NREL proportions (average)	86%	9%	5%	100%	--
250-MW wind facility	48,825	7,664	2,839	59,328	1,978
Coal					
NREL proportions (average)	<1%	>99%	<1%	100%	--
250-MW coal facility	9,297	1,896,563	9,297	1,915,156	63,839
Natural Gas					
NREL proportions (average)	<1%	>99%	<1%	100%	--
250-MW natural gas facility	1,485	853,791	37	855,313	28,510

Source: Prepared by ESA based on NREL 2013.
Notes: Coal and natural gas estimates are based on the direct facility size, assuming 8,760 hours per year at a capacity factor of 85%. The onshore wind facility estimate is derived from environmental review documentation estimates of operational GHG emissions. These operational emissions were then used with the NREL LCA percentages to estimate the upstream and downstream contributions.

The operation of onshore wind energy facilities would reduce overall GHG emissions compared to a fossil fuel power plant that would otherwise be in operation to supply the same amount of electricity. Overall, GHG emissions would be reduced if onshore wind energy production replaces fossil fuel energy production over the next 20 years. CETA requires utilities to have net-zero GHG emissions by 2045.

GHG life-cycle emissions for a small to medium onshore wind facility would be up to 1,978 MT CO_2e a year. These impacts are **less than significant** and offsets could be used to reduce the amount of GHGs in the atmosphere.

3.4.5 Actions to avoid and reduce impacts

Potential actions that could avoid or reduce impacts from construction, operation, or decommissioning of facilities are outlined below.

3.4.5.1 Siting and design considerations

- Design the facility to minimize the use of fossil fuels to limit GHG and air emissions (e.g., efficient transportation routing, hybrid or zero-emission construction equipment, electric maintenance trucks).

- Surface access roads, on-site roads, and parking lots with aggregate with hardness sufficient to prevent vehicles from crushing the aggregate and causing dust or compacted soil conditions. Paving could also be used on access roads and parking lots.

3.4.5.2 Permits, plans, and best management practices

This section lists actions associated with potential permits, plans, or best management practices (BMPs). BMPs are activities, maintenance procedures, managerial practices, or structural features that prevent or reduce pollutants or other adverse impacts. These may be required in permits or plans by a regulatory agency and include the following:

- BMPs identified in the “Guide to Handling Fugitive Dust from Construction Projects,” as published by the Associated General Contractors of Washington (AGC 2009)
- New industrial sources of air pollution must receive an air quality permit prior to operation. An NOC/New Source Review is required if there is a source of regulated air emissions.
- Replant or gravel disturbed areas during and after construction to reduce dust.
- Salvage topsoil from all excavations and construction activities and reapply during reclamation or, where feasible, use for interim reclamation by reapplying to construction areas not needed for facility operation as soon as activities in that area have ceased.
- Use non-road equipment with engines certified to the most current tier of emissions standards.
- Apply add-on pollution control technologies to facility generators.
- Suspend all soil disturbance activities and travel on unpaved roads during periods of high winds. Establish a critical site-specific wind speed on the basis of soil properties determined during site characterization and monitor the wind speed on site.
- Maintain vehicles and equipment to minimize exhaust emissions.
- Implement operational measures such as limiting engine idling time and shutting down equipment when not in use.
- Limit the idling time of diesel equipment to no more than 5 minutes unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).
- Use watering or other fugitive dust-abatement measures as needed to control fugitive dust. Use water or water-based environmentally safe dust suppression materials for dust control in compliance with state and local regulations.
- Implement erosion-control measures to limit deposition of silt to roadways.
- Cover construction materials that could be a source of fugitive dust when stored.
- Limit traffic speeds to 25 miles per hour on unpaved roads to minimize generation of fugitive dust.
- Cover truck beds when transporting dirt or soil.
- Encourage carpooling among construction workers to minimize construction-related traffic and associated emissions.
- Use only ultra-low-sulfur diesel fuel with a sulfur content of 15 parts per million or less for all diesel engines used in the facility.
- Use alternative fuel, electric, or latest-model-year vehicles as facility service vehicles.

3.4.5.3 Additional mitigation measures

This section contains the following additional measures that could be implemented to reduce adverse impacts on air quality and GHG emissions:

- Use offsets to reduce the amount of GHGs in the atmosphere. Offset projects must result in GHG reductions that are real, permanent, quantifiable, verifiable, and enforceable.

3.4.6 Unavoidable significant adverse impacts

Through compliance with laws and permits and with implementation of actions to avoid and mitigate significant impacts, small to medium utility-scale solar facilities would have **no significant and unavoidable adverse impacts** related to air quality or GHGs from construction, operation, or decommissioning.

3.5 Large utility-scale facilities of 251 MW to 1,500 MW (Alternative 2)

3.5.1 Air quality impacts from construction

Site characterization and construction of large utility-scale onshore wind energy facilities (Alternative 2) would generate more emissions than those of small to medium utility-scale facilities due to the larger proposed facilities, which would require more construction equipment and more on-road vehicles than small to medium facilities. Emissions would be generated by non-road construction equipment and on-road vehicles. Construction emissions for large facilities were calculated using the same construction emissions base rate as used for small to medium facilities. Emissions shown in Table 6 were estimated for the construction of a 1,500-MW wind energy facility.

Table 6. Construction emissions from a 1,500-MW onshore wind energy facility

	Estimated emissions (tons)					
	VOC	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
Construction	4.4	54.7	62.9	49.8	8.5	0.2
Threshold (tons per year)	100	100	100	100	100	100
Exceed threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Prepared by ESA based on emissions per MW of development from published Environmental Impact Statements produced at the project-specific level. Evaluated projects were: Fountain Wind Project (ESA 2021), Horse Heaven Wind Farm (EFSEC 2023), and Humboldt Wind Energy Project (Humboldt County 2019).

A significant air quality impact would occur if emissions generated exceeded the annual threshold presented in Table 6. As shown in Table 6, thresholds for construction emissions from a 1,500-MW wind energy facility are not anticipated to be exceeded for any criteria pollutant. Impacts to air quality from construction would be the same as described in Section 3.4.

3.5.2 Impacts from operation

Operations of a large utility-scale onshore wind energy facility would generate more emissions than those for small to medium utility-scale facilities due to the larger facility, which is assumed to require more maintenance activity. Annual operational emissions for large utility-scale facilities were calculated using the same operational emissions base rate as used for small to medium facilities. Emissions shown in Table 7 were estimated for the operations of a 1,500-MW wind energy facility.

Table 7. Annual operational emissions for a 1,500-MW onshore wind energy facility

	Estimated annual emissions (tons per year)					
	VOC	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
Operations	1.1	5.5	3.5	34.6	3.7	<0.01
Threshold (tons per year)	100	100	100	100	100	100
Exceed threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Prepared by ESA based on emissions per MW of development from published Environmental Impact Statements produced at the project-specific level. Evaluated projects were: Fountain Wind Project (ESA 2021), Horse Heaven Wind Farm (EFSEC 2023), and Humboldt Wind Energy Project (Humboldt County 2019).

A significant air quality impact would occur if emissions generated exceeded the annual threshold presented in Table 7. As shown in Table 7, operations of a 1,500-MW wind energy facility are not anticipated to exceed any criteria pollutant thresholds. Impacts to air quality from construction would be the same as described in Section 3.4.

3.5.3 Air quality impacts from decommissioning

Decommissioning emissions for large utility-scale facilities would be similar to the emissions generated from the construction phase of the facilities. If facilities were to be repowered after decommissioning, emissions would also be similar to the emissions generated from construction; however, they would include emissions from the installation of new turbines and components. Impacts to air quality from construction would be the same as described in Section 3.4.

3.5.4 GHG impacts from the entire lifetime of the wind energy facility

GHG emissions for the lifetime of a large wind energy facility would be greater than those for small to medium facilities due to a larger facility being proposed. Lifetime emissions were calculated using the same approach for all types of facilities. For large facilities, maximum GHG emissions were calculated to be 355,965 MT CO_2e for the 30-year lifetime of a 1,500-MW wind energy facility (Table 8). Table 8 also compares these life-cycle GHG emissions to those of 1,500-MW coal-fired and natural gas electricity generation facilities.

Table 8. Life-cycle GHG emissions comparison for 1,500-MW facilities

Life-cycle GHG emissions	Upstream processes (MT CO2e)	Operational processes (MT CO2e)	Downstream processes (MT CO2e)	Total life-cycle emissions (MT CO2e)	Amortized GHG emissions (MT CO2e/year)
1,500-MW onshore wind facility	292,948	45,986	17,032	355,965	11,866
1,500-MW coal facility	55,781	11,379,375	55,781	11,490,938	383,031
1,500-MW natural gas facility	8,909	5,122,743	223	5,131,875	171,063

Source: Prepared by ESA based on NREL 2013.
Notes: Coal and natural gas estimates are based on the direct facility size, assuming 8,760 hours per year at a capacity factor of 85%. The onshore wind facility estimate is derived from environmental review documentation estimates of operational GHG emissions. These operational emissions were then used with the NREL LCA percentages to estimate the upstream and downstream contributions.

GHG life-cycle emissions for a large onshore wind facility would be up to 11,866 MT CO_2e a year. These impacts are **less than significant** and offsets could be used to reduce the amount of GHGs in the atmosphere.

3.5.5 Actions to avoid and reduce impacts

Available means of reducing air and GHG-related impacts for large utility-scale facilities are the same as those identified in Section 3.4.5 for small to medium facilities.

3.5.6 Unavoidable significant adverse impacts

Through compliance with laws and with implementation of the actions to avoid and reduce impacts, there would be **no significant and unavoidable adverse impacts** related to air quality or GHGs from the construction, operation, or decommissioning of large utility-scale wind energy facilities.

3.6 Wind facility and co-located battery energy storage system (Alternative 3)

3.6.1 Air quality impacts from construction

Site characterization and construction-related air emissions for utility-scale onshore wind energy facilities and co-located battery energy storage systems (BESSs) (Alternative 3) would be generated by construction activities for both an onshore wind energy facility as well as up to two BESSs at 500 MW each. This would require more construction equipment and on-road vehicles than for large utility-scale facilities without a BESS. Emissions shown in Table 9 were estimated for the construction of a 1,500-MW facility and two 500-MW BESSs.

Table 9. Construction emissions for a 1,500-MW onshore wind energy facility and two 500-MW co-located battery energy storage systems

	Estimated emissions (tons)					
	VOC	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
BESS construction	1.7	14.7	7.3	0.5	0.5	0.02
Facility construction (excluding BESS)	4.4	54.7	62.9	49.8	8.5	0.2
Facility construction total (including BESS)	6.1	69.4	70.2	50.2	9.0	0.2
Threshold (tons per year)	100	100	100	100	100	100
Exceed threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Prepared by ESA based on emissions per MW of development from published Environmental Impact Statements produced at the project-specific level. Evaluated projects were: Fountain Wind Project (ESA 2021), Horse Heaven Wind Farm (EFSEC 2023), and Humboldt Wind Energy Project (Humboldt County 2019).

A significant air quality impact would occur if emissions generated exceeded the annual threshold presented in Table 9. As shown in Table 9, construction emissions from a 1,500-MW wind energy facility and two 500-MW BESSs are not anticipated to exceed any criteria pollutant thresholds. Impacts to air quality from construction would be the same as described in Section 3.5.

3.6.2 Impacts from operation

Operation of an onshore wind energy facility and two BESSs would generate similar emissions as those analyzed previously for large utility-scale facilities without a BESS. Impacts to air quality from construction would be the same as described in Section 3.5.

3.6.3 Air quality impacts from decommissioning

For utility-scale onshore wind energy facilities and co-located BESSs, decommissioning emissions would be similar to the emissions generated from the construction phase. If facilities were to be repowered after decommissioning, emissions would also be similar to the emissions generated from construction; however, they would include emissions from the installation of new turbines and components. Impacts to air quality from construction or repowering would be the same as described in Section 3.5.

3.6.4 GHG impacts from the entire lifetime of the wind energy facility

The GHG emissions for utility-scale onshore wind energy facilities and co-located BESSs would be greater than the range described previously for large utility-scale facilities without a BESS due to the addition to upstream and downstream LCA emissions from the BESS.

GHG life-cycle emissions have been previously modeled using OpenLCA software for the addition of 500-MW BESS systems for a case study in Texas (Das et al. 2024). The study indicated that the addition of a 500-MW BESS increased the LCA footprint by 7.58 kilograms of carbon dioxide equivalents per megawatt hour (kg CO_2e/MWh) for either solar or wind applications, and the addition of two 500-MW BESSs increased the LCA footprint by 15.16 kg CO_2e/MWh. Relative to the wind facilities evaluated in the Texas case study (1,273-MW wind facility), two 500-MW BESS installations increased the LCA of the entire facility by 83%. Applying this percentage increase to estimated annual emissions for small to large facilities, overall emissions including the two 500-MW co-located BESS installations would range from 3,619 to 21,711 MT CO_2e a year. These impacts are **less than significant** and offsets could be used to reduce the amount of GHGs in the atmosphere.

3.6.5 Actions to avoid and reduce impacts

Available means of reducing air and GHG-related impacts for utility-scale onshore wind energy facilities and co-located BESSs are the same as those in Section 3.4.5.

3.6.6 Unavoidable significant adverse impacts

Through compliance with laws and with implementation of the actions to avoid and reduce impacts, there would be **no significant and unavoidable adverse impacts** related to air quality or GHGs from the construction, operation, or decommissioning of utility-scale onshore wind energy facilities and co-located BESSs.

3.7 Wind facilities that include agricultural land use (Alternative 4)

3.7.1 Air quality impacts from construction

Site characterization and construction-related air emissions for utility-scale onshore wind energy facilities that include agricultural land use (Alternative 4) would be similar to those generated by large utility-scale facilities that do not include agricultural land use. Wind facilities with co-located agricultural use may include locating a wind facility on lands where there is already existing agricultural activity, with or without changing the type of agricultural activity, or a facility could add a new agricultural use to a site.

Construction methods for facilities that include agricultural land use would be similar to those of facilities that do not include agricultural land use, and criteria pollutants would be generated by non-road construction equipment and on-road vehicles. Impacts to air quality from construction would be the same as described in Section 3.5.

3.7.2 Air quality impacts from operation

Operation of onshore wind energy facilities that include agricultural use would generate similar emissions as those analyzed previously for large utility-scale facilities that do not include agricultural land use. Emissions from agricultural diesel-powered equipment would vary depending on the type of crops planted, level of activity, and the size and age of equipment, but are not anticipated to generate emissions above and beyond those of existing agricultural practices. If the facility includes new agricultural uses, there could be additional air quality emissions, which would vary based on the type and scale of use for each project. The overall emissions footprint of an agricultural operation is highly dependent on the types of crops, number of tilling operations per year, age of equipment being used, and many other variables. If new agricultural uses require air permits, the facility would be required to meet air quality standards. Impacts to air quality from operation would be the same as described in Section 3.5.

3.7.3 Air quality impacts from decommissioning

Decommissioning emissions for onshore wind energy facilities that include agricultural land use would be similar to the emissions generated from the construction phase of the same facilities. If facilities were to be repowered after decommissioning, emissions would also be similar to the emissions generated from construction; however, they would include emissions from the installation of new turbines and components. Impacts to air quality from decommissioning and repowering would be the same as described in Section 3.5.

3.7.4 GHG impacts from the entire lifetime of the wind energy facility

The GHG emissions for agrivoltaic facilities would likely be similar to the range described for utility-scale large onshore wind energy facilities that do not include agricultural land use but would vary based on the type of land use and amount of land. Impacts would be **less than significant** and offsets could be used to reduce the amount of GHGs in the atmosphere. An LCA would need to be conducted to estimate GHGs for each project based on its specific design.

3.7.5 Actions to avoid and reduce impacts

Available means of reducing air and GHG-related impacts for onshore wind energy facilities that include agricultural land use are generally the same as those identified previously for facilities that do not include agricultural land use (see Section 3.4.5). There are additional agriculture-specific measures that can help to limit the emissions produced from agriculture operations (USDA 2012), including the following:

- Limit the amount of soil or unpaved surface disturbances during operations:
  - Use wind barriers to limit windblown dust.
  - Provide soil surface covers to reduce windblown dust.
  - Optimize timing of operations to limit disturbance in high wind and dry conditions.
- Optimize agricultural operations to reduce air emissions:
  - Maintain agricultural equipment and repower/replace to reduce emissions.
  - Reduce the number of passes by equipment to reduce suspension of particulate matter and engine-generated emissions.
  - Integrate advanced technologies to reduce equipment operation overlap.

3.7.6 Unavoidable significant adverse impacts

Through compliance with laws and with implementation of the actions to avoid and reduce impacts described in Section 3.4.5, there would be **no significant and unavoidable adverse impacts** related to air quality or GHGs from the construction, operation, or decommissioning of onshore wind energy facilities that include agricultural land use.

3.8 No Action Alternative

The PEIS is a planning document, so under the No Action Alternative, city, county, and state agencies would continue to conduct environmental review and permitting for utility-scale wind energy development under existing state and local laws on a facility-by-facility basis.

Facilities developed under the No Action Alternative could be subject to the same regulatory standards and emissions resources permit conditions as all types of utility-scale onshore wind energy facilities included in this analysis. Through compliance with laws, there would be **less-than-significant impacts** from air and GHG emissions from the construction, operation, or decommissioning of wind energy facilities under the No Action Alternative.

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