5.8 Greenhouse Gas Emissions and Climate Change

This section describes the estimated greenhouse gas emissions that would result from construction and operation of the Proposed Action (Section 5.8.1) and assesses the potential climate change impacts on the Proposed Action (Section 5.8.2).

5.8.1 Greenhouse Gas Emissions

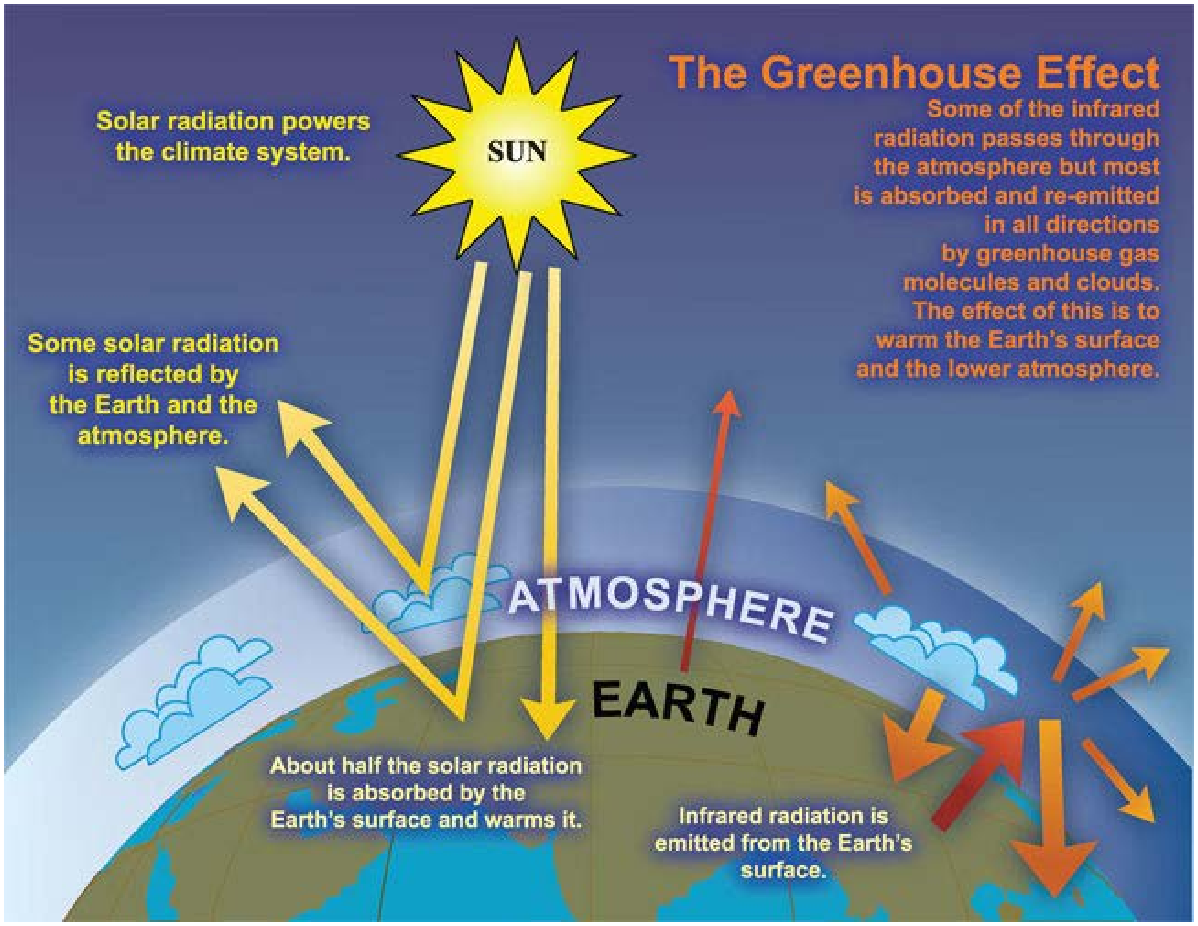
Greenhouse gases are air pollutants that trap solar energy in the atmosphere and contribute to global warming and climate change. Greenhouse gases are emitted from natural sources and are removed from the atmosphere by natural processes. Greenhouse gases are also emitted from human processes, which are now outpacing the natural processes that remove greenhouse gases from the atmosphere. Identifying and reducing excess greenhouse gas emissions from human processes are critical to reducing climate change. Greenhouse gases are global, rather than local, air pollutants with worldwide impacts.

5.8.1.1 Greenhouse Effect

The Earth retains outgoing thermal energy and incoming solar energy in the atmosphere, thus maintaining temperatures suitable for biological life. This retention of energy by the atmosphere is known as the greenhouse effect. When solar radiation reaches the Earth, most of it is either reflected or absorbed by the Earth's surface—or to a lesser degree, its atmosphere. Simultaneously, the Earth radiates its own heat and energy out into space. Factors such as the reflectivity of the Earth's surface, the abundance of water vapor, or the extent of cloud cover affects the degree to which solar radiation may be absorbed and reflected. Figure 5.8-1 shows how the energy flows to and from Earth and the role that the greenhouse effect plays in maintaining heat in the atmosphere.

The composition of gases in the Earth's atmosphere determines the amount of energy absorbed and reemitted by the atmosphere or simply reflected back into space. The predominant gases in the Earth's atmosphere, nitrogen and oxygen (which together account for nearly 90% of the atmosphere), exert little to no greenhouse effect. Some naturally occurring gases, such as carbon dioxide (CO_2), methane, and nitrous oxide trap outgoing energy and contribute to the greenhouse effect. Additionally, manufactured pollutants, such as hydrofluorocarbons, can contribute to the greenhouse effect. Unlike most air pollutants (e.g., sulfur dioxide and particulate matter) that have only a local impact on air quality, greenhouse gases affect the atmosphere equally, regardless of where they are emitted, and thus they are truly global pollutants. A ton of methane emissions in Asia affects the global atmosphere to the same degree as a ton of methane emissions in the United States.

Figure 5.8-1. Model of the Natural Greenhouse Effect



Source: Intergovernmental Panel on Climate Change 2007

The extent to which a given greenhouse gas traps energy in the atmosphere and contributes to the overall greenhouse effect is characterized by its global-warming potential. Some gases are more effective at trapping heat, while others may be longer-lived in the atmosphere. The reference gas against which others are compared is carbon dioxide, and global warming potential is thus expressed in terms of carbon dioxide equivalent (CO_2e). CO_2e reflects both a gas's ability to trap heat and the rate at which it breaks down in the atmosphere. Most analyses use 100 years as the period of reference for global warming potential. For example, 1 unit of carbon dioxide has a 100-year global warming potential of 1, whereas an equivalent amount of methane has a global warming potential of 25.

Greenhouse gas emissions occur from both natural as well as human (anthropogenic) sources. Natural sources include decomposition of organic matter and aerobic respiration. Anthropogenic greenhouse gas emissions are predominantly from the combustion of fossil fuels, although industrial processes, land-use change, agriculture, and waste management are also significant.

Atmospheric concentrations of greenhouse gases have increased since the Industrial Revolution, but the natural processes that remove those greenhouse gases from the atmosphere have not increased proportionally. Additionally, concentrations of long-lived manufactured pollutants such as hydrofluorocarbons have increased in recent decades. As the atmospheric concentrations of greenhouse gases increase, the atmosphere's ability to retain heat increases as well. Since the instrumental record began in 1895, the average temperature in the United States has risen by approximately 1.3 to 1.9 degrees Fahrenheit (°F) (U.S. Global Change Research Program 2014). Furthermore, these average temperatures are expected to increase at a faster pace in the 21st century, by 2.5°F to 11°F above preindustrial levels by 2100 (U.S. Global Change Research Program 2014).

The increase of greenhouse gas emissions in the atmosphere has been determined to pose risks to human and natural systems (Intergovernmental Panel on Climate Change 2014). Higher global surface temperatures cause widespread changes in the Earth's climate system. These changes may adversely affect weather patterns, biodiversity, human health, and infrastructure. A discussion of projected climate change in Cowlitz County and Washington State is provided in Section 5.8.2.4, *Climate Change Existing and Future Conditions*.

5.8.1.2 Regulatory Setting

Laws and regulations relevant to greenhouse gases are summarized in Table 5.8-1.

Table 5.8-1. Regulations, Statutes, and Guidelines for Greenhouse Gases

Regulation, Statute, Guideline	Description
Federal	
Clean Air Act of 1963 (42 USC 7401) as amended	In 2007, the U.S. Supreme Court ruled that greenhouse gases are air pollutants under the Clean Air Act.
The President's Climate Action Plan (2013)	Sets forth plan for cutting carbon pollution, preparing for the impacts of climate change, and leading international efforts to address climate change.[a]
Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units	In 2015, under the Clean Power Plan, EPA set state-specific target emissions reductions to reduce carbon dioxide emissions in the power sector by 32% below 2005 levels by 2030 (80 FR 64661). The greenhouse gas analysis uses the proposed Clean Power Plan. The final Clean Power Plan was released in August 2015, after the modeling was completed for the greenhouse gas analysis.
United States Submittal to the United Nations Framework on Climate Change	U.S. and other nations submitted INDC to the United Nations in 2015.
Revised Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews	The Council on Environmental Quality has published revised draft guidance on how NEPA analysis and documentation should address greenhouse gas emissions and the impacts of climate change.
State	
Limiting Greenhouse Gas Emissions (RCW 70.235)	Requires state to reduce overall greenhouse gas emissions as compared to a 1990 baseline and report emissions to the governor biannually. Specific goals include achieving 1990 greenhouse gas emissions levels by 2020; 25% below 1990 levels by 2035; and 50% below 1990 levels by 2050 or 70% below the State's expected emissions that year.

Regulation, Statute, Guideline	Description
Washington Clean Air Act (RCW 70.94)	Establishes rules regarding preservation of air quality and penalties for violations. Carbon dioxide mitigation fees are evaluated as part of the permit required by the Clean Air Act (RCW 70.94.892) to reflect requirements from RCW 80.70. RCW 70.94.151 states that the department will be responsible for adopting rules requiring reporting of emissions defined by 70.235.010 from facility, source, site, or fossil fuel supplier that meet or exceed 10,000 metric tons of CO_2e annually.
Washington Carbon Pollution and Clean Energy Action (Executive Order 14-04, 2014)	In December 2014, Governor Inslee established the Governor's Carbon Emissions Reduction Taskforce to provide recommendations to the 2015 legislative session on the design and implementation of carbon emissions limits and market mechanisms program for Washington State.
Washington's Leadership on Climate Change (Executive Order 09-05, 2009)	In 2009, Governor Gregoire ordered the state to assess the effectiveness of various greenhouse gas reduction strategies by estimating emissions, quantifying necessary reductions, and identifying strategies and actions that could be used to meet the 2020 target. Assessments were done across multiple sectors and sources of emissions, including industrial facilities, the electricity sector, low-carbon fuel standards, vehicle miles traveled, coal plants, and forestry.
Path to a Low-Carbon Economy: An Interim Plan to Address Washington's Greenhouse Gas Emissions (2010)	The second Climate Comprehensive Plan report to the Governor and State Legislature outlines a plan to achieve emissions reductions to 1990 levels by 2020, as required by RCW 70.235.
Local	
No local laws or regulations apply to greenhouse gas emissions.	

Notes:
[a] Executive Office of the President 2013
USC = United States Code; EPA = U.S. Environmental Protection Agency; INDC = Intended Nationally Determined Contribution; NEPA = National Environmental Policy Act; FR = *Federal Register*; CO_2e = carbon dioxide equivalent; RCW = Revised Code of Washington

5.8.1.3 Study Area

The study area for greenhouse gas emissions for Cowlitz County, as a SEPA co-lead agency, is defined as Cowlitz County. For the Washington State Department of Ecology (Ecology) as a SEPA co-lead agency, greenhouse gas emissions were studied based on the expected transportation routes and emissions from the combustion of coal. While the study areas for the co-lead agencies are different, the analysis used the same approach to calculate greenhouse gas emissions.

5.8.1.4 Methods

This section describes the sources of information and methods used to evaluate the greenhouse gas emissions associated with the construction and operation of the Proposed Action and the No-Action Alternative. The *SEPA Greenhouse Gas Emissions Technical Report* (ICF International 2016a) provides detailed descriptions of the methods summarized below.

Information Sources

The following sources of information were used to identify the existing conditions relevant to greenhouse gas emissions in the study areas.

- *SEPA Coal Market Assessment Technical Report* (ICF International 2016b) and emissions data used to evaluate the greenhouse gas emissions.
- *SEPA Air Quality Technical Report* (ICF International 2016c)
- *SEPA Energy and Natural Resources Technical Report* (ICF International 2016d)
- *SEPA Rail Transportation Technical Report* (ICF International 2016e)
- *SEPA Vessel Transportation Technical Report* (ICF International 2016f)

To estimate the greenhouse gases emitted as a result of the activities and processes described in the above reports, the greenhouse gas analysis combined those reports' estimates of fuel consumption and vehicle operation with greenhouse gas emissions factors to estimate greenhouse gas emissions for construction and operation aspects of the Proposed Action. The greenhouse gas emissions factors were drawn from the following sources.

- California Air Resources Board (2011)
- Clean Cargo Working Group (2014)
- Energy Information Agency (1994)
- U.S. Environmental Protection Agency (2015a)
- Intergovernmental Panel on Climate Change (2006, 2007)

Impact Analysis

The following methods were used to evaluate the potential impacts of the Proposed Action and the No-Action Alternative on greenhouse gas emissions. This section also describes the method for estimating the greenhouse gas emissions associated with each emissions source.

Scope of the Analysis

The Proposed Action would emit greenhouse gases during construction and operation. Emissions in Cowlitz County would come predominantly from the combustion of fossil fuels for construction and operation of the Proposed Action. Emissions outside of Cowlitz County would also result from the changes due to transportation and combustion of coal, both domestically and internationally, as related to the Proposed Action. This analysis includes activity data from the reports identified in Section 5.8.1.4, *Methods, Information Sources,* to estimate emissions in and outside of Cowlitz County. Additionally, this greenhouse gas analysis evaluates emissions scenarios based on the flow of coal to and through the coal export terminal.

Geographically, the analysis of greenhouse gas emissions from the Proposed Action includes emissions from the transport of Powder River Basin and Uinta Basin coals from their points of extraction to the coal export terminal in Cowlitz County, final transport to Asia, and the end-use combustion of coal in Asia. The analysis also considers changes in coal combustion and emissions elsewhere that could occur when imported coal from the Proposed Action displaces other coal. The substitution of natural gas for coal in the United States because of an increase in domestic coal prices is also evaluated. This analysis of greenhouse gas emissions does not include emissions from future coal extraction in the Powder River Basin and the Uinta Basin. Emissions from extraction are covered in separate greenhouse gas analyses as part of the National Environmental Policy Act (NEPA) requirements for coal mines. Additionally, any future coal mine leases would require separate greenhouse gas analyses as part of the NEPA requirements for new coal mines. The greenhouse gas emissions analysis considers the following elements.

- **Analysis period.** To be consistent with activity data from the other technical reports, this analysis considers construction, operation, transportation, and fossil fuel combustion emissions from 2018 through 2038.
- **Emissions in Cowlitz County.** Greenhouse gas emissions in Cowlitz County are estimated for the construction and operation of the Proposed Action. These are described in *Method for Impact Analysis*, *Sources of Emissions in Cowlitz County*. Greenhouse gas emissions are measured in CO_2e, which is based on the global warming potential factors consistent with the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007) for carbon dioxide, methane, and nitrous oxide.[1]
- **Emissions Outside of Cowlitz County.** Greenhouse gas emissions from the Proposed Action outside of Cowlitz County were estimated. These are described below in *Method for Impact Analysis*, *Emissions Outside of Cowlitz County*. Greenhouse gas emissions calculations are characterized in terms of CO_2e.
- **Induced demand for energy.** This analysis addresses coal combustion in Asia that would result from the increased supply of coal from the Proposed Action. As described in the *SEPA Coal Market Assessment Technical Report*, the addition of 44 million metric tons of coal to the Asian market would increase supply and lower international coal prices. Asian coal markets would respond to lower prices by consuming more coal overall. This additional demand for coal that would result from more supply and lower prices is referred to as induced demand.
- **Displacement of other energy sources.** Coal transported through the coal export terminal could displace other energy sources, nationally and internationally. Depending on the scenario, coal transported through the terminal could affect coal production in Australia, China, and Indonesia, and could affect coal consumption throughout Asia. Conversely, in the United States, natural gas could be used as a substitute for coal combustion. The analysis of greenhouse gas emissions considers this displacement.
- **Coal market assessment scenarios.** Each coal market assessment scenario represents a range of greenhouse gas emissions estimates, based on economic and policy projections from 2020 to 2040. For each scenario, the greenhouse gas emissions from Asian coal combustion, U.S. coal combustion, and U.S. natural gas combustion are influenced by factors such as coal prices, transportation costs, and competing energy sources. Estimates of coal transport, coal consumption, and natural gas substitution are informed by projections in the *SEPA Coal Market Assessment Technical Report*, which considers four scenarios based on economic and policy projections from 2020 to 2040. The scenarios represent a range of greenhouse gas emissions estimates determined using a multidimensional model. The four scenarios and their key

[1] The U.S. Greenhouse Gas Emissions Inventory covers six greenhouse gases; however, since the Proposed Action does not include refrigeration, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride were not included in the estimate of greenhouse gas emissions.

concepts are described below. The four scenarios were compared against a baseline existing condition where the Proposed Action would not be built.

- **2015 Energy Policy Scenario.** The 2015 Energy Policy scenario represents the potential impact of new international climate and energy policies on international coal demand. Functionally, this scenario is the same as the Past Conditions (2014) scenario except for two parameters. First, the international thermal coal demand is derived from an international policy perspective (International Energy Agency 2014). Second, this scenario includes the Clean Power Plan in the form in which it was originally proposed, which will reduce coal consumption in the United States (U.S. Environmental Protection Agency 2014). The final Clean Power Plan was released in August 2015, after the modeling was completed for the coal market assessment and greenhouse gas analysis. This scenario more accurately reflects current global conditions and is the preferred scenario for purposes of this study.
- **Past Conditions (2014) Scenario.** The Past Conditions (2014) scenario represents the state of the energy markets as of 2014 and, therefore, assumes no climate policies enacted. Consequently, it does not include the Clean Power Plan effective in late 2015, and does not, therefore, reflect current energy policy conditions. The international demand for coal varies by country, using "business-as-usual" projections described in the *SEPA Coal Market Assessment Technical Report*.
- **Lower Bound Scenario.** The Lower Bound scenario minimizes induced coal demand as a result of the Proposed Action. This scenario evaluates the net carbon dioxide emissions from construction and operation of the Proposed Action in which the induced coal demand from the coal export terminal is minimized. The resulting low estimate of global carbon dioxide emissions from coal combustion is meant to be plausible and does not represent the absolute lowest amount of carbon dioxide emissions. The energy market under the Lower Bound scenario could reflect a large demand for renewable energy resulting in reduced demand for coal combustion (described in the *SEPA Coal Market Assessment Technical Report*).
- **Upper Bound Scenario.** The Upper Bound scenario maximizes induced coal demand as a result of the Proposed Action. In this scenario, more coal plants are constructed than in the Past Conditions (2014) scenario, thus driving up demand. The increase in demand causes both international coal consumption and prices to increase. The Upper Bound scenario is also meant to be a plausible scenario and does not represent an absolute maximum of global carbon dioxide emissions or carbon dioxide emissions that would result from the Proposed Action (described in the *SEPA Coal Market Assessment Technical Report*).

  Table 5.8-2 summarizes the characteristics of the four scenarios. For each scenario, the table provides the following information.

  - **Purpose:** the characteristics that the scenario is intended to represent.
  - **U.S. coal markets:** how the domestic coal market would react to changes in demand due to changes in supply and pricing.
  - **Asian coal markets:** how the international coal market would react to changes in coal demand due to changes in supply and pricing.
  - **Coal prices:** a range of coal prices captures increases and decreases in coal production and transportation costs relative to the Past Conditions (2014) scenario.
  - **Climate policy:** the effect of meeting the 2014 goals of the proposed Clean Power Plan and U.S.–China climate negotiations.

Table 5.8-2. Coal Market Assessment Scenarios Definitions in Relation to the Baseline Assumptions

Scenario	Purpose	U.S. Coal Market Conditions (Relative to Baseline Assumptions)	Asian Coal Market Conditions (Relative to Baseline Assumptions)	Coal Prices (Relative to Baseline Assumptions)	Climate Policy
2015 Energy Policy	Represents impacts of an international climate policy on the coal market as enacted by 2014 and the proposed domestic Clean Power Plan	Coal demand is *less* sensitive to price changes because coal demand is very low due to climate policies	Coal demand is *less* sensitive to price changes because coal demand is very low due to climate policies	Baseline assumptions	Climate policy resembling implementation of proposed Clean Power Plan and meeting goals of 2014 U.S.–China climate negotiations
Lower Bound	Represents energy markets where renewable penetration is high and international coal prices and demand are low, making domestic coal exports less attractive to international markets	• Lower coal demand due to higher Powder River Basin and Uinta Basin coal prices • Decreased coal combustion emission factors • Overall *less* sensitive to price changes	• Lower coal demand due to increased renewables • Lower coal prices due to lower demand • Decreased coal combustion emission factors • Overall *less* sensitive to price changes	• Higher Powder River Basin and Uinta Basin coal prices due to assumed higher production costs • Higher U.S. rail transportation costs due to higher overall system use	No climate policy; however, assumes significant renewable energy use
Upper Bound	Represents energy markets where coal consumption is high, leading to high international demand and prices, making domestic coal exports more attractive to international markets	• Higher coal demand due to lower Powder River Basin and Uinta Basin coal prices • Higher coal combustion emission factors • Overall *more* sensitive to price changes	• Higher coal demand resulting in higher coal prices • Higher coal combustion emission factors • Overall *more* sensitive to price changes	• Lower Powder River Basin and Uinta Basin coal prices due to assumed lower production costs • Lower U.S. rail transportation costs due to continuing low oil prices and increased competition with trucking	No climate policy
Past Conditions (2014)	Represents the state of energy markets in the absence of climate policies	Baseline assumptions	Baseline assumptions	Baseline assumptions	No climate policy

Method for Assembling an Emissions Time Series

Because greenhouse gases accumulate in the atmosphere, this assessment characterizes greenhouse gases over the full analysis period (2018 to 2038) for each year as well as for each scenario. The time series was estimated from existing data and assembled as follows.

- **Coal market assessment.** The *SEPA Coal Market Assessment Technical Report* provides estimates for throughput for 2020, 2025, 2030, and 2040. It does not consider a start-up period, so the activity data and emissions estimates for 2025, which assume a full throughput of 44 million metric tons, are prorated. Assuming that *net* emissions and activity are zero in 2020, the analysis assumes a linear growth to a throughput of 25 million metric tons in 2025. Between 2025 and 2028, the throughput increases linearly at a slightly faster rate to reach full capacity at 44 million metric tons by 2028.
- **Activity data.** The activity data that characterize coal export terminal operations represent conditions in 2028, when the facility is expected to be fully operational. These data do not reflect the coal export terminal startup, in which the coal throughput increases from zero immediately after construction in 2020 to full capacity of 44 million metric tons by 2028. Emissions estimates are proportional to throughput and can be expressed as emissions per unit of coal throughput.

5.8.1.5 Existing Conditions

This section describes the existing environmental conditions in the study areas related to greenhouse gas emissions that could be affected by the construction and operation of the Proposed Action and the No-Action Alternative.

As discussed in Section 5.8.1.1, *Greenhouse Effect,* greenhouse gas emissions trap heat in the atmosphere and increase surface temperatures on the Earth, which contribute to global warming and climate change. The climate impacts of global warming include sea level rise, changes in precipitation and snowpack patterns, ocean acidification, wildfire seasons, and fluctuations in surface temperatures.

In 2012, Washington State was responsible for contributing 92.0 million metric tons of CO_2e. Of that 2012 total for Washington State, 42.5 million metric tons of CO_2e (46.2%) are attributable to the transportation sector, and 12.1 million metric tons of CO_2e (13.2%) are attributable to coal combustion in the electricity sector (Washington State Department of Ecology 2016).

Near the project area, greenhouse gas emission sources include locomotives for rail traffic along the BNSF Spur (approximately seven trains per day), Reynolds Lead (approximately two trains per day), vehicular traffic on area roadways, ongoing operations of the existing bulk product terminal in the Applicant's leased area, and other industrial uses along the Columbia River. The *SEPA Greenhouse Gas Technical Report* provides estimates of selected greenhouse gas emissions near the project area.

Method for Impact Analysis

This section provides an overview of the method for calculating greenhouse gas emissions in the study areas for each source. More information about each method is described in the *SEPA Greenhouse Gas Emissions Technical Report*.

Sources of Emissions in Cowlitz County

As previously described, greenhouse gas emissions were estimated from construction, operation, and transportation in Cowlitz County. Changes in greenhouse gas emissions in Cowlitz County were calculated from the following activities related to the Proposed Action.

- **Vegetation and soil removal.** Construction of the Proposed Action would clear vegetation and remove surface soil, both of which sequester carbon dioxide (remove carbon dioxide from the atmosphere).
- **Coal export terminal construction.** Construction of the Proposed Action would generate greenhouse gas emissions from operation of construction equipment and transport of employees and construction materials to the project area.
- **Employee commuting.** Construction and operation of the Proposed Action would generate greenhouse gas emissions from construction workers commuting to the project area, and during operations, daily employee commuting to and from the project area.
- **Rail transport.** Operation of the Proposed Action would require rail transport of coal in Cowlitz County and in the project area.
    - Rail transport in Cowlitz County to and from the coal export terminal on the BNSF Railway Company (BNSF) main line, BNSF Spur, and Reynolds Lead.
    - Rail operations in the project area, including emissions from movement, switching, and idling on site.
- **Vehicle-crossing delay.** Operation of trains for the Proposed Action would result in additional vehicle delay at at-grade rail crossings. Engine idling would generate greenhouse gas emissions.
- **Coal export terminal operation.** Operation of the Proposed Action would generate greenhouse gas emissions from equipment such as loaders, maintenance vehicles, and cranes.
- **Vessel idling and tugboat use at the coal export terminal.** Operation of the Proposed Action would generate greenhouse gas emissions from vessel maneuvering into and then idling at the loading area. Additionally, tugboats assisting in vessel maneuvering would generate greenhouse gas emissions.
- **Vessel transport.** Operation of the Proposed Action would generate greenhouse gas emissions from vessels transporting coal in Cowlitz County from the project area down the Columbia River to the border of Cowlitz County.

Sources of Emissions Outside of Cowlitz County

To assess broader potential impacts on Washington State, changes in greenhouse gas emissions outside Cowlitz County were calculated from the following activities related to the Proposed Action.

- **Rail transport.** Operation of the Proposed Action would require rail transport from the extraction sites in the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado to the project area (see Section 5.1, *Rail Transportation*, for expected routes). Relative rail traffic by coal market scenario and year was determined based on the *SEPA Coal Market Assessment Technical Report*.

- **Coal export terminal electricity consumption.** Operation of the Proposed Action would consume electricity, generating greenhouse gas emissions from fuel combustion emissions at off-site power plants.
- **Helicopter and pilot boat trips.** Operation of the Proposed Action would generate greenhouse gas emissions from helicopter and pilot boat transfers along the Columbia River outside of Cowlitz County.
- **Vessel transport.** Operation of the Proposed Action would generate greenhouse gas emissions from vessels transporting coal outside of Cowlitz County.
    - Vessel transport in Washington State beyond Cowlitz County to 3 nautical miles past the mouth of the Columbia River.
    - Vessel transport from the United States to markets in China, Hong Kong, Japan, South Korea, and Taiwan.
- **Coal combustion in Asia and the United States.** Operation of the Proposed Action would generate greenhouse gas emissions from project-related coal combustion in the United States and the Pacific Basin.
- **Induced natural gas consumption in the United States.** Operation of the Proposed Action would change greenhouse gas emission rates as a function of changes in the coal market. As coal prices increase due to the increased demand for coal to export, the United States' natural gas consumption is expected to increase. While greenhouse gas emissions from coal combustion would decrease, emissions from natural gas combustion would increase.

5.8.1.6 Impacts

This section describes the greenhouse gas emissions that would result from construction and operation of the Proposed Action and the No-Action Alternative. Detailed emissions by scenario are available in the *SEPA Greenhouse Gas Emissions Technical Report* and *SEPA Coal Market Assessment Technical Report*.

Proposed Action

This section describes the greenhouse gas emissions that could occur in the study areas as a result of construction and operation of the Proposed Action.

Greenhouse gas emissions are presented as 2028 emissions (the first year of full export capacity operation for the coal export terminal) and total net emissions over the 2018 to 2038 time series. The total net emissions are the sum of emissions for the total time series, including construction beginning in 2018 and operation of the Proposed Action through 2038.

This section presents the aggregated results of each of the emissions sources described in Section 5.8.1.4, *Methods*. Details of the emissions associated with each source are available in the *SEPA Greenhouse Gas Emissions Technical Report.*

Construction

Construction-related activities associated with the Proposed Action would result in greenhouse gas emissions in Cowlitz County of 23,601 metric tons of CO_2e for all scenarios as described below. As explained in Chapter 2, *Project Objectives, Proposed Action*, *and Alternatives,* construction-related activities include demolishing existing structures and preparing the site, constructing the rail loop and dock, and constructing supporting infrastructure (i.e., conveyors and transfer towers).

Initial construction was assumed to occur over an 18-month period (2018 to 2020). Consequently, except for vegetation and wetlands cover, the total greenhouse gas construction-related emissions from 2018 to 2020 are 1.5 times the initial 12-month period (Table 5.8-3). For construction emissions from lost sequestration related to vegetation and wetland clearing, the emissions occur in the first year. Construction greenhouse gas emissions would be the same across all four scenarios.

Table 5.8-3. Construction Greenhouse Gas Emissions (metric tons of CO_2e)

	Scenario			
Source	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Vegetation and Soil Removal [a]				
Emissions During 12 Months of Construction Period	11,776	11,776	11,776	11,776
Total Emissions 2018–2020	11,825	11,825	11,825	11,825
Construction Equipment				
Emissions During 12 Months of Construction Period	5,349	5,349	5,349	5,349
Total Emissions 2018–2020[a]	8,024	8,024	8,024	8,024
Construction Worker Commuting				
Emissions During 12 Months of Construction Period	465	465	465	465
Total Emissions 2018–2020[b]	698	698	698	698
Construction Trucks				
Emissions During 12 Months of Construction Period	1,081	1,081	1,081	1,081
Total Emissions 2018–2020[b]	1,621	1,621	1,621	1,621
Construction Barges				
Emissions During 12 Months of Construction Period	955	955	955	955
Total Emissions 2018–2020[b]	1,433	1,433	1,433	1,433
Subtotal Construction Emissions				
Emissions During 12 Months of Construction Period	19,627	19,627	19,627	19,627
Total Emissions, 2018–2020[a]	23,601	23,601	23,601	23,601

Notes:
[a] Loss of accumulated carbon stocks during construction plus the loss of ongoing carbon sequestration.
[b] Construction emissions occur over an 18-month period prior to the operation of the coal export terminal; therefore, emissions from 2021 through 2038 are zero. Given the 18-month period for construction, total construction emissions are those for the 12-month period multiplied by 1.5.

Operations—Cowlitz County

Operation of the Proposed Action would result in annual greenhouse gas emissions of 38,477 metric tons of CO_2e in Cowlitz County for all scenarios. Operations-related activities are described in Chapter 2, *Project Objectives, Proposed Action*, *and Alternatives*.

Greenhouse gas emissions in Cowlitz County during operations are primarily driven by rail transport of coal, vessel idling and tugboat use at the coal export terminal, and vessel transport of coal (Table 5.8-4). The greenhouse gas emissions are presented in terms of the 2028 emissions (the assumed first year of full export capacity operation for the coal export terminal) and total net emissions from 2021 (when export operation begins) to 2038. Greenhouse gas emissions in Cowlitz County would be the same across all four scenarios.

Table 5.8-4. Operations—Cowlitz County Greenhouse Gas Emissions (metric tons of CO_2e)

	Scenario			
Source	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Vegetation and Soil Removal				
Annual Emissions, 2028	16	16	16	16
Total Emissions, 2021–2038	294	294	294	294
Rail Transport				
Annual Emissions, 2028	21,489	21,489	21,489	21,489
Total Emissions, 2021–2038	306,313	306,313	306,313	306,313
Vehicle-Crossing Delay				
Annual Emissions, 2028	223	223	223	223
Total Emissions, 2021–2038	3,178	3,178	3,178	3,178
Coal Export Terminal Equipment Operation				
Annual Emissions, 2028	903	903	903	903
Total Emissions, 2021–2038	12,894	12,894	12,894	12,894
Vessel Idling and Tugboat Use at the Coal Export Terminal				
Annual Emissions, 2028	7,338	7,338	7,338	7,338
Total Emissions, 2021–2038	104,740	104,740	104,740	104,740
Vessel Transport				
Annual Emissions, 2028	8,232	8,232	8,232	8,232
Total Emissions, 2021–2038	118,573	118,573	118,573	118,573
Employee Commuting				
Annual Emissions, 2028	275	275	275	275
Total Emissions, 2021–2038	3,922	3,922	3,922	3,922
Subtotal—Cowlitz County Emissions				
Annual Emissions, 2028	38,477	38,477	38,477	38,477
Total Emissions, 2021–2038	549,915	549,915	549,915	549,915

Operations—Outside of Cowlitz County

For full coal export terminal operations in 2028, the Proposed Action would result in the following annual greenhouse gas emissions outside of Cowlitz County of 3,192,548 metric tons of CO_2e for the preferred 2015 Energy Policy scenario. Operations-related activities are described in Chapter 2, *Project Objectives, Proposed Action, and Alternatives*.

Greenhouse gas emissions outside of Cowlitz County during operations are primarily driven by coal combustion in Asia and the United States, which varies greatly between coal market assessment scenarios (Table 5.8-5). The greenhouse gas emissions are presented in terms of the 2028 emissions (the first year of full export capacity operation for the coal export terminal) and total net emissions from 2021 (when export operation begins) to 2038.

Table 5.8-5. Operations—Emissions Outside of Cowlitz County (metric tons of CO_2e)

	Scenario			
Source	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Rail Transport				
Annual Emissions, 2028	951,505	951,505	897,328	951,505
Total Emissions, 2021–2038	13,349,583	13,451,684	12,920,725	13,410,738
Coal Export Terminal Electricity Consumption				
Annual Emissions, 2028	177	177	177	177
Total Emissions, 2021–2038	3,191	3,191	3,191	3,191
Helicopter and Pilot Boat Trips				
Annual Emissions, 2028	756	756	756	756
Total Emissions, 2021–2038	10,796	10,796	10,796	10,796
Vessel Transport[a]				
Annual Emissions, 2028	296,012	657,591	1,580,050	670,643
Total Emissions, 2021–2038	3,158,808	2,732,158	22,724,743	7,511,454
Coal Combustion in Asia and the United States[a]				
Annual Emissions, 2028	1,773,662	-3,603,435	27,047,892	-1,951,264
Total Emissions, 2021–2038	18,744,034	-54,610,906	373,134,929	-53,493,618
Induced Natural Gas Consumption in the United States[a]				
Annual Emissions, 2028	170,435	850,628	1,781,076	1,225,279
Total Emissions, 2021–2038	1,750,895	13,202,107	33,324,486	23,662,506
Subtotal—Emissions Outside of Cowlitz County				
Annual Emissions, 2028	3,192,548	-1,142,778	31,307,280	897,097
Total Emissions, 2021–2038	37,017,307	-25,210,970	442,118,871	-8,894,933

Notes:

[a] Emissions for these sources are presented as net emissions. Net greenhouse emissions represent the difference between the Proposed Action and the no-action for each scenario as defined in the *SEPA Coal Market Assessment Technical Report*.

Total Greenhouse Gas Emissions

This section presents the aggregated results of each of the emissions sources described previously. The total net emissions are the sum of emissions for the total time series, including construction beginning in 2018 and operation through 2038.

Table 5.8-6 shows the greenhouse gas emissions in Cowlitz County from construction and operation of the Proposed Action (Table 5.8-6) as 573,516 metric tons of CO_2e. These emissions are the same for each of the four scenarios, as they are emitted in proportion to throughput and are not influenced by outside economic factors. The largest contributors to the emissions are transportation-related emissions, including locomotive operation and vessel transport in Cowlitz County. Together, these two sources contribute about 74% of the emissions generated in Cowlitz County.

Table 5.8-6. Total Greenhouse Gas Emissions in Cowlitz County (metric tons of CO_2e)

	Scenario			
Period	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Annual Emissions, 2028	38,477	38,477	38,477	38,477
Total Emissions, 2018–2038	573,516	573,516	573,516	573,516

Table 5.8-7 shows the annual greenhouse gas emissions in Washington State (not including Cowlitz County) from transportation for the preferred 2015 Energy Policy scenario is 364,162 metric tons of CO_2e. Emissions in Washington State (outside of Cowlitz County) are approximately nine times as high as emissions in Cowlitz County, largely driven by the greater distances traveled by trains and vessels outside of Cowlitz County. Rail transport constitutes about 88% of the emissions generated within Washington State and outside of Cowlitz County (Table 5.8-7).

Table 5.8-7. Total Greenhouse Gas Emissions in Washington State, Excluding Cowlitz County (metric tons of CO_2e)

	Scenario			
Period	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Annual Emissions, 2028[a]	364,162	364,162	244,169	364,162
Total Emissions, 2018–2038	4,686,634	4,912,768	3,723,459	4,822,082

Notes:

[a] The only emission source within Washington State that varies between scenarios comes from rail transportation. The Upper Bound scenario emissions from 2028 differ from the other scenarios because coal is transported from the Uinta Basin and the Powder River Basin as opposed to the other three scenarios that source coal solely from the Powder River Basin in 2028. Since in-state rail distances are significantly shorter for Uinta Basin coal, Upper Bound emissions are lower. Total emissions differ between all scenarios since the two coal basins are drawn from two different extents across the lifetime of the Proposed Action.

Table 5.8-8 summarizes the total *net* greenhouse gas emissions for each scenario compared to the baseline conditions for each scenario. The net greenhouse gas emissions for the preferred 2015 Energy Policy scenario is 3.2 million metric tons of CO_2e. The 2015 Energy Policy scenario most accurately represents current global conditions, including a close approximation of Clean Power Plan implementation.

Table 5.8-8. Total Net Emissions (metric tons of CO_2e)[a]

	Scenario			
Period	**2015 Energy Policy**	**Lower Bound**	**Upper Bound**	**Past Conditions (2014)**
Net Annual Emissions, 2028[b]	3,231,025	-1,104,301	31,345,757	935,574
Total Net Emissions, 2018–2038[b]	37,590,823	-24,637,454	442,692,386	-8,321,417

Notes:

[a] Net greenhouse gas emissions represent the difference between each Proposed Action scenario and the no-action specific to each scenario in the *SEPA Coal Market Assessment Technical Report*.

[b] Scenarios where net emissions are negative are due to domestic coal displacement. For scenarios with positive net emissions, emissions increases from Asian coal displacement are a more significant factor than domestic coal displacement

Assessing Significance

The scenarios described in the *SEPA Coal Market Assessment Technical Report* identify a range of net emissions attributable to the Proposed Action. The 2015 Energy Policy scenario is intended to represent existing conditions under which the Proposed Action would operate. Although the 2015 Energy Policy is based on the draft Clean Power Plan as proposed in June 2014, rather than the final Clean Power Plan promulgated in August 2015, this scenario is the most representative of current U.S. policy of the scenarios modeled, and consequently is the preferred scenario for the analysis (Table 5.8-9).

Table 5.8-9. Greenhouse Gas Emissions for the 2015 Energy Policy Scenario (metric tons of CO_2e)

Phase	Years	Greenhouse Gas Emissions	Average Annual Emissions
Construction Emissions	2018–2020	23,601	7,867
Total Net Emissions for Initial Operation	2021–2027	9,712,124	1,387,446
Total Net Emissions for Full Operations	2028–2038	27,855,098	2,532,282
Total Emissions	**2018–2038**	**37,590,823**	

The average annual amount of emissions for operations in Table 5.8-9 exceeds various intensity considerations that are proposed in federal and state regulations and guidance. For example, the draft Washington State Clean Air Rule establishes an initial compliance threshold for greenhouse gas emissions of 100,000 metric tons of CO_2e per year. Similarly, EPA's Tailoring Rule, 40 CFR Parts 51, 52, 70 et al. applies to sources that emit more than 75,000 short tons of CO_2e per year.

Draft guidance from the federal Council on Environmental Quality identifies a threshold of 25,000 metric tons of CO_2e per year for quantification of greenhouse gas emissions under the National Environmental Policy Act (Council on Environmental Quality 2014).

These standards provide guidance on assessing the significance of various levels of greenhouse gas emissions. Since the net greenhouse gas emissions attributable to the Proposed Action in the preferred scenario exceed these standards, the emissions are considered to be significant impacts. The climate change impacts resulting from this increase to greenhouse gases would persist for a long period of time, beyond the analysis period and are considered permanent and, while global in nature, would affect Washington State. Based on these considerations, emissions attributable to operations of the Proposed Action under the 2015 Energy Policy Scenario are considered adverse and significant.

Market Effects on Coal Combustion and Emissions

The Applicant proposes to export up to 44 million metric tons of coal each year. Modeling was done to identify the changes in the coal markets and the resulting changes in potential greenhouse gas emissions that could be attributed to the Proposed Action. This is because, based on the changes in the market, transportation pathways, use of natural gas to replace coal, and other factors described previously and in the *SEPA Coal Market Assessment Technical Report*, the emissions for each of these areas could result in the following.

- Add to and increase the overall amount of global greenhouse gases.
- Replace other emissions with no change in the overall amount of global greenhouse gases.
- Reduce and decrease the overall amount of global greenhouses gases.

The purpose of this analysis is to identify how these changes by modeling the shift in coal prices both domestically and internationally affect the resulting net greenhouse gas emissions for each scenario. In summary, the Proposed Action would have the following market impacts, regardless of scenario.

- It would increase coal supplied to international markets.
- The increase in supply would decrease international coal prices.
- The decrease in international coal prices would increase the international demand for U.S. coal.
- The increase in international demand would increase U.S. coal prices.
- The increase in U.S. coal prices would reduce domestic coal demand.

Table 5.8-10 compares how coal and natural gas combustion change in response to market and policy conditions.

Table 5.8-10. Impacts on Coal and Natural Gas Markets and Emissions Resulting from the Proposed Action

Scenario	U.S. Coal Markets	Asian Coal Markets	U.S. Natural Gas Markets
2015 Energy Policy	Decrease in domestic coal emissions in early years, followed by a slight increase from 2030. In 2030 and later, coal is not replaced by natural gas to the same extent as other scenarios.	Increase in Asian coal emissions. The Proposed Action causes a decrease in Asian coal prices from increased supply, creating induced demand. The magnitude is smaller than in the Past Conditions (2014) scenario because coal prices are already low in this scenario, and the market reacts less sharply.	Decrease in domestic natural gas emissions. Due to the high renewable penetration and the Clean Power Plan Policy.

Scenario	U.S. Coal Markets	Asian Coal Markets	U.S. Natural Gas Markets
Lower Bound	Decrease in domestic coal emissions. The Proposed Action causes an increase in domestic coal prices, reducing consumption. The magnitude is smaller than the Past Conditions (2014) scenario because coal prices are already low in this scenario, and the market reacts less sharply.	Increase in Asian coal emissions. The Proposed Action causes an increase in emissions due solely to changes in the coal mix consumed.	Increase in domestic natural gas emissions. The Proposed Action causes an increase in domestic coal prices, increasing natural gas substitution for coal to meet energy demands. The magnitude is lower than in the Past Conditions (2014) scenario because domestic coal markets are less sensitive to the Proposed Action.
Upper Bound	Decrease in domestic coal emissions. The Proposed Action causes an increase in domestic coal prices, reducing consumption. The magnitude is higher than the Past Conditions (2014) scenario because coal prices are already high in this scenario, and the market reacts more sharply.	Increase in Asian coal emissions. The Proposed Action causes a decrease in Asian coal prices from increased supply, creating induced demand. The magnitude is higher than in the Past Conditions (2014) scenario because coal prices and demand are already high; adding coal from The Proposed Action to Asian markets would create induced demand with low rates of coal substitution.	Increase in domestic natural gas emissions. The Proposed Action causes an increase in domestic coal prices, increasing natural gas substitution for coal to meet energy demands. The magnitude is higher than in the Past Conditions (2014) scenario because domestic coal markets are more sensitive to the Proposed Action.
Past Conditions (2014)	Decrease in domestic coal emissions. The Proposed Action causes an increase in domestic coal prices, reducing consumption.	Increase in Asian coal emissions. The Proposed Action causes a decrease in Asian coal prices from increased supply, creating induced demand.	Increase in domestic natural gas emissions. The Proposed Action causes an increase in domestic coal prices, increasing natural gas substitution for coal to meet energy demands.

The largest contributor to net emissions is the extent to which coal and natural gas combustion are influenced in Asia and the United States. In the Past Conditions (2014) and Lower Bound scenarios, the largest contributor to the net emissions is the displacement of coal combustion in the United States, driven by an increase in coal prices in response to the Proposed Action. Coal displacement results in a reduction of greenhouse gas emissions. In the Upper Bound scenario, the emissions induced demand from lower coal prices in Asia in response to the Proposed Action outweighs the emissions from domestic coal displacement, resulting in positive net emissions. For additional information on the impacts on the coal market and emissions across the four scenarios, see the *SEPA Greenhouse Gas Emissions Technical Report*.

Emissions in Context

Each coal market assessment scenario represents a range of greenhouse gas emissions estimates, based on economic and policy projections from 2020 to 2040. For each scenario, the net greenhouse gas emissions from Asian coal combustion, U.S. coal combustion, and U.S. natural gas combustion are influenced by factors such as coal prices, transportation costs, and competing energy sources.

To provide a frame of reference, net greenhouse gas emissions from the Proposed Action for the preferred 2015 Energy Policy scenario are compared to emissions from the transportation and coal combustion sectors in the United States, as well as to greenhouse gas reduction targets from state and federal programs.

Emissions in Cowlitz County and Washington State in Context

Across all scenarios, the total Cowlitz County emissions associated with the Proposed Action are 573,516 metric tons of CO_2e from 2018 to 2038, with annual emissions of 38,477 metric tons of CO_2e in 2028 when the coal export terminal reaches full export capacity. This is equivalent to adding about 8,100 passenger cars on the road each year (U.S. Environmental Protection Agency 2015b).

Washington State's total greenhouse gas emissions were 92.0 million metric tons of CO_2e in 2012, the most recent year for which a greenhouse gas inventory was published. Of that total, 42.5 million metric tons of CO_2e (46.2%) are attributable to the transportation sector and 12.1 million metric tons of CO_2e (13.2%) are attributable to coal combustion in the electricity sector (Washington State Department of Ecology, 2016). Based on 2012 emissions data, the Proposed Action's emissions in Cowlitz County of 38,477 metric tons of CO_2e in 2028 would be less than 0.05% of Washington State's total annual emissions of 92.0 million metric tons of CO_2e (Washington State Department of Ecology 2016). Based on 2012 emissions data, the Proposed Action's emissions in Washington State (excluding Cowlitz County) of 364,162 metric tons of CO_2e in 2028 would be less than 0.4% of Washington State's total annual emissions of 92.0 million metric tons of CO_2e (Washington State Department of Ecology 2016).

In 2015, the U.S. Environmental Protection Agency (EPA) finalized state-specific targets to reduce carbon dioxide emissions in the power sector by 32% below 2005 levels by 2030. The statewide mass-based carbon dioxide performance goal for Washington State is approximately 10.74 million short tons (U.S. Environmental Protection Agency 2015a). The 2028 emissions in Cowlitz County for the Proposed Action would be about 0.3% of that total. The 2028 emissions in Washington State (excluding Cowlitz County) would be about 3.4% of that total.

Washington State law requires annual greenhouse gas emissions to be reduced to 1990 levels (88.4 million metric tons of CO_2e) by 2020 (Revised Code of Washington [RCW] 70.235.050). The Washington State goal represents an annual reduction of 3.6 million metric tons of CO_2e below the 2012 state emissions levels. The statewide annual emissions associated with the Proposed Action under the 2015 Energy Policy scenario is approximately 0.4 million metric ton of CO_2e and represents about 11% of the emissions reduction goal.

U.S. and Worldwide Emissions in Context

The net annual emissions from the Proposed Action under the preferred 2015 Energy Policy scenario in 2028 would be 3.2 million metric tons of CO_2e (Table 5.8-8). This is equivalent to adding about 672,100 passenger cars on the road each year (U.S. Environmental Protection Agency 2015b).

Coal combustion emissions in the United States were 1,658.1 million metric tons of carbon dioxide in 2013, whereas the total transportation emissions in the United States were 1,718.4 million metric tons of carbon dioxide (U.S. Environmental Protection Agency 2015a).

The United States has committed to reduce its greenhouse gas emissions by approximately 17% from 2005 levels (7,350.2 million metric tons of CO_2e) by 2020—a decrease of about 1,250 million metric tons of CO_2e (Executive Office of the President 2013). As part of the nonbinding climate policy agreement with China and the Intended Nationally Determined Contribution levels submitted to the United Nations in 2015, the United States has set a target to reduce emissions 26 to 28% below 2005 emissions (6,428 million metric tons of CO_2e) by 2025 (White House Office of the Press Secretary 2015). This policy would reduce annual emissions to a level of 4,628 to 4,757 million metric tons of CO_2e by 2025. The reduction in annual emissions would range from 1,035 to 1,163 million metric tons of CO_2e below 2013 annual emissions. If the target were reached through consistent annual reductions, the United States would have to reduce annual emissions by 86 to 97 million metric tons of CO_2e each consecutive year, beginning in 2014. Under the 2015 Energy Policy Scenario, the Proposed Action would add 0.9 million metric tons of CO_2e annually to domestic emissions by 2028, and 3.2 million metric tons of CO_2e globally.[2]

No-Action Alternative

Under the No-Action Alternative, the Applicant would not construct the coal export terminal. The Applicant would continue with current and future increased operations in the project area. The project area could be developed for other industrial uses including an expanded bulk product terminal or other industrial uses. The Applicant has indicated that, over the long term, it would expand the existing bulk product terminal and develop new facilities to handle more products such as calcine petroleum coke, coal tar pitch, and cement.

Alternative uses of the project area, as described in Chapter 2, *Project Objectives, Proposed Action, and Alternatives*, would be expected to result in an estimated annual increase of 1,242 metric tons of CO_2e relative to current conditions in Cowlitz County for locomotive combustion, vessel combustion, and truck transport (Table 5.8-11).

Table 5.8-11. No-Action Alternative Annual Average Emissions from Rail, Vessel, and Haul Trucks Operating within Cowlitz County

Source	Maximum Annual Average Emissions (metric tons of CO_2e)
Locomotive Combustion	593
Vessel Combustion	411
Haul Trucks	238
Total	**1,242**

5.8.1.7 Required Permits

No permits related to greenhouse gas emissions would be required for the Proposed Action.

[2] On the global scale, the International Energy Agency's 450 Scenario projects an energy pathway that is consistent with a stabilization of greenhouse gases at 450 ppm CO_2e and the internationally agreed target of limiting the long-term increase in average global temperature to no more than 2°Centigrade compared with preindustrial levels. The 450 Scenario results in energy-related carbon dioxide emissions decreasing from 31.6 billion metric tons in 2012 to 25.4 billion metric tons in 2030 (International Energy Agency 2014).

5.8.1.8 Potential Mitigation Measures

This section describes the mitigation measures that would reduce greenhouse gas emissions from construction and operation of the Proposed Action. These mitigation measures would be implemented in addition to project design measures, best management practices, and compliance with environmental permits, plans, and authorizations that are assumed as part of the Proposed Action and described below.

Applicant Mitigation

The Applicant will implement the following measures to mitigate greenhouse gas emissions.

MM GHG-1. Provide Fuel Efficiency Training to Equipment Operators.

To reduce greenhouse gas emissions from construction equipment, the Applicant will provide a fuel efficiency training program to locomotive, vessel, and construction equipment operators.

MM GHG-2. Implement an Anti-Idling Policy.

To reduce emissions from vessel and locomotive idling in the project area, the Applicant will implement an anti-idling policy.

MM GHG-3. Reduce Emissions from Cars.

The Applicant will evaluate the use of electric cars for company cars, incentivize the use of electric vehicles by providing charging stations, and develop an incentive program for carpooling.

MM GHG-4. Mitigate for Impacts on Washington State from Net Greenhouse Gas Emissions Attributable to the Proposed Action.

Under the 2015 Energy Policy scenario, which best reflects the existing policy requirements and conditions, the average net greenhouse gas emissions for operations from 2021 to 2027 would be 1,387,446 metric tons of CO_2e per year and from 2028 to 2038 would be 2,532,282 metric tons of CO_2e per year.

Washington State laws provide mitigation requirements for greenhouse gas emissions associated with electricity generation. These include RCW 80.70 (Carbon Dioxide Mitigation), which requires mitigation of 20% of the gross emissions from new thermal power plants and RCW 80.80 (Greenhouse Gas Emissions – Baseload Electric Generation Performance Standard), which sets an emissions performance standard for new power generation based on the performance of natural gas fired plants. In addition, RCW 70.235 establishes an emission reduction level for Washington State of 25% of 1990 levels by 2035. The mitigation requirements in RCW 80.70 and RCW 80.80 are not directly applicable to the Proposed Action, but these state laws establish a useful framework for comparison. If the coal transported by the Proposed Action was used for power plants located in Washington State, those standards would require mitigation of between 20% and approximately 55% of the gross emissions, depending on the efficiency of the plant and the standard chosen. The coal transported by the Proposed Action is for export to Asia to be combusted for power generation. Washington State standards would not apply to these facilities; however, the impact of the net greenhouse gas emissions attributable to the Proposed Action would affect Washington State regardless of the location of the facilities.

Under the Proposed Action, 44 million metric tons of coal would pass through the coal export terminal at full operation. Downstream combustion emissions from this coal equals approximately 90 million tons of CO_2e per year. However, not all of the emissions are attributable to the Proposed Action because some of the coal being shipped from the coal export terminal could displace other coal shipped from other areas and change transportation pathways. In particular, according to the model results from the preferred 2015 Energy Policy Scenario, average annual net emissions from the Proposed Action at full operation would be approximately 2.8% (i.e., 2.5 million metric tons of CO_2e) of the downstream combustion emissions from the coal that passes through the coal export terminal. By approximation to the standards in RCW 80.70, 80.80 and RCW 70.235, a mitigation rate of 50% of projected net emissions is reasonable and appropriate. This mitigation rate also takes into account potential variability in projected emissions.

To address the potential impacts of greenhouse gas emissions attributable to the Proposed Action, the Applicant will prepare a greenhouse gas mitigation plan that mitigates for 50% of the greenhouse gas emissions identified in the 2015 Energy Policy Scenario. For initial operations this is 693,723 metric tons of CO_2e (or 50% of 1,387,446) per year from 2021to 2027. For operations at maximum capacity this is 1.27 million metric tons CO_2e per year (or 50% of 2.53 million) from 2028 to 2038. The plan must be approved by the Washington State Department of Ecology. For mitigation that occurs in Cowlitz County, the plan will be approved by Cowlitz County and Ecology. The plan must be implemented prior to the start of operations. The measures described in the plan may include a range of mitigation options. The measures must achieve emission reductions that are real, permanent, enforceable, verifiable and additional. The emission reductions may occur in Washington State or outside of Washington State but must meet all five criteria.

5.8.1.9 Unavoidable and Significant Adverse Environmental Impacts

The mitigation measures identified above would substantially reduce, but not completely eliminate, the greenhouse gas emissions attributable to the Proposed Action. The Proposed Action's remaining projected contribution to greenhouse gas emissions impacts, which are cumulative in nature, would still be significant and adverse under the greenhouse gas emissions intensity considerations previously noted.

5.8.2 Climate Change

The international scientific community is in agreement that human activities have contributed—and continue to contribute—to climate change. One of the primary causes of climate change is the emission of greenhouse gases, which trap heat in the atmosphere. The Applicant has stated that coal exported through the terminal would be combusted in Asia, and the combustion of coal would emit greenhouse gases. Analysis of greenhouse gas emissions related to the Proposed Action and potential mitigation measures from greenhouse emissions are discussed in Section 5.8.1, *Greenhouse Gas Emissions*. Studies have found, in general, that climate change could result in changes in precipitation, temperature, and storm intensity and could increase risks of damage from flooding, drought, heat waves, winds, and storm surge. This section discusses existing and future conditions.

The changing climate could affect the Proposed Action. This section describes potential climate change impacts in the study area related to the construction and operation of the Proposed Action and No-Action Alternative. This section does not discuss impacts impacts or mitigation for general climate change.

5.8.2.1 Regulatory Setting

Laws and regulations relevant to climate change are summarized in Table 5.8-12.

Table 5.8-12. Regulations, Statutes, and Guidelines for Climate Change

Regulation, Statute, Guideline	Description
Federal	
Clean Air Act of 1963 (42 USC 7401)	Directs the control of air pollutants nationally. The U.S. Supreme Court in 2007 established that greenhouse gases are air pollutants, and are therefore covered under this Act.
State	
Requirements of Strategy—Initial Climate Change Response Strategy (RCW 43.21M.020)	Directs state agencies to develop an integrated climate change response strategy to enable state, tribal, and local governments and public and private organizations to prepare for and adapt to the impacts of changing climate conditions. Outlines strategies for protecting human health, safeguarding infrastructure and transportation systems, improving water management, reducing losses to agriculture and forestry, protecting sensitive and vulnerable species, and supporting communities by involving the public.
Washington State Growth Management Act (WAC 365-195-920, RCW 36.70A)	Requires state and local governments to use "best available science" when developing policies and development regulations. Suggests using adaptive management as an interim approach for managing scientific uncertainty.
Local	
No local laws or regulations apply to climate change.	

Notes:
USC = United States Code; RCW = Revised Code of Washington; WAC = Washington Administrative Code

5.8.2.2 Study Area

The study area for potential impacts from climate change effects is defined as the project area for the Proposed Action and the access roads and rail leading to the project area.

5.8.2.3 Methods

This section describes the sources of information and methods used to identify projected changes in climate and to evaluate the impacts of climate change on the construction and operation of the Proposed Action and No-Action Alternative.

Information Sources

The following sources provided information on historical climate and projected changes in climate for southwestern Washington State.

- **National Climate Change Viewer.** The U.S. Geological Survey (USGS) National Climate Change Viewer (U.S. Geological Survey 2014a) contains historical and future climate projections at watershed, state, and county levels for the continental United States. The viewer contains *multimodel ensemble data* (*mean model*), combining the results from 30 independent climate models developed by researchers around the world under the coordination of the Fifth Coupled Model Intercomparison Project (CMIP5).[3] Multimodel data increase the robustness of projections and provide information on the level of uncertainty in the direction and magnitude of future climate trends. Climate information in the viewer has been *downscaled*, or processed using statistical analysis to provide projections with higher geographic resolution of temperature, precipitation, and snowfall. Historical values and future projections of temperature were examined for Cowlitz County where the Proposed Action would be located. Historical values and future projections of precipitation and snowfall were examined for the Lower Columbia River Basin.
- **2014 National Climate Assessment.** The 2014 National Climate Assessment was conducted by the U.S. Global Change Research Program (2014). This assessment summarizes the current and future impacts of climate change in the United States. Its findings, which have undergone extensive public and expert peer review, were compiled by a team of more than 300 experts guided by the 60-member Federal Advisory Committee of the National Academy of Sciences. The report uses multimodel ensemble projections developed under CMIP5, supplemented by information from an earlier phase of the project, CMIP3, where necessary.

Impact Analysis

The following methods were used to evaluate the potential impacts of climate change on the Proposed Action.

For each potential climate change impact, this analysis determined how changes in climate could affect the Proposed Action or No-Action Alternative by comparing climate change projections against the following data.

- Historical records of relevant events or climate hazards.
- Current maps and risk or hazard indices (e.g., flood rate insurance maps, wildfire hazard maps).
- Established temperature or precipitation thresholds at which climate impacts are expected to become more severe.
- Information on engineering, design, and operational characteristics of the coal export terminal.

[3] CMIP5 is the fifth phase of the World Climate Research Programme's Coupled Model Intercomparison Project, which has established a standard set of simulations for coordinated climate experiments among international climate modeling groups. CMIP5 data is accessible over the internet and has been used in the Intergovernmental Panel on Climate Change's Fifth Assessment Report, an internationally vetted and authoritative report on global climate change. A list of the climate models can be found in Appendix 5 of the National Climate Change Viewer Tutorial (U.S. Geological Survey 2014b).

5.8.2.4 Existing and Future Conditions

Temperatures have increased across the Pacific Northwest by 1.3 degrees Fahrenheit (°F) since 1895. Precipitation has increased but these increases are small and vary in location within the region. Under the changing climate, temperatures could rise by as much as 9.7°F by the end of the century. Future trends in average precipitation are very uncertain and could increase or decrease, but summer precipitation is projected to decrease by as much as 30% by 2100.

Snowpack averaged over the Cascade Mountains has declined by about 20% since 1950. In the future, snowpack is expected to continue its downward trend, causing declines in snowmelt. According to Elsner et al. (2010), the snow water equivalent on April 1 could decline by almost half (46%) by the 2040s and virtually disappear by the 2080s, greatly reducing streamflow in some areas.

The incidence of extreme precipitation may have increased over time, but it has not yet been demonstrated to be statistically significant. It varies with location within the region. Under the changing climate in the Pacific Northwest, the number of days with daily rainfall greater than 1 inch could increase by 13% between 2041 and 2070.

Sea levels are rising but uplift of the land in parts of the Pacific Northwest mitigates possible impacts from sea-level rise. By contrast, areas around Puget Sound are subsiding and causing larger-than-average increases in sea levels. For the Pacific Northwest, sea-level rise is expected to be as little as 5 inches or less to greater than 4 feet by the end of the century. The impacts of the El Nino South Oscillation phenomenon on climate variability can be significant. During El Nino years, regional sea levels can increase by 4 to 12 inches and last for many months.

Climatic changes in precipitation could have far-reaching effects for the Pacific Northwest. Reduced summer rainfall and reductions in snowmelt could result in reduced streamflow. Increases in extreme precipitation could lead to increased flooding, especially in basins that derive their water from both rainfall and snowfall. Rising sea levels could also lead to flooding. Increasing temperatures and reduced precipitation could lead to an increase in wildfires, which are driven, in part, by water deficits. By the 2080s, the median area burned annually in the Pacific Northwest could quadruple compared to the 1916-to-2007 period (Mote et al. 2014).

Ocean acidification is the decrease of pH of ocean water over an extended period caused by the uptake of carbon dioxide from the atmosphere. This results in changes in seawater carbonate chemistry that can affect marine organisms such as shellfish. Biological impacts from ocean acidification are expected to vary but could be significant.

This section describes the historical and projected climate conditions in the study area that include changes in temperature, precipitation, and snowfall.

Historical and Projected Changes in Temperature

One of the most notable characteristics of climate change is the increase in temperatures over time.

Historical Temperatures

Washington State has a varied climate with significant differences in temperature and precipitation on the east and west sides of the Cascade Mountains. Temperatures across the Pacific Northwest have increased from 1895 to 2011 by 1.3°F (Mote et al. 2014). West of the Cascades, where the study area is located, the climate is characterized by mild temperatures and heavy annual precipitation. From 1950 to 2005, the highest monthly average temperatures in Cowlitz County were more than 75°F, cooler than Washington State as a whole (77.5°F) but warmer than the lower Columbia River Basin of which it is part (73.4°F). The highest monthly average temperature in Cowlitz County over this period was a moderate 77.2°F (August) (U.S. Geological Survey 2014a). In general, the lowest monthly average temperatures in Cowlitz County during winter were below 31.6°F from 1950 to 2005. The area has experienced a warming trend in the past 50 years; the annual average maximum temperatures have increased by 0.9°F (U.S. Geological Survey 2014a).

Projected Temperatures—Near-Term Future

In the near-term future, seasonal temperatures in the study area are projected to increase. In Cowlitz County, hot summer temperatures could rise by as much as 4.3°F in the high greenhouse gas emissions scenario from 2025 to 2049,[4] compared to baseline (U.S. Geological Survey 2014a). Cold winter temperatures are projected to increase by 2.4 to 3.0°F in moderate and high greenhouse gas emissions scenarios over this period.

Projected Temperatures—Midterm Future

The warming trend continues into the midterm future (2050 to 2075), when hot summer temperatures in Cowlitz County are projected to increase by 5.4 to 7.2°F. Coldest temperatures are expected to increase by as much as 5.2°F. These increases will likely bring the coldest temperatures near to or above the freezing point. While some models project higher or lower increases in temperature, all 30 models agree that temperatures will increase in Cowlitz County. Table 5.8-13 summarizes these historical and projected changes in temperature.

Table 5.8-13. Historical and Projected Changes in Temperature in Cowlitz County, Washington

Historical Climate and Observed Changes (1950–2005)	Near-Term Projected Changes (2025–2049 Compared to 1950–2005)	Midterm Projected Changes (2050–2075 Compared to 1950–2005)	Level of Certainty in Projections
The average monthly summer and winter temperatures (approximately 75°F and 32°F, respectively) reflect the moderate climate of the area.	Summer and winter temperature extremes are projected to increase.	Summer and winter temperature extremes are projected to increase.	There is excellent agreement across models on the direction of change.
Highest average monthly summer temperatures (top 10%, or 90th percentile) were above 75.0°F. Max monthly average temperature for August was 77.2°F.	90th percentile temperature is projected to increase by 3.8 to 4.3°F under moderate and high emissions scenarios.	90th percentile temperature is projected to increase by 5.4 to 7.2°F under moderate and high emissions scenarios.	Monthly average temperature is projected to increase in all months across all models compared to 1950–2005.

[4] Greenhouse gas scenarios are based on the flow of coal from extraction points through transport to export terminals, distribution to local and global markets, and combustion. Section 5.8.1, *Greenhouse Gas Emissions*, provides a discussion of these scenarios.

Historical Climate and Observed Changes (1950–2005)	Near-Term Projected Changes (2025–2049 Compared to 1950–2005)	Midterm Projected Changes (2050–2075 Compared to 1950–2005)	Level of Certainty in Projections
Lowest monthly average winter temperatures (10th percentile) were below 31.6°F.	10th percentile temperature is projected to increase by 2.4 to 3.0°F under moderate and high emissions scenarios.	10th percentile temperature is projected to increase by 4.0 to 5.2°F under moderate and high emissions.	Monthly average temperature is projected to increase in all months across all models compared to 1950–2005.

Historical and Projected Changes in Precipitation

Precipitation in the Pacific Northwest affects Columbia River water levels. The Columbia River is the fourth largest river in North America. It is influenced by multiple river basins from multiple states and British Columbia, Canada. The geographic and hydrologic characteristics of the river, which drains an approximately 259,000-square-mile basin, are suited to beneficial multipurpose storage development. Since the 1930s, numerous dams, both federal and private, have been built to store water for flood control, to generate hydroelectric power, and for other purposes. Total storage capacity of these dams is about 25% of the 156-million-acre-foot average annual runoff volume for the Columbia River at the mouth of the river at the Pacific Ocean. Federal projects in the basin have 19,900 megawatts of existing hydroelectric capacity, and non-federal projects add 10,700 megawatts (U.S. Army Corps of Engineers 2015).

The primary concerns about precipitation are whether there is enough precipitation (e.g., drought conditions), when it occurs (winter snowpack levels), and whether the precipitation is delivered in extreme events, which can cause significant damage.

Washington State defines drought as 75% of normal water conditions (Revised Code of Washington [RCW] 43.83B.400). In the past century, drought occurred from 1928 to 1932, 1992 to 1994, and 1996 to 1997, and most recently in 2015. Drought has caused shipping costs to rise, sometimes requiring wheat growers to move their product by rail or truck instead of barge transport. Washington State estimates that it will experience severe or extreme drought 5% of the time in the future and more frequently east of the Cascade Mountains (Washington State Emergency Management Division 2012a). The 2015 drought emergency affected all of Washington State (Washington State Department of Ecology 2015).

Extreme precipitation, especially during the winter, has frequently led to flooding events in the Pacific Northwest. Major flooding in western Washington in January 2009 closed Interstate 5, heavily damaged the Howard Hanson Dam, and put tens of thousands of people at risk. (Warner et al. 2012). A key driver of these precipitation events is the phenomenon of atmospheric rivers that form in the Pacific Ocean and move eastward toward the Pacific Northwest. In December 2015, an atmospheric river formed and made landfall along the Washington coast, resulting in approximately 16 inches of precipitation over 3 days across Oregon, Washington, and British Columbia. Although future trends in average precipitation are very uncertain and could increase or decrease, summer precipitation is projected to decrease significantly.

The incidence of extreme precipitation events may have increased over time, but it has not yet been demonstrated to be statistically significant. It varies with location within the region. Under the changing climate in the Pacific Northwest, the number of days with daily rainfall of more than 1 inch could increase by 13% from 2041 to 2070.

Historical Precipitation

According to the National Climate Assessment (Mote et al. 2014), the anticipated change in annual precipitation in the Pacific Northwest (2030 to 2059) ranges from decreases (-11%) to increases (+12%) for scenarios ranging from low to high greenhouse gas emissions (Intergovernmental Panel on Climate Change 2000). This variability makes the analysis of potential impacts problematic. Typically, average monthly precipitation is greatest in winter (December through February) and least in summer (June through August) (U.S. Geological Survey 2014a). From 1950 to 2005, precipitation in the lower Columbia River Basin averaged 0.40 inch per day in winter (U.S. Geological Survey 2014a) and about half that in spring (0.22 inch) and fall (0.25 inch). By contrast, only 0.07 inch per day fell during the summer months.

Projected Precipitation—Near-Term Future

In the near term, the model indicates slight increases in the winter, spring, and fall compared to the 1950 to 2005 average. The largest increase in precipitation is projected to occur in fall (4.1 to 2.1%) and winter (2.3 to 4.8%). Very little increase is projected for the spring (0 to 1%) (U.S. Geological Survey 2014a). By contrast, summers in the near-term future are projected to become drier by 10 to 12%, although some climate models disagree and instead project that summer precipitation will remain the same or increase (U.S. Geological Survey 2014a). Overall, model agreement on precipitation is not strong. For example, in some cases, 19 models project decreases in June precipitation and 11 indicate increases for the near-term future. Agreement for the month of August, however, was closer, with 26 models showing decreases and only four demonstrating increases.

Projected Precipitation—Midterm Future

Similar changes are projected to continue in the midterm future: the winter, spring, and fall seasons could become wetter, while summers could become drier. In the lower Columbia River Basin, winter and fall precipitation levels are projected to increase by 4.9 to 7.1% and 3.6 to 1.5%, respectively, while spring levels remain relatively constant (0 to 1.8% increase) in moderate and high greenhouse gas emission scenarios compared to the 1950 to 2005 average. Extreme precipitation events could increase by 5.0 to 6.1% in the near-term future and 6.1 to 8.0% in the midterm future (U.S. Geological Survey 2014a), but studies of past trends in observed changes in extreme precipitation have yielded ambiguous results (Mote et al. 2014). Model discrepancies are similar with most models showing increases and others showing decreases. Table 5.8-14 summarizes these historical and projected changes in precipitation.

Table 5.8-14. Historical and Projected Changes in Precipitation in the Lower Columbia River Basin

Historical Climate and Observed Changes (1950–2005)	Near-Term Projected Changes (2025–2049 Compared to 1950–2005)	Midterm Projected Changes (2050–2075 Compared to 1950–2005)	Level of Certainty in Projections
Average annual precipitation was 0.24 inch/day.	Wetter winter, spring, and fall seasons; possible drier summers.	Wetter winter, spring, and fall seasons; possible drier summers.	Some models show increases in precipitation while others show decreases.

Historical Climate and Observed Changes (1950–2005)	Near-Term Projected Changes (2025–2049 Compared to 1950–2005)	Midterm Projected Changes (2050–2075 Compared to 1950–2005)	Level of Certainty in Projections
			Incidence of extreme precipitation is more likely to increase.
The highest (90th percentile) monthly average precipitation was 0.43 inch/day.	Change in average precipitation by season under moderate and high emission scenarios. Winter: +2 to 5% Spring: 0 to +1% Summer: -10 to -12% Fall: +4 to +2%	Change in average precipitation by under moderate and high emission scenarios Winter: +5 to +7% Spring: +0 to +2% Summer: -10 to -16% Fall: +4 to +2%	A majority of models (18 to 26 of 30, depending on the scenario and timeframe) project that precipitation will decrease in the summer.
The lowest (10th percentile) monthly average precipitation was 0.06 inch/day.	Intensity of extreme precipitation could increase. 90th percentile precipitation is projected to increase by 5 to 6% under moderate and high emissions scenarios	Intensity of extreme precipitation could increase. 90th percentile precipitation is projected to increase by 6 to 8% under moderate and high emissions scenarios	Most models (20 of 30) project an increase in extreme precipitation.

Historical and Projected Changes in Snowfall

Snowfall in the Canadian Rockies and the Cascade Mountains provides much of the water flowing in the Columbia River. In contrast to the variable projections in overall precipitation, the anticipated changes in snowfall are large and model agreement is very high. Significant projected declines in snowpack could greatly reduce stream flow in some areas.

Historical Snowfall

Average annual snowfall was 5.6 inches per month from 1950 to 2005. Average winter and spring snowfall, when virtually all snowfall occurs, was about 29.7 and 33.3 inches, respectively. However, since 1950, snowpack in the Pacific Northwest has declined by about 20%.

Projected Snowfall—Near-Term Future

Annual snowfall is expected to decline by 39 to 45% in the near-term future for the moderate and high greenhouse gas emissions scenarios. This substantial decrease is projected to occur within relatively narrow bands (winter: 33 to 40%; spring: 41 to 47%). All models indicate decreases in annual, winter, and spring snowfall (U.S. Geological Survey 2014a).

Projected Snowfall—Midterm Future

In the midterm future, declining snowfall is expected to intensify. Winter snowfall could decline by as much as 62% (ranging from 49 to 62% under the moderate and high emissions scenarios); spring snowfall could decrease by as much as 75% under the moderate emissions scenario and 68% under the high emissions scenario. All models agree that snowfall will decline over time. Table 5.8-15 summarizes these historical and projected changes in snowfall.

Table 5.8-15. Historical and Projected Changes in Snow in the Lower Columbia River Basin

Historical Climate and Observed Changes (1950–2005)	Near-Term Projected Changes (2025–2049 Compared to 1950–2005)	Midterm Projected Changes (2050–2075 Compared to 1950–2005)	Level of Certainty in Projections
Heaviest snowfall occurs in the winter and spring leading to high average annual snowfall totals	Average annual, winter, and spring snowfall will likely decline under the moderate and high emission scenarios in the near term	Average annual, winter and spring snowfall will likely decline under the moderate and high emission scenarios in the mid-term	All models agree on the direction of change
Average annual snowfall was 5.6 inches/month	Change in average monthly snowfall could decline by 39 to 45%	Change in average monthly snowfall could decline by 54 to 66%	All models agree on the direction of the change
Average winter and spring snowfall was 29.7 and 33.3 inches, respectively	Change in average winter and spring snowfall under moderate and high emission scenarios • Winter: -33 to -40% • Spring: -41 to -47%	Change in average winter and spring snowfall under moderate and high emission scenarios • Winter: -49 to -62% • Spring: -75 to -68%	All models agree that snowfall will decline in the winter and spring in near– and midterms

Sea-Level Rise

Sea levels are rising. However, some areas of the Pacific Northwest are experiencing uplift; by contrast, areas around Puget Sound are subsiding and experiencing larger-than-average impacts from rising sea levels. Sea-level rise in the Pacific Northwest is expected to be as little as 5 inches or less to more than 4 feet by the end of the century. The impacts of the El Niño Southern Oscillation phenomenon on climate variability can be significant. During El Niño years, regional sea levels can increase by 4 to 12 inches and last for many months.

5.8.2.5 Impacts

This section describes the potential impacts related to climate change that could affect construction and operation of the Proposed Action or No-Action Alternative in the study area.

Proposed Action

This section describes the potential impacts of climate change on the construction and operation of the Proposed Action that could occur within the study area.

Cause Possible Service Disruptions from Low Water Levels

Changes to precipitation could have far-reaching effects for the Pacific Northwest. Reduced summer rainfall and reductions in snowmelt will probably result in reduced stream flow. This trend could cause tradeoffs among the many water uses, including transport, agriculture, recreation, and others, and a possible reduction in hydropower. Decreased snowfall in the

Lower Columbia River Basin, especially in the winter and spring, coupled with potential declines in rainfall in the summer could lead to abnormally low levels of water in the Columbia River. Low water levels could impede the passage of large ships to and from the docks at the project area and could increase for electricity or otherwise force difficult choices on competing water usage.

Proposed Action-related Panamax ships would berth at two docks (Docks 2 and 3) to receive coal shipments. Panamax ships are midsized cargo ships, the largest that could fit through the Panama Canal prior to expansion. They have a capacity of 60,000- to 100,000-deadweight tonnage and require a draft of 42 to 49 feet. The depth of the Columbia River at the project area varies by season. If precipitation from snow and rain cause Columbia River water levels to decline, shipping could be restricted or more dredging could be required more frequently.

At the project area, the Columbia River experiences tidal fluctuation, although less than at the mouth of the river. Tidal forces could replace some or all of the water needed for ship passage in the event of low runoff from reduced snowmelt and rainfall. The potential for low water disruptions could also be reduced by future sea-level rise. Sea levels are expected to increase by as much as 4 feet in the Pacific Northwest, but this could be significantly less if the project area is—as much of the Pacific Northwest is—subject to uplift. The Columbia River is also highly managed to provide water for multiple competing uses. For example, low water levels upstream of the project area have constrained recreational boating at times.

Washington State is heavily dependent on hydropower for electricity. Approximately 75% of its electricity comes from hydropower generated by its systems of rivers and dams. The rivers also supply water for irrigation, municipalities, and industry. Drought-induced loss of hydropower could raise costs. As the supply of locally generated hydropower is reduced, utilities must seek additional sources of electricity, which could drive up electricity prices for construction and operation of the Proposed Action (Washington State Emergency Management Division 2012a).

Although the project area is located within the Columbia River estuary, is protected by levies, and therefore, the main impact of sea-level rise at the project area is expected to be minimal, but could reduce the potential for service disruptions from low water.

Cause Possible Damage and Service Disruptions from Flooding

Potential precipitation increases and intense downpours could cause flooding in basins that derive their water from both rainfall and snowfall, such as the Cowlitz River or Columbia River. Rising sea levels could also lead to flooding of public and private property, roads, and railways.

Water levels in the Columbia River vary by season and year, depending on the snow mass in the upper watershed. Historic crests on the Columbia River range from 13 to 24 feet with flood stage at 13.5 feet. Historic crests on the Cowlitz River range from 21 to 29.5 feet and have been recorded well above flood stage (21 feet). Above 28.5 feet, major flooding is expected. This flood stage could overtop the levee and increase erosion (ICF International 2016b). The project area is on the Columbia River, about 5 miles from the confluence of the Columbia and Cowlitz Rivers (ICF International 2016b). The study area is protected from flooding by a levee maintained by the Consolidated Diking Improvement District (CDID) #1, which is 34 feet above the Columbia River Datum. It is also protected by a system of sloughs, ditches, and drains. The Federal Emergency Management Agency classifies the project area as Zone B in its Flood Insurance Rate Map, meaning the area is expected to flood every 100 to 500 years.

Under current conditions, flooding is expected to be minimal at the project area (ICF International 2016b). In the future, flooding could be of concern, particularly from the Cowlitz River. In August 2014, the U.S. Army Corps of Engineers found that sediment buildup on the Cowlitz River was increasing the potential for flooding. Without further action, the flood risk level on the river (0.6%) would be exceeded by 2018 (U.S. Army Corps of Engineers 2014). While future precipitation is somewhat uncertain, the mean model indicates increases in fall and winter precipitation for both the near and midterm futures, which could increase flood risk. Because the project area is approximately 50 miles inland from the Columbia River estuary, the main impact of sea-level rise at the project area is expected to be minimal, but sea-level rise could exacerbate the potential for flooding at discrete locations.

The BNSF Spur and Reynolds Lead that would carry Proposed Action-related trains to the project area could be subjected to flooding. The rail line crosses the Cowlitz River near the confluence with the Columbia River and runs near the rivers for the 5 miles to the project area. Because historical and recent crests have been reported on the Cowlitz River, flood risk from sedimentation is increasing, and future precipitation could increase, flooding of the Reynolds Lead is possible. Cowlitz River flooding at this location would likely disrupt rail and terminal operations, and ballast supporting the rail line could be dislodged. Therefore, Proposed Action-related trains could be affected by a Cowlitz River flood.

Cause Possible Service Disruptions from Wildfires

Wildfire is a threat in Washington State. Cowlitz County is considered a high-risk area (Washington State Emergency Planning Division 2012c). A wildfire could affect the project area from the undeveloped areas adjacent to the project area or a Proposed Action-related train in the study area. Wildfires in Cowlitz County numbered more than 350 from 2004 to 2013, burning more than 561 acres. In late summer and early fall, dry easterly winds can produce extreme fire conditions. This threat has increased over time because of four climate-related factors: earlier snowmelt, higher summer temperatures, longer fire season, and an expanded vulnerable area of high-elevation forests (Washington State Emergency Planning Division 2012c). Increasing temperatures, extreme heat events, and drought could have an effect on fire regimes in Washington State by influencing the length of the fire season and contributing to drier conditions and the availability of readily combustible fuel for fires (Mote et al. 2014). By the 2080s, the median area burned annually in the Pacific Northwest could quadruple compared to the 1916 to 2007 period (Mote et al. 2014).

Maximum temperatures are predicted to increase while summer precipitation is predicted to decrease in the study area, although there is some disagreement among the models, and some indicate that summers could become slightly wetter. Hotter and drier summers would increase the likelihood of wildfires.

No-Action Alternative

Under the No Action Alternative, the Applicant would not construct the coal export terminal and potential climate change impacts related to construction and operation of the Proposed Action would not occur. The Applicant would continue with current and future increased operations in the project area. The project area could be developed for other industrial uses, including an expanded bulk product terminal or other industrial uses. The Applicant has indicated that, over the long term, it would expand the existing bulk product terminal and develop new facilities to handle more products such as calcine petroleum coke, coal tar pitch, and cement.

Ongoing and expanded operations in the project area would be affected by climate change as described for the Proposed Action. These impacts could include possible service disruptions from low water levels, flooding, and wildfires.

5.8.2.6 Required Permits

No permits related to climate change would be required for the Proposed Action.

5.8.2.7 Potential Mitigation Measures

Potential climate change impacts on the Proposed Action in the project area are not considered significant and would not necessitate mitigation.

5.8.2.8 Unavoidable and Significant Adverse Environmental Impacts

There would be no unavoidable and significant adverse environmental impacts.