Review and Comments on
Washington Department of Ecology's
Draft Regional Haze Plan for the Second Implementation Period:
Long Term Strategy and Four-Factor Analysis of Controls

By Victoria Stamper

November 19, 2021

Prepared for
National Parks Conservation Association

Table of Contents

The Clean Air Act's regional haze provisions require states to adopt periodic, comprehensive revisions to their implementation plans for regional haze on 10-year increments to achieve reasonable progress towards the national visibility goal. The plan revision for the second implementation period was due to be submitted to EPA by July 31, 2021.[1] As part of the comprehensive revisions to their regional haze plan, states must submit a long-term strategy that includes enforceable emission limits and other measures as may be necessary to make reasonable progress towards the national visibility goal.[2]

To that end, in October of 2021, the Washington Department of Ecology (Ecology or WDOE) made available its plan for addressing reasonable progress toward the national visibility goal for Class I areas.[3] Ecology has proposed to include requirements for five facilities in its regional haze plan: the TransAlta Centralia Plant, the Ash Grove Cement Plant, the Cardinal FG Winlock Glass Plan, the Intalco Aluminum Plant, and the Alcoa Wenatchee Plant. However, the Agreed Orders, Consent Decree, and Permits that it has included in its proposed Long Term Strategy primarily rely on control requirements the owners already planned to meet under other Clean Air Act requirements (including under the first round regional haze plan) or reflect a commitment to conduct a four factor analysis of controls if/when a currently shutdown plant begins operations. In other words, Ecology's draft regional haze plan for the second implementation period does not include any additional regional haze control requirements for industrial sources of regional haze pollution beyond what was already required and on the books.

There are several other facilities that met Ecology's criteria for selecting sources to evaluate for controls in its regional haze plan for the second implementation period for which Ecology is not currently proposing to adopt any new controls as part of its second round regional haze plan. Yet, there are pollution controls (primarily for nitrogen oxides (NOx)) that Ecology found could be cost effectively installed at these sources to significantly reduce emissions of the visibility-impairing pollutants. Ecology has indicated that it will address these sources in a subsequent revision to its regional haze plan. In other words, Ecology's regional haze plan for the second implementation period is not complete.

The four factors that must be considered in determining appropriate emissions controls for the second implementation period are as follows: (1) the costs of compliance, (2) the time necessary for compliance, (3) the energy and non-air quality environmental impacts of compliance, and (4) the remaining useful life of any source being evaluated for controls.[4] EPA states that it anticipates the cost of controls being the predominant factor in the evaluation of reasonable

[1] 40 C.F.R. §51.308(f).
[2] 40 C.F.R. §51.308(f)(2)(i); 42 U.S.C. § 7491(b)(2). Under the Clean Air Act, state implementation plans must include "include enforceable emission limitations and other control measures, means, or techniques . . . , as well as schedules and timetables for compliance, as may be necessary or appropriate to meet the applicable requirements of this chapter." 42 U.S.C. § 7491(a)(2)(A). An emission limitation is a "requirement" that "limits the quantity, rate, or concentration of emissions of air pollutants on a continuous basis, including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction." *Id*. § 7602(k).
[3] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021.
[4] 40 C.F.R. §51.308(f)(2)(i).

progress controls and that the other factors will either be considered in the cost analysis or not be a major consideration.[5] Such is the case with the add-on controls evaluated in this report. Specifically, the remaining useful life of a source is taken into account in assessing the length of time the pollution control will be in service to determine the annualized costs of controls. If there are no enforceable limitations on the remaining useful life of a source, the expected life of the pollution controls is generally considered the remaining life of the source.[6] In addition, costs of energy for selective noncatalytic reduction (SNCR), selective catalytic reduction (SCR), and other controls at a particular source are considered in determining the annual costs of these controls, which means that the bulk of the non-air quality and energy impacts are generally taken into account in the cost effectiveness analyses as is the remaining useful life of a unit. With respect to the length of time to install controls, that is not generally an issue for SCR or SNCR which can and have been installed within three to five years of promulgation of a requirement to install such controls.[7] In any event, EPA's August 20, 2019 regional haze guidance states that, with respect to controls needed to make reasonable progress, the "time necessary for compliance" factor does not limit the ability of EPA or the states to impose controls that might not be able to be fully implemented within the planning period; more specifically, when considering the time necessary for compliance, a state may not reject a control measure because it cannot be installed and become operational until after the end of the implementation period."[8]

This report comments on the proposed Long Term Strategy and on Ecology's review of the four-factor analyses of pollution controls that were submitted for facilities in Washington.

I. Background.

Ecology used 2014 emissions data and Q/d (i.e., the ratio of a source's visibility-impairing emissions in tons per year (Q) divided by the source's distance from the nearest Class I area (d)) to identify sources to prioritize for evaluation of regional haze controls for its plan for the second implementation period. Ecology based on their review only on major sources. Ecology did not explain whether it focused on major sources based on the actual emissions of each source or based on the potential emissions of each source, and that should be clarified. Ecology used a

---

[5] *See* U.S. EPA, August 20, 2019 Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 37.

[6] *Id.* at 33. While we are aware that some EGUs evaluated in this report have planned decommission dates, we are not aware that any of those dates are enforceable. Thus, for all of the EGUs evaluated for add-on NOx controls in this report, we assumed that the expected useful life of the pollution control being evaluated was the remaining useful life of the source, as directed to by EPA in its August 2019 guidance.

[7] For example, in Colorado, SCR was operational at Hayden Unit 1 in August of 2015 and at Hayden Unit 2 in June of 2016, according to data in EPA's Air Markets Program Database, within 3.5 years of EPA's December 31, 2012 approval of Colorado's regional haze plan. In Wyoming, SCR was operational at Jim Bridger Units 3 and 4 in 2015 and 2016, less than three years from EPA's January 30, 2014 final approval of Wyoming's regional haze plan.

[8] *See* U.S. EPA, August 20, 2019 Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 41 (it would be inconsistent with the regional haze regulations to discount an otherwise reasonable control "simply because the time frame for implementing it falls outside the regulatory established implementation period.").

Q/d value of 10 or higher as a cutoff for selecting major sources and included two other facilities with a lower than 10 Q/d value because they were in a selected source category. Based on this analysis, Ecology came up with the following list of sources to evaluate for controls.

Table 1. WDOE's List of Sources to Conduct a Four-Factor Analysis of Controls[9]

Facility Site Name	Q (tons of NOx, PM10, SO2, and NH3)	D (km) to nearest Class I area	Q/d	Nearest Class I Area	Number of Class I Areas Impacted (NPCA Analysis)[10]	Source Category
TransAlta Centralia Generation LLC	10,749.4	71.8	149.8	Mount Rainier NP		Coal-powered electric
McKinley Paper Company	367.2	4.4	83.1	Olympic NP	1	Pulp and Paper Plant
Alcoa Primary Metals Wenatchee Works	3,461.7	42.8	80.9	Alpine Lakes WA		Alumina Refining and Aluminum Production
Alcoa Primary Metals Intalco Works	5,658.5	78.9	71.7	North Cascades NP	38	Alumina Refining and Aluminum Production
BP Cherry Point Refinery	2,945.1	80.8	36.4	North Cascades NP	14	Petroleum refineries
Tesoro Northwest Company	2,312.3	75.4	30.7	Olympic NP	10	Petroleum refineries
WestRock Tacoma	1,353.7	48.4	27.9	Mount Rainier NP	10	Pulp, Paper, and Paperboard Mills

[9] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 161-162.
[10] Based on NPCA's Regional Haze Fact Sheet for Washington, Sources of Visibility Impairing Pollution in Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view. Note that neither the TransAlta Centralia power plant nor the Alcoa Wenatchee plant were included in NPCA's evaluation, presumably because of TransAlta's prior requirement to decommission the Centralia coal-fired power plant by 2025 and because the Alcoa Wenatchee plant has been shut down since 2015. Note that in the NPCA fact sheet, the Weyerhauser NR Company plant is now the Nippon Dynawave plant, and the Boise Paper facility is now the Packaging Corp. of America plant. Note that the U.S. Oil refinery in Tacoma is not in NPCA's Fact Sheet.

Facility Site Name	Q (tons of NOx, PM10, SO2, and NH3)	D (km) to nearest Class I area	Q/d	Nearest Class I Area	Number of Class I Areas Impacted (NPCA Analysis)[10]	Source Category
Nippon Dynawave Packaging Company	2,656.0	104.8	25.3	Mount Adams WA	21	Paperboard Mills
Puget Sound Refining Co. (Shell)	1,793.1	73.0	24.5	Olympic NP	8	Petroleum Refineries
Pt Townsend Paper Corp.	848.0	35.0	24.2	Olympic NP	5	Paper (not Newsprint) Mills
Ash Grove Cement Co., E Marginal	1,243.6	53.8	23.1	Alpine Lakes WA	9	Cement Manufacturing
Cosmo Specialty Fibers, Inc.	973.8	58.2	16.7	Olympic NP	5	Paperboard Mills
WestRock Longview, LLC	1,574.2	100.7	15.6	Mount Adams WA	10	Paperboard Mills
Georgia-Pacific Consumer Operations LLC	653.0	45.4	14.4	Mount Hood WA	5	Paper (except Newsprint) Mills
Phillips 66	840.6	77.2	10.9	North Cascades NP	5	Petroleum Refineries
Cardinal FG Winlock	859.8	80.1	10.7	Mount Rainier NP	6	Flat Glass Manufacture
Packaging Corp. of America (PCA), Wallowa	1,048.3	111.5	9.4	Eagle Cap WA	16	Paperboard Mills
U.S. Oil & Refining Co.	149.2	46.4	3.2	Mount Rainier NP		Oil Refinery

Of the above list, there were a few sources for which Ecology did not request a four-factor analysis of controls for, because "[s]ome of these facilities had existing legal requirements or pending permit actions to reduce emissions."[11] Those facilities were the TransAlta Centralia power plant, the Cardinal FG Winlock glass plant, and the Ash Grove Cement Plant.[12] Ecology also will only request a four-factor analysis of controls for the Intalco Aluminum Plant and the Alcoa Wenatchee Aluminum Plant if the plants restart operations.[13] In addition, it appears that Ecology did not request a four-factor analysis of controls for the McKinley Paper Company located near Port Angeles, and Ecology's draft regional haze plan does not mention this facility other than to show its Q/d value of 83.1 (making it the facility with the second highest Q/d value).[14]

Its Long Term Strategy addresses the Centralia Power Plant, Intalco and Alcoa Wenatchee Aluminum plants, the Ash Grove Cement Plant, and the Cardinal FG Winlock Glass Plant, although it does not require additional pollution control measures other than what was already required for these facilities. This is discussed in Section II below.

For the remaining facilities for which Ecology requested four-factor analyses of controls, Ecology selected the refineries as the first priority of sources to focus on for regional haze controls. Ecology's reasons for prioritizing the refineries included the following:

- Four of the five refinery facilities are located in the Puget trough, west of several Class 1 Areas. Their cumulative regional haze causing emissions influence the same Class 1 Areas.

- Predominant winds direct the emissions from the refineries toward several Class 1 Areas.

- The refineries' potential emission reductions of 4,200 tons per year account for the vast amount of potential emission reductions.

WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 166.

Ecology prioritized pulp and paper mills lower than refineries because they "are not located as close to each other as the refineries so they do not have as great of a cumulative effect."[15] Ecology also states that the potential reduction in regional haze emissions from pulp and paper mills is "vastly less than the potential refinery emission reductions."[16]

---

[11] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 163.
[12] *Id.* at 212.
[13] *Id.* at 178, 180-181.
[14] Note that the Technical Support Document for the current operating permit for the McKinley Plant states that the McKinley facility was purchased from Nippon Paper Industries USA Co. in 2017. *See* https://www.orcaa.org/wp-content/uploads/TSD_McKinley_Final_17August2021.pdf. This is a different facility than the Nippon Dynawave facility that is located in Longview, Washington.
[15] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 166.
[16] *Id.* at 167.

The regional haze plan regulations require states to include a description of the criteria that it used to determine the sources or groups of sources that it evaluated for controls,[17] which Ecology has done in its draft regional haze plan. As stated above, it selected sources with a Q/d value equal to or greater than 10. EPA's July 8, 2021 guidance memo states that "[u]nder the [regional haze rule], each state has an obligation to submit a long-term strategy that addresses the regional haze visibility impairment resulting from emissions from within that state."[18] While states have the discretion to select any reasonable source selection methodology, the source selection methodology must "produce a reasonable outcome."[19] In the case of Ecology's source selection process and four factor analyses, the outcome of its approach as proposed in the draft regional haze plan is a long term strategy that does not include any control measures other than those control measures that were either previously imposed to meet best available retrofit technology (BART), i.e., at the TransAlta Centralia Plant, that were already required under other requirements, i.e., Ash Grove Cement Plant, that were voluntarily proposed by the source due to an increase in capacity (i.e., Cardinal FG Winlock Glass Plant), or that simply require the submittal of a four-factor analysis of controls if the currently "curtailed" plants start operating again (Intalco Aluminum and Alcoa Wenatchee). Ecology's selection of sources to include in its long term strategy ignored the fact that Ecology has found cost effective control options for several sources identified in Table 1 above. Ecology states that it must follow its reasonably available control technology (RACT) rule requirements before it can establish legally establish control requirements.[20] Given that the regional haze pollution controls are required to be part of the regional haze plan pursuant to 40 C.F.R. 51.308(f)(2)(i), Ecology's regional haze plan for the second implementation period is not yet complete or it otherwise fails to meet the requirements for regional haze plans. Given that Ecology's Public Review Draft is stated to be its State Implementation Plan (SIP) revision for the second regional haze plan implementation period of 2018 to 2028, it will be assumed for the purpose of these comments that the Public Review Draft is the complete plan to be submitted to EPA for approval. This report provides comments and analyses on the source-specific requirements of Ecology's proposed Long Term Strategy of the Public Review Draft and also on the other sources evaluated for control by Ecology in the context of its regional haze plan for the second implementation period.

[17] 40 C.F.R. 51.308(f)(2)(i).
[18] July 8, 2021 EPA RHR Clarifications Memo at 3. See also 40 C.F.R. 51.308(f)(2).
[19] *Id.*
[20] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 163.

II. Review and Comments on Ecology's Proposed Long Term Strategy Source-Specific Control Measures

Ecology lists the following source-specific emission limits and shutdowns of its long term strategy:

- TransAlta Centralia Generation BART order revision, which ceased coal-fired operation of one boiler in December 2020 and will cease coal-fired operation of the other boiler by the end of 2025.

- Cardinal FG Winlock Glass Plant, which voluntarily requested a permit to install selective catalytic reduction (SCR) on its glass furnace in conjunction with an increase in glass production capacity. A permit was issued authorizing these actions on February 11, 2001, and Ecology states that the SCR should be installed and operating by 2022.

- Ash Grove Cement Company, which entered into a Consent Decree in 2013 with EPA, Ecology, and other state agencies that required optimization of the Seattle Kiln to reduce NOx emissions and is currently subject to a NOx limit of 5.1 pounds per ton ("lb/ton") of clinker.

- Alcoa Wenatchee and Intalco Aluminum, which are both currently in "curtailment due to market conditions," for which ECOLOGY has proposed Agreed Orders to require the plants to conduct and submit a four-factor analysis of controls if they decide to restart operations.[21]

A. TransAlta Centralia Generation

The TransAlta Centralia Generating Station is a coal-fired power plant located near Centralia, Washington. In its 2010 Regional Haze SIP, Ecology indicated that the Centralia plant significantly impacts regional haze in twelve Class I areas in Washington and Oregon.[22] The Centralia power plant was subject to BART in Washington's regional haze plan. In 2003, EPA approved requirements applicable to the Centralia units' SO2 and PM emissions as meeting BART.[23] In 2012, EPA approved a NOx BART determination in First Revised BART Order 6426 for the Centralia power plant, which included the following control requirements: an initial NOx emission limitation of 0.21 lb/MMBtu for each unit based on the installation of SNCR on both coal-fired units plus Flex Fuel followed by an optimization study and lowering of the

---

[21] *Id.* at 212.
[22] WDOE, Regional Haze Plan, December 2010, at 11-13 (Table 11-11), available at https://apps.ecology.wa.gov/publications/documents/1002041.pdf.
[23] *See* 68 Fed. Reg. 34821 (June 11, 2003).

emission limits based on the study results.[24] In addition, the BART order required each of the two Centralia units to cease burning coal and be "decommissioned" by December 31, 2020 for one unit and by December 31, 2025 for the other unit, unless Ecology determined that state or federal law requires selective catalytic reduction (SCR) to be installed on either unit.[25] In 2021, EPA approved a revision to the BART requirements for the Centralia power plant.[26] Specifically, TransAlta had installed a Combustion Optimization System with Neural Network program (Neural Net) to decrease ammonia slip from the SNCR, and such Neural Net controls also help to reduce NOx emissions among other things. Ecology reduced the NOx limit applicable to one unit from to 0.18 lb/MMBtu and changed other requirements pertaining to use and monitoring of ammonia and analyzing coal sulfur and nitrogen content.[27] Ecology also eliminated the requirement in the BART Order 6426 that required that the units be "decommissioned" once they stopped burning coal, based on 2017 changes to a Memorandum of Agreement between TransAlta and the state of Washington.[28] As EPA states "[t]he 2017 MOA makes clear that TransAlta is not precluded from the possibility of retrofitting the facility to natural gas, or other non-coal energy source, as long as it meets the statutory requirements of Chapter 80.80 RCW."[29] This state statute addresses greenhouse gas emissions from baseload electric generating plants.[30]

Ecology's Technical Support Document for its 2020 BART SIP revision states that "Ecology is aware that if TransAlta repowers the units on natural gas the visibility improvements anticipated by the current BART order and state implementation plan limits would not be met. Repowering would change the emission reduction used in determining the 2028 further progress goals for the nearby Class I Areas (Mt. Rainier and Olympic National Parks, and the Goat Rocks and Alpine Lakes Wilderness Areas) under the 2021 Regional Haze State Implementation Plan." It would also change the emission reductions used in determining the 2028 reasonable progress goals for several Oregon Class I areas. In its 2010 Regional Haze SIP, Washington identified twelve Class I areas where the Centralia Power Plant had an impact greater than or equal to 0.5 deciviews (dvs). Thus, if the Centralia units repowered to natural gas, it could significantly affect the reasonable progress goals for all of those Class I areas, which are listed in Table 2.

[24] *See* 77 Fed. Reg. 72742(12/6/2012). *See also* First Revised BART Order 6426, attached as Ex. 1.
[25] *See* 77 Fed. Reg. 72742(12/6/2012). *See also* First Revised BART Order 6426, available at Ex. 1.
[26] 86 Fed. Reg. 24502 (May 7, 2021).
[27] Ecology, Technical Support Document for Second BART (Best Available Retrofit Technology) Order Revision, July 2020, at i (attached as Ex. 2).
[28] As discussed in 86 Fed. Reg. 13256 at 13258 (Mar. 8, 2021)
[29] 86 Fed. Reg. 13258 (Mar. 8, 2021).
[30] See Chapter 80.80 RCW, available at https://app.leg.wa.gov/rcw/default.aspx?cite=80.80.

Table 2. Washington and Oregon Class I Areas Where Ecology Modeled Significant Visibility Impacts from the Centralia Power Plant in its 2010 Regional Haze SIP.[31]

Alpine Lakes Wilderness (WA)
Glacier Peak Wilderness (WA)
Goat Rocks Wilderness (WA)
Mt. Adams Wilderness (WA)
Mt. Hood Wilderness (OR)
Mt. Jefferson Wilderness (OR)
Mt. Rainier National Park (WA)
Mt. Washington Wilderness (OR)
North Cascades National Park (WA)
Olympic National Park (WA)
Pasayten Wilderness (WA)
Three Sisters Wilderness (OR)

In its Technical Support Document for its 2020 BART SIP revision, Ecology states "[i]f TransAlta decides to switch to non-coal power generation, a Notice of Construction application would need to be submitted to Southwest Clean Air Agency by the company. Ecology would require the company to do, at a minimum, emissions modeling that would be required under the BART process to quantify the visibility impacts resulting from the operation as a natural gas boiler plant (EGU)."[32] It appears that Ecology may have been stating that it would evaluate whether the Centralia plant, powered with a fuel other than coal, would be subject to BART or subject to additional control requirements, by evaluating what the impacts of the plant would be on visibility in Class I areas. But the Centralia plant was already determined to be subject to BART.[33] Applicability to BART would not change if either or both units were repowered to natural gas or some other fuel.[34]

Ecology's draft regional haze plan for the second implementation period does not address the possibility that one or both the Centralia units could be allowed to repower with a fuel other than coal under the revised 2020 BART Order. In fact, Ecology states that the 2028 "on the books" emissions of SO2 and NOx will decrease significantly when coal-fired power production ceases at TransAlta.[35] Ecology also makes clear in its draft regional haze plan that it set Centralia's 2028 emissions to zero based on the facility ceasing coal-fired energy production by 2020 for one unit and by 2025 for the other unit.[36] Ecology identifies the cessation of coal-firing at the

---

[31] 2010 Washington Regional Haze State Implementation Plan at 11-13 (Table 11-11), available at https://apps.ecology.wa.gov/publications/documents/1002041.pdf.
[32] Ecology, Technical Support Document for Second BART (Best Available Retrofit Technology) Order Revision, July 2020, at 3 (Ex. 2).
[33] 2010 Washington Regional Haze State Implementation Plan at 11-13 (Table 11-9), available at https://apps.ecology.wa.gov/publications/documents/1002041.pdf.
[34] *See*, e.g., 77 Fed. Reg. 39425 at 39429 (July 3, 2012).
[35] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 77-78.
[36] *Id.* at 82 and at 176.

Centralia units as a "shutdown schedule" control and as part of its Long Term Strategy.[37] Yet, if the Centralia units could lawfully be repowered with natural gas or another fuel, which Ecology has made clear in its 2020 Technical Support Document for its BART order revision could occur, then its assumption of zero emissions in 2028 from the Centralia Power Plant is significantly flawed. EPA has said if a state is going to rely on a source shutdown in its regional haze plan, the shutdown needs to be federally enforceable.[38] Thus, Ecology needs to make federally enforceable the decommissioning of the Centralia Generating Station's coal-fired units in its SIP and issue a revised Order, as was required in the Order prior to the 2020 revisions.

In its 2020 Technical Support Document for the 2020 BART Revision, Ecology explains some of the requirements that would apply if the Centralia units repowered to natural gas or another fuel. For example, Ecology states that under Chapter 80.80 RCW that sets greenhouse gas emission limits reflective of combined cycle combustion turbines, TransAlta would need to take an enforceable limit to keep operations annually below a 60% capacity factor to avoid being classified as a baseload power plant under Chapter 80.80 RCW which would require that the facility meet GHG emission limits.[39] Ecology ignores the possibility that the units could be repowered to a natural gas-fired combined cycle power plant by retaining the steam turbine but replacing the coal boiler with a gas-fired combustion turbine and a heat recovery steam generator, in which case it could likely meet the GHG emission limit of Chapter 80.80 RCW and thus be allowed to operate at higher capacity factors.

Ecology also states that if TransAlta decided to switch to non-coal fired power generation, they would have to submit a Notice of Construction application to the Southwest Clean Air Agency and that Ecology would "require the company to do, at a minimum, emissions modeling that would be required under the BART process to quantify the visibility impacts resulting from the operation as a natural gas boiler plant (EGU)."[40] Neither the modeling nor the requirement to obtain a construction permit would guarantee that any specified level of emissions reduction would be required if the units were repowered with another fuel such as natural gas because it depends on how applicability to emissions control requirements such as best available control technology (BACT) would be determined.

---

[37] *Id.* at 212.

[38] *See* U.S. EPA, Clarifications Regarding Regional Haze State Implementation Plans for the Second Implementation Period, July 8, 2021, at 10 ("[O]n the way measures, including anticipated shutdowns that are relied on to forgo a four-factor analysis or shorten the remaining useful life of a source, are necessary to make reasonable progress and must be included in a SIP."). *See also*, e.g., 11/1/2021 EPA letter to Wyoming Department of Environmental Quality, Comments on Draft Wyoming State Implementation Plan Regional Haze Round Two, at 5 ("If the State is relying on the source shutdowns as part of its long-term strategy for making reasonable progress, Wyoming must make these planned retirements enforceable in the SIP. Similarly, if the State is relying on the source shutdowns to forgo conducting a four-factor analysis because a shutdown is effectively the most stringent control available, the shutdown must be in the SIP.)

[39] Ecology, Technical Support Document for Second BART (Best Available Retrofit Technology) Order Revision, July 2020, at 6-7 (Ex. 2).

[40] *Id.* at 3.

An estimate of what the NOx emissions could be assuming a conversion of the existing boilers from coal to natural gas can be made based on the following assumptions:

- Assume same generating capacity with gas of 670 MW
- Assume slightly higher hourly heat input with natural gas, based on Energy Information Administration data that shows the average heat rate of a natural gas-fired steam generation is 10,416 Btu/kW-hr as compared to the average heat rate of a coal-fired steam generator of 10,142 Btu/kW-hr[41] (meaning the heat input per hour would be 2.7% higher for natural gas firing, assuming the same generating capacity could be achieved with natural gas). Thus, assuming a coal-fired heat rate of 10,142 Btu/kW-hr, the hourly heat input to each boiler with coal would be approximately 6,795 MMBtu/hour, and the maximum hourly heat input to each boiler with natural gas would be 2.7% higher or 6,979 MMBtu/hour.

Using AP-42 emission factors and assuming that the burners would continue to be low NOx burners, the NOx emission factor for the boilers would be 140 lb per MMscf, which equates to approximately 0.14 lb/MMBtu.[42] If the units had to be limited to 60% capacity factor to avoid the GHG emission limits of Chapter 80.80 RCW, the potential NOx emissions of each Centralia unit repowered to natural gas would be 2,568 tons per year per unit or 5,135 tons per year total. In comparison, the NOx emissions from the two Centralia units per 2018-2020 averaged about 3,300 tons per year per unit or 6,600 tons per year when both units were operating. Thus, while repowering the Centralia units from coal to gas would reduce emissions from the units, it would not by any means eliminate the regional haze pollutants from the units as was required in the first planning period SIP and was assumed for the plant in the reasonable progress goals determination and in the modeling of the Long Term Strategy for this second planning period SIP.

It appears that TransAlta has been pursuing a coal-to-gas conversion program at some of its other units in Canada.[43] Thus, Ecology cannot just dismiss the possibility of repowering the Centralia units as unlikely. For these reasons, Ecology needs to specifically require the decommissioning of the Centralia Generating Station's coal-fired units to be consistent with its proposed Long Term Strategy and its determination of reasonable progress goals. Failing that, Ecology must include the expected emissions from a re-powered Centralia Power Plant in its 2028 modeling and determination of reasonable progress goals and advise nearby states of the changes in 2028 emissions from the facility so that they also revise their Class I area reasonable progress goals.

B. Alcoa Primary Metals Intalco Works and Alcoa Wenatchee

The Alcoa Primary Metals Intalco Works Plant (Intalco Plant) is an aluminum smelter located in Ferndale, Washington. In its 2010 Regional Haze SIP, Ecology indicated that the Intalco plant

---

[41] *See* https://www.eia.gov/electricity/annual/html/epa_08_02.html.
[42] EPA, AP-42, table 1.4-1.
[43] https://www.nsenergybusiness.com/features/coal-gas-conversion-us-canada/.

significantly impacted regional haze in seven Class I areas in Washington.[44] NPCA has found that the Alcoa Intalco plant potentially impacts up to 42 Class I areas and that it is the most significant industrial contributor to regional haze at North Cascades National Park.[45] Ecology states that the Intalco Plant has been under curtailment since 2020.[46]

The Alcoa Wenatchee Plant is an aluminum smelter located in Wenatchee, Washington. As shown in Table 1 above, the Wenatchee plant has a Q/d value of 80.9 based on 2014 emissions. According to NPCA's analysis, emissions from the Wenatchee plant potentially impact 34 Class I areas, including the Alpine Lakes Wilderness area,[47] located approximately 28 miles west of the facility, and also North Cascades National Park to the northwest and Mount Rainier National Park to the southwest.[48] Ecology states that the Wenatchee plant has been in curtailment since 2015.[49]

Washington's 5-year regional haze progress report acknowledged that the SO2 emissions from Intalco and, to a lesser extent the Wenatchee facility, create a challenge to additional visibility improvement in North Cascades and Olympic National Park.[50] Thus, Ecology is including the Intalco plant and the Wenatchee plant as part of its Long Term Strategy for the regional haze plan for the second implementation period.[51] These plants have the third and fourth highest Q/d values based on 2014 emissions, and Ecology has acknowledged that the plants would contribute to regional haze if the plants restarted operations.[52] However, Ecology's Long Term Strategy does not specify any controls to be installed at these plants if operations resume.

Ecology has developed Agreed Orders 18100 and 18216 that require these plants to complete a four-factor analysis of controls prior to startup, if either plant decides to restart.[53] The Agreed Orders require that Alcoa submit four-factor analyses at least 180 days before restarting any of the facilities' potlines, and the analyses must be based on permitted emission limits (not the recent past years of zero to very low emissions). Compliance with any controls identified in the four-factor analyses would not be required until three years after Ecology's approval of the four-factor analyses. However, the Agreed Orders do not set any deadline for Ecology to approve the four-factor analyses, nor do they define the process that would be followed for Ecology to grant approval. The Agreed Orders also do not spell out what the public review and input process would be. Moreover, the Agreed Orders allow Alcoa or Ecology "to request a change to the

---

[44] WDOE, Regional Haze Plan, December 2010, at 11-10 (Table 11-6), available at https://apps.ecology.wa.gov/publications/documents/1002041.pdf.
[45] NPCA, Comments on Draft Air Quality Agreed Orders for Alcoa Wenatchee Agreed Order 18100 (Chelan County), Intalco Agreed Order 18216 (Whatcom County), at 3.
[46] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 82.
[47] 78 Fed. Reg. 79344, 79348-79349. (Dec. 30, 2013).
[48] NPCA, Comments on Draft Air Quality Agreed Orders for Alcoa Wenatchee Agreed Order 18100 (Chelan County), Intalco Agreed Order 18216 (Whatcom County), at 3.
[49] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 82.
[50] WDOE, "Washington State Regional Haze 5-Year Progress Report," at 213, (Sept. 2017), https://www.regulations.gov/document?D=EPA-R10-OAR-2018-0001-0004. (Progress Report)
[51] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 212.
[52] *Id.* at 82.
[53] *Id.*

conditions" of each Order by submitting a written request to the other party.[54] Thus, these requirements of the Agreed Orders, which do not in and of themselves require implementation of any control measures, could be modified via a written request by Alcoa. These Agreed Orders cannot be considered to suffice for the four-factor analyses and control measures that Ecology states are needed in the event the plants start up again. Instead, Ecology must conduct four-factor analyses for these plants now based on permitted emission rates, so Alcoa is on notice as to the control requirements it must meet before it decides whether to restart either plant. Alternatively, Ecology should revoke the plants' operating permits and require each plant to go through major source new source review permitting before restarting operations.

Ecology states that if it conducted a four-factor analysis on the Intalco planta and the Wenatchee plant now, controls would not be cost effective because the plants have extremely low emissions due to being "in curtailment."[55] However, Ecology has not revoked either plants' permits, and Ecology states the plants could restart at any time.[56] Further, Ecology has included both plants' emissions in its 2028 emissions inventory, and both plants' emissions are reflected in the reasonable progress goals.[57] Thus, Ecology is without justification to claim that it can delay conducting a four-factor analysis and imposing control requirements because controls based on current emissions would not be cost effective. Just as EPA requires forthcoming source shutdowns to be enforceable in order for a state to take into account a shortened remaining useful life in a four-factor control analysis, states cannot take into account significantly reduced emissions to determine no controls are cost effective without making such assumptions enforceable.[58] This is particularly true for the two aluminum plants, for which Ecology states could restart at any time under their existing permits and for which Ecology claims controls would be needed to address regional haze impacts if these sources restart.

With respect to the Intalco Plant, Alcoa had previously agreed to complete a Notice of Construction application for the installation of a wet scrubber.[59] That wet scrubber was required to address the area's noncompliance with the 1-hour SO2 National Ambient Air Quality Standard (NAAQS). However, according to Ecology, once Alcoa decided to curtail operations of the Intalco plant, the requirement to install a scrubber became null and void.[60]

Since the Intalco plant has curtailed operations and emissions have essentially been close to nil, the 1-hour SO2 ambient air concentrations in the area have decreased considerably. The table below presents the 99th percentile 1-hour average SO2 values from the two ambient air SO2 monitors in Whatcom County: One that is located at the same address as the Intalco Plant (4050 Mountain View Road, Ferndale) and the other that is located 0.5 miles away from the Intalco

---

[54] *See* Section V Agreed Order Nos. 18100 and 18216 in Appendix Q of WDOE Public Review Draft, Second Regional Haze Plan, October 2021.
[55] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 177-180.
[56] *Id.*
[57] *Id.* at 82, 84-86, and 176.
[58] *See* U.S. EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, August 20, 2019, at 17, 20. *See also* U.S. EPA, Clarification Regarding Regional Haze Plans for the Second Implementation Period, July 8, 2021, at 12.
[59] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 179. *See also* Agreed Order 16449.
[60] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 179.

Plant (6036 Kickerville Road, Ferndale). EPA has indicated that both of these monitoring sites were established to characterize air quality around the Intalco plant.[61] For comparison, compliance with the 1-hour SO2 NAAQS of 75 parts per billion (ppb) is based on the three-year average of the 99th percentile of the daily maximum 1-hour average SO2 concentration.[62]

Table 3. 99th Percentile 1-hour SO2 Concentrations in Whatcom County, 2017 to 2021[63]

Year	Monitor Location	99th Percentile 1-hour SO2 Concentration, ppb	Observations, 1-hour
2017	6036 Kickerville Road, Ferndale, WA	70	7884
2018		74	8087
2019		70	7688
2020		59	8133
2021		2	4083
2017	4050 Mountain View Rd, Ferndale, WA	114	8469
2018		101	8542
2019		105	8535
2020		62	8541
2021		3	4239

According to Ecology, the Intalco facility began curtailing production in April 2020. The SO2 monitors around the plant showed a dramatic decrease in hourly SO2 concentrations in 2020 and 2021, compared to the three years prior. EPA designated part of Whatcom County as nonattainment for the 1-hour SO2 NAAQS effective April 3, 2021.[64] Ecology must develop and submit a nonattainment plan to EPA by October 30, 2022, which is less than a year from now.[65] Given that the SO2 emissions from the Intalco plant also are the primary contributor to regional haze, Ecology should coordinate the development of regional haze measures and 1-hour SO2 measures.

The EPA has previously found that the cost effectiveness of a lime spray forced oxidation (LSFO) scrubber at the Intalco plant would cost $3,875/ton to $4,363/ton in a 2012 proposed rulemaking.[66] That would equate to roughly $4,530/ton at most in 2019 dollars.[67] Not only would those SO2 controls be cost effective at the Intalco Plant, but such controls would presumably be required in order for the Intalco Plant to restart since the area must demonstrate attainment with the 1-hour SO2 NAAQS as expeditiously as practicable and no later than April

---

[61] *See*, e.g., 85 Fed. Reg. 45146 at 45150 (Table 6) (July 27, 2020).
[62] 40 C.F.R. 50.17
[63] Data from EPA's Air Data Monitor Values Report for Whatcom County SO2 Monitors available at https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.
[64] 86 Fed. Reg. 16055 at 16073 (Mar. 26, 2021); 40 C.F.R. 81.348.
[65] 86 Fed. Reg. 16055 at 16057, 16059 (Mar. 26, 2021). (Nonattainment plans are due within 18 months of the effective date of the nonattainment designation).
[66] 77 Fed. Reg. 76174 at 76191 (Dec. 26, 2012).
[67] Based on changes in the Chemical Engineering Plant Cost Indices (CEPCI).

2026 (i.e., five years after the effective date of the SO2 nonattainment designation).[68] Ecology states it generally takes two to three years for the design and installation of SO2 controls,[69] and it is commonly assumed that a 180 day shakedown period is needed after installation of a pollution control. Thus, to attain the SO2 NAAQS by April 2026, the permit to install the scrubber should be approved by no later than October 2023, which is less than one year away. Based on that timeframe, Ecology should require the submittal of a construction permit application to install an LSFO scrubber at the Intalco Plant now, so that the permit authorizing such controls can be issued no later than October 2023.

It has recently been reported that negotiations are underway to potentially restart the Intalco aluminum plant (possibly under a different owner) or to build a steel mill on the site.[70] Thus, with the possibility of aluminum plant operations resuming and the fact that an SO2 nonattainment plan is required for the Intalco plant area, Ecology has no reasonable justification to allow Alcoa to wait to submit its regional haze control analysis. If the Intalco plant resumes operation, the level of SO2 control that needs to be met is known and the most effective way to meet that level of control is the installation of an LSFO wet scrubber, based on the analysis EPA previously conducted for the BART evaluation and based on analyses that presumably was done by Alcoa and Ecology in the process of developing Agreed Order 16449.[71] Thus, Ecology should re-impose the requirement in Agreed Order 16449 for Alcoa to apply for a permit to construct a new scrubber at the Intalco Plant, which presumably was necessary for the Intalco plant to comply with the SO2 NAAQS. And Ecology should issue the permit for the new scrubber no later than October 2022.

For the Intalco Wenatchee plant, Ecology should not wait to decide what controls to require to address regional haze until Alcoa decides to restart the plant. Ecology must require the submittal of a four-factor analysis of regional haze controls now and propose appropriate controls as part of its regional haze plan that would apply should the plant restart. Alternatively, Ecology should revoke the permit for the Alcoa Wenatchee plant and require the facility to obtain a new source review permit as a new source if it decides to restart.

If Ecology is going to claim that controls at these two aluminum plants are necessary as part of its Long Term Strategy for the second implementation period, then the state's plan must include the requirements that would be imposed if either of the plants resume operation. Such evaluations of the emission reduction measures necessary to make reasonable progress is required to be included in the long term strategy pursuant to 40 C.F.R. 51.308(f)(2)(i). Further, it would also give Alcoa notice as to the control requirements it must meet before it decides whether to restart either plant which would ensure expeditious limitations emissions should either plant restart.

---

[68] 86 Fed. Reg. 16055 at 16057 (Mar. 26. 2021).

[69] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 170.

[70] *See*, e.g., Gallagher, Dave, Two front-runners in reopening the Intalco facility offer jobs, cleaner operation, Bellingham Herald, October 20, 2021, available at https://www.bellinghamherald.com/news/business/article255135332.html.

[71] 77 Fed. Reg. 76174 at 76191 (Dec. 26, 2012).

C. Ash Grove Cement Plant

The Ash Grove Cement plant is a dry process cement kiln in the Duwamish Industrial area of Seattle. The cement plant has a Q/d value based on 2014 emissions of 23.1. The plant is located only 53.8 kilometers from Alpine Lakes Wilderness Area[72] and, according to NPCA, impacts 9 Class I areas in total.[73] According to Ecology, the primary regional haze pollution from the plant come from the cement kiln and the associated clinker cooler baghouses.[74] The plant is capable of burning coal, natural gas, and tire-derived fuels.[75] The plant is equipped with a Dustex 10-module pulse jet baghouse which it installed in 2019.[76]

Ecology identifies a 5.1 pound NOx per ton of clinker on a 30-day rolling average as an emission limit for the Ash Grove cement plant that is part of its long term strategy.[77] However, Ecology has not included any evidence in its draft SIP that the 5.1 lb NOx/ton clinker emission limit is an enforceable requirement of any permit or rule, or that there is an enforceable requirement to install SNCR which Ecology also states must be installed (or perhaps is currently installed). Ecology did include in the draft SIP a 2013 Consent Decree between EPA, Ash Grove Cement Company, and other parties including Ecology and Puget Sound Clean Air Agency (PSCAA) in Appendix E of its draft regional haze SIP. That Consent Decree did not set any specific NOx emission limit or NOx control requirement for the Seattle Ash Grove cement plant, although it did set specific limits for other Ash Grove cement plants located in other states. For example, for the Ash Grove cement plants in Foreman, Arkansas and in Chanute, Kansas, the 2013 Consent Decree required installation of SNCR and imposed a NOx limit of 1.5 lb/ton of clinker, applicable on a 30-day rolling average, to be met by 12/31/2015.[78] For the Ash Grove cement plant in Seattle, the 2013 Consent Decree required Ash Grove to submit an optimization protocol in accordance with Appendix A of the Consent Decree "for the purpose of optimizing the operation of the Seattle Kiln to reduce NOx emissions to the maximum extent practicable from that Kiln."[79] The Consent Decree requires that the "Seattle Kiln NOx Emission Reduction Report shall conform to the applicable procedures set forth in Appendix A [of the Consent Decree] for the establishment of a 30-Day Rolling Average Emission Limit for NOx at the Seattle Kiln" and that Ash Grove must demonstrate compliance with that emission limit "consistent with the requirements and deadlines specified in Appendix A" of the Consent Decree.[80] While the Consent Decree outlined the process for establishing and complying with a

---

[72] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 162.
[73] Based on NPCA's Regional Haze Fact Sheet for Washington, Sources of Visibility Impairing Pollution in Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.
[74] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 167.
[75] *Id.*
[76] *Id.* at 169.
[77] *Id.* at 212.
[78] *See* 2013 Consent Decree, *United States et al. v. Ash Grove Cement Company*, (No. 2:13-cv-02299-JTM-DJW) at 22-23 (¶¶13 and 15), in Appendix E of the Public Review Draft, Second Regional Haze Plan, October 2021.
[79] 2013 Consent Decree, *United States et al. v. Ash Grove Cement Company*, (No. 2:13-cv-02299-JTM-DJW) at 25 (¶¶21), in Appendix E of the Public Review Draft, Second Regional Haze Plan, October 2021.
[80] *Id.*

NOx emission limit with EPA and PSCAA,[81] it does not specify a specific emission limit to be complied with. Ecology has not adequately explained or provided any documents that show how the 5.1 lb/ton of clinker NOx limit has been made into an enforceable requirement[82] or that it is being complied with. It does not appear that requirements that Ecology states have been established under the 2013 Consent Decree have been incorporated into the Ash Grove operating permit yet either, as the current operating permit in place for the Ash Grove cement plant does not require the use of SNCR and does not specify a NOx emission limit of 5.1 lb/ton of clinker.[83]

While it is assumed that the 5.1 lb/ton of clinker limit is enforceable by the PSCAA and Ecology through the mechanism established under 2013 Consent Decree, for the purpose of taking credit for the NOx emission limit as part of its Long Term Strategy and Regional Haze SIP, Ecology is required to provide evidence that it has adopted any requirement of its Long Term Strategy in final form.[84] Such evidence would include the submittal of the actual regulation or document to be incorporated into the SIP as an enforceable requirement.[85] However, the Draft SIP does not cite to any documents which include the 5.1 lb/ton of clinker NOx limit at the Ash Grove Cement Plant. Any measure included in the Long Term Strategy is required to have enforceable emission limitations pursuant to 40 C.F.R. 51.308(f)(2), and Ecology thus needs to provide evidence that the 5.1 lb/ton of clinker NOx limit is an enforceable emission limit.

In its discussion of the facility-specific four factor analyses for the Ash Grove Cement Plant, Ecology states that the 2013 Consent Decree required the Seattle Ash Grove Cement Plant to optimize an SNCR system.[86] However, the Consent Decree does not specifically refer to an SNCR system at the Seattle Ash Grove plant, and the current operating permit for the Seattle Ash Grove plant does not even mention an SNCR system. Ecology acknowledges that Ash Grove submitted a permit application in 2016 for installation of an SNCR system, but a permit has not been issued yet "because of unresolved technical issues."[87] Ecology describes the main technical issue as that the "permit application requested to be operated the SNCR process on an 'as needed' basis" to achieve the 5.1 lb/ton of clinker NOx limit.[88] The facility, which has a capacity of 750,000 tons of clinker per year,[89] is currently subject to a NOx limit of 1,846 tons

---

[81] *Id.* at ¶22.

[82] Appendix M of the WDOE Draft Regional Haze Plan does include an August 26, 2016 letter from EPA to Ash Grove Cement Company that approves the limit of 5.1 pounds of NOx per ton of clinker on a 30-day rolling average, but it is not clear that the EPA letter is an enforceable document. Further, the EPA letter does not mention an SNCR system.

[83] Air Operating Permit No. 11339 issued to Ash Grove Cement Company, last amended June 13, 2018, available at https://pscleanair.gov/DocumentCenter/View/214/Air-Operating-Permit-PDF?bidId=.

[84] This is required by EPA's SIP submittal completeness guidelines in 40 C.F.R. Part 51, Appendix V, Sections 2.1.b and d.

[85] 40 C.F.R. Part 51, Appendix V, Section 2.1.d.

[86] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 169.

[87] *Id.* at 169.

[88] *Id.*

[89] PSCAA Statement of Basis for Ash Grove Cement Company, Air Operating Permit Administrative Amendment 4 issued 6/13/18, at 1, 47, available at https://pscleanair.gov/DocumentCenter/View/216/Statement-of-Basis-PDF?bidId=.

per 12-month period,[90] which equates to an annual limit of 4.92 lb/ton of clinker when the plant is operating at maximum capacity. Unless the Ash Grove plant is not currently complying with the 5.1 lb/ton of clinker NOx limit, it is not clear that SNCR would be required to meet the 5.1 lb/ton clinker NOx limit. Ecology must disclose the current compliance status of the Ash Grove plant with the 5.1 lb/ton limit on NOx which Ecology is claiming is part of its Long Term Strategy.

Further, Ecology has failed to provide an adequate four-factor analysis of controls for the Ash Grove Cement Plant. It appears that Ecology may be finding that SNCR is a cost effective control for the Ash Grove plant that it will require as part of its regional haze plan, but it is unclear. Ecology states "PSCAA and Ash Grove are working on resolving the technical issues in the [SNCR] application with the goal of issuing a permit for the SNCR system. This permit will form the basis for emission standards that will apply to the SNCR system. Ecology intends to supplement the RHR SIP once the permit is issued."[91] Ecology has selected the Ash Grove Cement Plant as a facility to be included in its Long Term Strategy in its regional haze plan for the second implementation period. Thus, Ecology is required to perform a four-factor analysis of controls for the facility and to establish the enforceable requirements for the facility in the context of this current regional haze SIP revision. Considering that Ash Grove has requested to operate the SNCR on an "as needed" basis to achieve the NOx limit of 5.1 lb/ton of clinker, it is clear that the 5.1 lb/ton of clinker NOx limit is not reflective of the NOx removal capabilities of SNCR at the Ash Grove Cement Kiln. As stated above, the 2013 Consent Decree required at least two cement kilns to meet a much lower 1.5 lb/ton of clinker NOx limit with SNCR and .

Rather than determine the appropriate limit with SNCR at the Ash Grove cement kiln or address other methods of reducing NOx at the plant, Ecology states that it "has determined the EPA Consent Decree limit of 5.1 pounds of NOx per ton of clinker on a 30-day rolling average is adequate for reasonable progress at this time until a final permit for the SNCR system is issued by Puget Sound Clean Air Agency."[92] Ecology's approach does not meet the regional haze requirement that the emission reduction measures necessary to make reasonable progress be included in the long term strategy pursuant to 40 C.F.R. 51.308(f)(2)(i). Ecology must conduct a four-factor analysis now as part of its regional haze plan for the Ash Grove cement plant to fully evaluate all cost-effective controls and to impose an emission limit reflective of the efficacy of the control required.

Ecology briefly evaluated the top NOx control technology, SCR, for the Ash Grove plant, but discounted the control due to SCR operational problems that could occur if it was installed upstream of the baghouse (because the high particulate could foul the catalyst) or if it was installed downstream of the baghouse (because the exhaust temperature would be too low for effective operation of the SCR and require installation of a heat exchanger).[93] However, another top control that Ecology failed to evaluate is the control option of installing catalytic ceramic

---

[90] Air Operating Permit No. 11339, issued to Ash Grove Cement Company by PSCAA, last amended June 13, 2018, at 10, available at https://pscleanair.gov/DocumentCenter/View/214/Air-Operating-Permit-PDF?bidId=.
[91] *Id.*
[92] *Id.*
[93] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 168.

filters in the existing main baghouse at the cement kiln. Several vendors are offering catalytic ceramic filter systems for baghouses that can remove NOx through embedded catalysts in the filter, particulate matter, and SO2 with the use of dry sorbent injection, such as Tri-Mer UltraCat and Haldor Topsoe CataFlex™ catalytic filter bags that can be installed in place of or inside a standard filter bag at an existing baghouse. Such vendors claim that catalytic filters can achieve 90% or greater NOx removal.[94] Notably, the catalytic ceramic filters have been geared towards cement kilns, among other facilities, to help meet the Portland cement maximum achievable control technology (MACT) standards.[95]

Recently, a cost assessment for the use of a ceramic catalytic filtration system was done for the GCC Pueblo Cement Plant in Colorado.[96] That information can be used to estimate the costs of using a catalytic ceramic filtration system at the Ash Grove plant. The GCC plant is somewhat similar to the Ash Grove Seattle plant in that both cement kilns use the dry kiln process and use a preheater and precalciner.[97] The GCC Pueblo Plant has a higher cement production rate at 3,750 tons/day compared to 2,200 tons per day at the Seattle Ash Grove cement plant.[98] Thus, the cost estimate of the use of a ceramic catalytic filtration system would be higher than the costs of such a system at the Ash Grove plant in Seattle.

There are a few options for using a ceramic catalytic filtration system at the Ash Grove Plant: 1) install a stand-alone catalytic ceramic filtration system that would be used after the existing baghouse, 2) replace an existing baghouse with a stand-alone catalytic ceramic filter system, and 3) install catalytic filter bags within the existing baghouse. Given that a new baghouse was recently installed at the Ash Grove plant, the third option would be the most cost effective option.

Tri-Mer provided a cost estimate to replace the existing bags of the baghouse at the GCC Pueblo cement plant with catalytic ceramic filter elements. As discussed in the attached report on GCC Pueblo, Tri-Mer's costs take into account the addition of an ammonia injection system and that the exhaust flue gas of the cement kiln would no longer need to be cooled to a temperature required by the existing fabric filter bags.[99] Tri-Mer determined that the cost for a bag-to-ceramic filter retrofit would cost $800/ton of NOx removed at the GCC Pueblo Plant and would reduce NOx by 90%, as well as continuing to remove PM10 and PM2.5 at very high efficiencies (greater than 99.9%).[100] Tri-Mer's cost effectiveness value reflects a capital cost of $8,999,200

---

[94] *See*, e.g., https://tri-mer.com/hot-gas-treatment/hot-gas-filtration.html. *See also* Exhibit 3, Haldor Topsoe CataFlex™ brochure; and GEA BisCat – Ceramic catalyst filter information available at https://www.gea.com/en/news/trade-press/2019/biscat-ceramic-catalyst-filter.jsp.

[95] *See* Air & Waste Management Association, The Magazine for Environmental Managers, Sponsored Content, "Catalytic Filter Technology Provides Important Flexibility for Controlling PM, NOx, SOx, O-HAPS," October 2018, attached as Ex. 4 and available at https://pubs.awma.org/flip/EM-Oct-2018/sponsoredcontent_trimer.pdf.

[96] Klafka, Steve, Wingra Engineering, GCC Rio Grande – Pueblo Cement Plant, Four-Factor Reasonable Progress Analysis, September 23, 2021, hereinafter GCC Pueblo Four Factor Analysis, attached as Ex. 5.

[97] *See* GCC Pueblo Four Factor Analysis, Appendix B at 2 (Ex. 5); *see also* PSCAA Statement of Basis for Ash Grove Cement Company, Air Operating Permit Administrative Amendment 4 issued 6/13/18 at 3 (Ex. 6).

[98] *See* GCC Pueblo Four Factor Analysis, Appendix B at 2; *see also* PSCAA Statement of Basis for Ash Grove Cement Company Air Operating Permit at 1.

[99] GCC Pueblo Four Factor Analysis at 12.

[100] *Id.,* Appendix F at 5-6.

for bag replacement with catalytic ceramic filters and an annual operating expense cost for the control system of $1,620,000/year.[101] The annual operating costs take into account power costs, use of aqueous ammonia (19% by weight), maintenance, and replacement of the filters every 10 years.[102] The use of aqueous ammonia is safer than using anhydrous ammonia, and there is not a federal requirement for an accidental release plan.

Tri-Mer states that some of the added benefits of using a ceramic catalytic filtration system for control of NOx, as well as particulate, include that there is minimal catalyst plugging, reduced ammonia slip (well below 10 parts per million), and negligible catalyst deactivation.[103] Tri-Mer states that "a ceramic filter has no deactivation of the catalyst in a continuous operation for 10 years+."[104] In addition, with the use of sorbent injection, the catalytic ceramic filtration system could also be used to reduce SO2 emissions by 90% or more.[105]

The Seattle Ash Grove Cement facility had NOx emissions of 1,144 tons per year in 2014,[106] thus a 90% reduction would equate to 1,030 tons per year of NOx reduced from 2014 levels. Based on the allowable NOx emission rate of 1,846 tons per 12-month period and the annual capacity of the Ash Grove plant of 750,000 tons of clinker production, the use of catalytic ceramic baghouse filters would allow for a NOx emission limit of approximately 0.5 lb/ton of clinker.[107] This is significantly lower than the 5.1 lb/ton clinker NOx limit that Ecology is proposing to be part of the state's Long Term Strategy. Thus, Ecology must fully evaluate the use of catalytic ceramic filter bags at the Ash Grove cement plant as a top regional haze control.

SNCR should be considered a second tier control compared to catalytic ceramic baghouse filters. However, SNCR can most assuredly reduce NOx to lower emission rates than the 5.1 lb/ton of clinker emission rate that Ash Grove is apparently negotiating with PSCAA for its SNCR system.[108] There are several cement kilns with SNCR with lower NOx limits than 5.1 lb/ton of clinker. Indeed, the 2013 Consent Decree requires a NOx limit of 1.5 lb/ton of clinker, applicable on a 30-day rolling average, to be met by 12/31/2015 at several cement kilns.[109] In any evaluation of SNCR as a regional haze control for the Seattle Ash Grove plant, Ecology must evaluate the maximum emission reduction capabilities of the control and not simply allow

---

101 *Id.*, Appendix F at 6. Note that the annual operating expense was calculated by subtracting the estimated Capital Investment of $8,999,200 from estimated lifetime cost (Capital expense plus 20 years of operating expenses) of $41,399,200 provided for the GCC Pueblo plant by Tri-Mer.
102 *Id.*, Appendix F at 6.
103 *Id.,* Appendix F at 7.
104 *Id.*
105 *Id.,* Appendix F at 5.
106 WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 84.
107 *See* PSCAA Statement of Basis for Ash Grove Cement Company, Air Operating Permit Administrative Amendment 4 issued 6/13/18, at 1 (Ex. 6); and Air Operating Permit No. 11339, issued to Ash Grove Cement Company by PSCAA, last amended June 13, 2018, at 10 (Ex. 7). Assuming 90% NOx control from the 1,846 tons NOx per 12-month period limit equates to 0.5 lb/ton of clinker at maximum production capacity of 750,000 tons of clinker per year.
108 WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 168.
109 *See* 2013 Consent Decree, *United States et al. v. Ash Grove Cement Company*, (No. 2:13-cv-02299-JTM-DJW) at 22-23 (¶¶13, 15, 25, 30), in Appendix E of the Public Review Draft, Second Regional Haze Plan, October 2021.

periodic implementation of an SNCR system at the Ash Grove cement plant to meet an unreasonably high NOx emission limit.

With respect to SO2 emissions from the Ash Grove Plant, Ecology states the following about the cement plant:

> SO2 emissions at the plant come from burning sulfur containing fuels. The plant is capable of burning coal, natural gas, and tire-derived fuels. The plant has not been using coal for the last couple of years, but still has the ability to use it. As the facility can still use coal, SO2 emissions from the 2014 EI (with coal combustion) were included in the modeling to determine progress. The alkaline cement clinker removes some SO2 from the combustion gases. The facility uses this as a primary method of SO2 control.

WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 167.

If the plant has not been using coal in the past couple of years then, assuming that fuel change has reduced SO2 emissions, an emission control requirement of at least no longer burning coal at the Seattle Ash Grove plant should be imposed as a minimum regional haze control for SO2 emissions from the cement plant. However, the use of catalytic ceramic filter with sorbent injection should also be evaluated as an available SO2 control for the cement plant.

In summary, if Ecology is going to include the Ash Grove cement plant as part of its Long Term Strategy, the state's plan must evaluate controls for the facility in a four-factor analysis and impose appropriate emission limits and control requirements. Ecology admits that the 5.1 lb/ton of clinker emission rate is not reflective of even full-time operation of an SNCR system, and yet it is proposing a 5.1 lb/ton NOx limit that purportedly requires SNCR for the facility in its Long Term Strategy with a plan to revise the regional haze plan once a permit for the SNCR system is issued by PSCAA. Ecology has not even provided evidence that the 5.1 lb/ton clinker NOx limit has been adopted in a final enforceable form such that it can be incorporated into the federally enforceable SIP. Ecology's approach does not meet the regional haze requirement that the emission reduction measures necessary to make reasonable progress be included in the long term strategy pursuant to 40 C.F.R. 51.308(f)(2)(i). Ecology must conduct a four-factor analysis now as part of its regional haze plan for the Ash Grove cement plant to fully evaluate all cost-effective controls and to impose an emission limit reflective of the efficacy of the control required.

D. Cardinal FG Winlock Glass Plant

The Cardinal FG Winlock plant is a flat glass manufacturing plant in Winlock, WA. According to Ecology, its 2014 NOx emissions were 791 tons per year based on 2014 emissions.[110] Thus, the facility is a large source of NOx. Ecology calculated a Q/d value for this facility of 10.7,

[110] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 84.

which exceeded its threshold of 10 that it used to select sources for four-factor analyses of controls.[111] Therefore, the Cardinal Glass Plant is subject to the four-factor analysis.

Ecology did not request a four-factor analysis of pollution controls for the Cardinal Glass Plant. Instead, Ecology proposes to rely on the fact that the company recently submitted a permit application to install SCR controls, which it proposed concurrently with an increase in glass production capacity from 650 tons per day to 750 tons per day.[112] According to Ecology, the company is also requesting a much lower facility-wide NOx limit of 249.62 tons per year, which apparently is 583.05 tons per year lower than the facility's current emission limits.[113] According to Ecology, to ensure kiln exhaust gas temperatures are high enough for the successful operation of the SCR, the existing spray dryer and electrostatic precipitator (ESP) will have to operate at higher temperatures which will increase emissions of SO2, PM10, and PM2.5.[114] It also appears that the company is requesting lower NOx limits, as well as lower carbon monoxide limits, to allow the Cardinal Glass Plant to be considered a minor source (i.e., under 250 tons per year), so that the emission increases of SO2 and PM2.5 due not trigger prevention of significant permitting requirements as a major modification.

Ecology is relying on the Cardinal's plans to install SCR as part of its Long Term Strategy. Ecology has included a copy of SWCAA's Air Discharge Permit 20-3409, issued February 11, 2021, in Appendix H of its SIP and presumably will be including that permit as the enforceable requirement to incorporate into its regional haze SIP.

However, the issuance of the permit for the SCR and increase in capacity does not negate the need for Ecology to conduct its own four-factor analysis of controls and, particularly in this case, to establish appropriate emission limits as is required to be included in the Long Term Strategy pursuant to 40 C.F.R. 51.308(f)(2).

With respect to NOx, the facility-wide NOx emissions in 2014 were 791 tons per year, and the facility-wide potential to emit is 249.62 tons per year,[115] which only reflects a NOx reduction with SCR of 68%. That is much lower than the 90%+ control efficiency that SCR is capable of achieving. In addition, the prior permit for the Cardinal FG Winlock Glass Plant required use of the 3R Process for control of NOx emissions,[116] and it appears that process is no longer required in the 2021 permit. The Pilkington 3R Process is described as using "various hydrocarbon fuels, injected into the furnace waste gas stream, as the agent to reduce NOx to harmless nitrogen and water vapor."[117] If the company were required to add SCR along with using the existing 3R Process, it could achieve lower NOx emission rates. Ecology must explain why it is justifiable

---

[111] *Id.* at 160 and 162.
[112] *Id.* at 171.
[113] *Id.* at 172.
[114] *Id.*
[115] *Id.*
[116] SWCAA Air Discharge Permit 04-2568R2, 12/16/2008, at 4, available at https://www.swcleanair.gov/docs/permits/TitleV/SW08-14-R1AOP.pdf and attached as Ex. 8.
[117] State of New Jersey, Department of Environmental Protection, State of the Art (SOTA) Manual for the Glass Industry, July 1997, at 3.15-22, available at https://p2infohouse.org/ref/14/13344.pdf.

for Cardinal FG Winlock to stop using the 3R Process to control NOx, when it could readily use additional NOx controls in addition to the 3R Process.

In addition, the use of low temperature catalysts should have been evaluated for the SCR, to avoid having to reheat the gas stream which will reduce the effectiveness of the PM and SO2 controls. Such low temperature catalysts would reduce if not eliminate the projected increases in SO2 and particulate matter with the SCR, which are claimed to be due to the need to achieve a higher temperature in the flue gas due to the SCR.

Another option Ecology should consider for the Cardinal Glass Plant is the use of ceramic catalyst filters along with the existing 3R process, which can reduce NOx at lower temperatures than conventional SCR and also capture particulate and SO2. This control method is discussed above in Section II.C above on the Ash Grove Cement Plant and it is also discussed in the January 27, 2021 Four-Factor Reasonable Progress Analysis for the Ardagh Glass plant in Seattle, Washington, done by Wingra Engineering, S.C. and attached as Exhibit 10.

Ecology states that RCS 70A.15.2220 "requires that when a source decides to modify or replace an existing emission control system, Ecology or the local air pollution control authority must assure that the modified ore replacement control system meets a reasonably available control technology (RACT) level of emissions control at a minimum."[118] RACT is defined under Washington State law as:

> *[T]he lowest emission limit* that a particular source or source category is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT is determined on a case-by-case basis for an individual source or source category taking into account the impact of the source upon air quality, the availability of additional controls, the emission reduction to be achieved by additional controls, the impact of additional controls on air quality, and the capital and operating costs of the additional controls. RACT requirements for a source or source category shall be adopted only after notice and opportunity for comment are afforded.

RWA 70A.15.1030(20) (emphasis added).

While SCR is a control technology capable of meeting the lowest emission limit, the proposed NOx emission limit does not appear to require the "lowest emission limit" that can be met with SCR. Further, with the decreases in SO2 and PM removal efficacy that will occur as a result of the SCR installation, it is questionable whether the SO2 and PM emission limits reflect RACT because the revised SO2 and PM emission limits do not reflect the lowest emission limit for the spray dryer and electrostatic precipitator that are installed at the glass furnace. Ecology must comply with the state law RCW 70A.15.2220 cited in its draft Long-Term Strategy as part of its review and determination of appropriate regional haze emission limitations for the Cardinal FG Winlock glass plant in its Regional Haze plan for the second implementation period. It has an obligation to ensure RACT level controls are met.

[118] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 215.

The regional haze four-factor analysis applies to the Cardinal Glass Plant *in conjunction with* any other Clean Air Act requirements. The fact that the Cardinal Glass Plant has received a permit requiring the installation of SCR does not obviate the need for the state to comply with reasonable progress requirements The emission limits of the permit, as described in the draft regional haze SIP, do not reflect the maximum capabilities of SCR, including the ability to use low temperature catalyst to avoid or eliminate the SO2 and particulate matter increases that were projected to occur with SCR. Ecology must conduct its own four-factor analysis of regional haze controls and impose emission limits that reflect the controls it determines are necessary to make reasonable progress towards the national visibility goal.

III. Review and Comments on Other Sources Selected by Ecology for Review That Were Unjustifiably Deferred from Ecology's Proposed Long Term Strategy

As previously stated, Ecology used a Q/d analysis and selected a Q/d value of 10 or higher as a threshold for selecting sources to require a four-factor analysis of regional haze controls.[119] Ecology required four-factor analyses for five petroleum refineries and seven pulp and paper mills.[120] Ecology then selected the refineries as the first priority of sources to focus on for regional haze controls. Ecology prioritized pulp and paper mills lower than refineries because they "are not located as close to each other as the refineries so they do not have as great of a cumulative effect."[121] Ecology also states that the potential reduction in regional haze emissions from pulp and paper mills is "vastly less than the potential refinery emission reductions."[122]

Ecology states that it must follow its RACT rule requirements before it can legally establish control requirements.[123] However, Ecology has not conducted a RACT evaluation in this regional haze plan. Yet, the regional haze plan for the second implementation period is required to evaluate controls for selected sources and determine through a four-factor analysis what control measures are necessary to make reasonable progress towards the national visibility goal.[124] For a source that is found subject to the required reasonable progress four-factor analysis as a result of a state's reasonable progress screening process, the state must ensure the analysis is conducted as part of its regional haze plan. Neither the Act nor EPA's rules provide an "off-ramp" for a source in this situation. Ecology's Public Review Draft is stated to be its State Implementation Plan (SIP) revision for the second regional haze plan implementation period of

---

[119] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 160.
[120] These company four-factor analyses are provided at https://fortress.wa.gov/ecy/ezshare/AQ/RegionalHaze/RegionalHaze.htm.
[121] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 166.
[122] *Id.* at 167.
[123] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 163.
[124] *See* U.S. EPA, Guidance on Regional Haze Plans for the Second Implementation Period, August 20, 2019, at 28 (Step 4).

2018 to 2028, and thus it is assumed for the purpose of these comments that the Public Review Draft is the plan to be submitted to EPA for approval.

Comments are provided herein on the four-factor analyses and Ecology's analysis of controls for the five refineries and the seven pulp and paper mills.

A. Four-Factor Analyses for the Oil Refineries

Ecology states in its draft regional haze plan that the refineries in Washington "are over 40 years old and the facilities have maintained the majority of the equipment in a manner that has not required updating emission controls to current standards."[125] Ecology did a nationwide comparison of 2014 facility-wide NOx emissions per barrel of production capacity for the five Washington refineries to 83 other refineries located in the U.S. and found that "Washington refineries represent four of the top five facilities in the nine states in terms of NOx emissions per 1,000 barrels produced per day."[126]

Ecology requested four-factor analyses from the five Washington refineries to address each fluid catalytic cracking unit (FCCU), each boiler with heat input greater than 40 MMBtu/hr, and each heater with heat input greater than 40 MMBtu/hr that has not been retrofitted with NOx controls since 2005.[127] None of the five refineries for which Ecology requested four-factor analyses found that low NOx burners or ultra low NOx burners (LNB/ULNB) or SCR were appropriate for regional haze reasonable progress controls. Either the companies claimed that a control, such as ULNB, was not technically feasible for a heater or boiler, or a company claimed that controls were not cost effective. Ecology conducted its own cost effectiveness analyses for the application of SCR to the refinery heaters and boilers. Ecology states that two refineries did not submit analyses for their FCCUs, and Ecology subsequently decided to evaluate SCR for those FCCUs "since they are a large source of NOx emissions."[128]

1. Comments on Ecology's Determination of Cost Effective Controls for the Petroleum Refineries

Ecology conducted SCR cost effectiveness analyses for several emissions units at the refineries using EPA's SCR cost calculation spreadsheet made available with its Control Cost Manual.[129] Ecology states in its discussion of the four-factor analyses of controls for the units at each refinery that it found SCR would be cost effective for the FCC units and for various heaters and boilers.[130] Ecology's draft SIP identifies a $6,300/ton reasonableness threshold for NOx controls

---

[125] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 184.
[126] *Id.* at 185-186 (Table 7-6).
[127] *See*, e.g., BP Cherry Point Refinery Regional Haze Four Factor Analysis, April 2020 (hereinafter "BP Cherry Point Analysis") at 2, available at https://fortress.wa.gov/ecy/ezshare/AQ/RegionalHaze/RegionalHaze.htm.
[128] *Id.* at 187.
[129] *Id.* at 187.
[130] *Id.*

in its discussion of controls for the pulp and paper industry.[131] It appears, but is not entirely clear, that Ecology is using a similar reasonableness threshold for NOx controls at the refineries. For any cost threshold selected by a state, EPA's regional haze guidance requires that the State Implementation Plan (SIP) "explain why the selected threshold is appropriate for that purpose and consistent with the requirements to make reasonable progress."[132] It must be noted that other states have adopted higher cost effectiveness reasonableness thresholds. For example, Oregon has adopted a much higher regional haze control cost threshold of $10,000/ton.[133] Colorado is also using a reasonableness cost threshold of $10,000/ton.[134] New Mexico is using a reasonableness cost effectiveness threshold of $7,000/ton.[135]

With respect to determining whether a NOx control is cost effective for a particular heater or boiler at a refinery, it is important to consider the costs that similar sources have had to bear to meet Clean Air Act requirements for NOx. For example, several Californian Air Districts as well as the states of Texas, Massachusetts, New York, and Georgia have set NOx emission limits for existing heaters and boilers that are reflective of the use of LNB/ULNB, SNCR, or SCR.[136] While these emission limits were often set to address ozone and/or PM2.5 nonattainment issues, the fact is that each of these controls can be quite cost effective. For example, a San Joaquin Valley Air Pollution Control District (SJVAPCD) cost analysis for ULNBs shows that the retrofitting of such controls to meet a NOx limit of 6 ppm would have cost effectiveness values ranging from $545/ton to $3,270/ton, with the higher cost effectiveness values being at smaller units (the smallest size unit evaluated was 30 MMBtu/hr) and/or lower capacity factors.[137] In addition, based on a SJVAPCD cost analysis for SCR to meet NOx emission rates of 2.5 ppm, SCR was found to have a cost effectiveness of $1,025/ton to $6,149/ton for heaters and boilers as small as 30 MMBtu/hr, with the lowest cost effectiveness values for the larger units and units that operate at higher capacity factors.[138]

We encourage Ecology to review Table 42 of the attached March 6, 2020 report of four-factor analyses for the oil and gas industry,[139] which includes a list of state and local air agency emission limits and rules applicable to existing natural gas-fired heaters and boilers. As that report indicates, the most stringent NOx limit for units greater than or equal to 75 MMBtu/hour required of existing sources in the listed state and local rules is 5 ppm, which most likely reflects

[131] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 182.
[132] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 39.
[133] *See* Oregon Regional Haze State Implementation Plan for the Period 2018-2028, Aug. 27, 2021 Public Notice Draft, at 35, 45.
[134] *See* Colorado Department of Public Health and Environment, In the Matter of Proposed Revisions to Regulation No. 23, November 17 to 19, 2021 Public Hearing, Prehearing Statement, at 7, available at https://drive.google.com/drive/u/1/folders/1TK41unOYnMKp5uuakhZiDK0-fuziE58v.
[135] *See* NMED and City of Albuquerque, Regional Haze Stakeholder Outreach Webinar #2, at 12, available at https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2017/01/NMED_EHD-RH2_8_25_2020.pdf.
[136] Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, March 6, 2020, at 139-145, attached as Ex. 10.
[137] *Id.* at 125 (Table 36).
[138] *Id.* at 135 (Table 41).
[139] Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, March 6, 2020, at 139-145, attached as Ex. 10.

use of SCR. There are several examples of similar sources having to bear the costs of these controls to meet Clean Air Act requirements. Ecology would thus be justified in finding SCR for the heaters, boilers and FCCUs that it evaluated in its draft regional haze plan as cost effective.

Although Ecology states that SCR would be cost effective for several refinery emission units, Ecology also states it "will perform a more extensive and in-depth engineering evaluation on each refinery to generate more accurate and defensible cost estimates."[140] Presumably, Ecology states this because the Western States Petroleum Association (WSPA) has apparently contended that Ecology did not use the EPA SCR cost spreadsheet appropriately and that Ecology's application of the EPA's SCR cost spreadsheet is not appropriate for refineries.[141] However, as Ecology stated in its draft regional haze plan, the Washington refineries generally did not adequately document the basis for their SCR cost assessments. Ecology chose to use EPA's SCR cost spreadsheet which is based on the SCR chapter of the Control Cost Manual and which, in turn, has been very well documented and which also went through public notice and comment.

The EPA's SCR cost calculation spreadsheet was based on cost algorithms for utility boilers, but that fact does not make the SCR cost algorithms not applicable to other types of emission units such as those at refineries. Several of the refinery emission units that Ecology evaluated for SCR are boilers and process heaters. The emissions characteristics from those sources are similar or identical to the emission characteristics from boilers. In fact, EPA's AP-42 emission factors for petroleum refining refer to its emission factors for boilers (i.e., Section 1.3 "Fuel Oil Combustion" or Section 1.4 "Natural Gas Combustion") for determining emissions from boilers and process heaters used in the petroleum refining industry.[142]

The SCR cost spreadsheet algorithms were developed based on its Integrated Planning Model (IPM) version 6. The SCR cost documentation for the IPM written by Sargent & Lundy was in turn based on a wealth of design and cost information, including from the "Analysis of the [Midwest Ozone Group (MOG)] and [Lake Michigan Air Directors Consortium (Ladco) FGD and SCR Capacity and Cost Assumptions in the Evaluation of the Proposed EGU 1 and EGU 2 Emission Controls" and the J.E. Cichanowicz study "Current Capital Costs and Cost-effectiveness of Power Plant Emissions Control Technologies," as well as Sargent & Lundy's in-house database of recent SCR projects.[143] The costs generally reflect hot side, high dust SCRs, which also likely reflects the type of SCR that would be employed at refinery emission units including FCCUs.[144] While the cost algorithms are identified as providing the "average" costs with the "average" project,[145] the algorithms are also based on a significant amount of SCR

---

[140] *Id.*
[141] *Id.* at 188, 192, and 194.
[142] *See* U.S. EPA, AP-42, Chapter 5.1, Table 5.5-1, available at https://www.epa.gov/sites/default/files/2020-09/documents/5.1_petroleum_refining.pdf. *See also* EPA, AP-42, Chapter 1 External Combustion Sources, Sections 1.3 and 1.4, available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-1-external-0.
[143] *See* Sargent & Lundy, IPM Model – Updates to Cost and Performance for APC Technologies, SCR Cost Development Methodology, Final, January 2017, prepared by Sargent & Lundy, at 1, available at https://www.epa.gov/sites/default/files/2018-05/documents/attachment_5-3_scr_cost_development_methodology.pdf.
[144] *Id.*
[145] *Id.*

installation and SCR retrofit data from the industry where such controls are probably the most widely used (i.e., the fossil fuel-fired electric utility industry).

EPA's August 20, 2019 regional haze guidance refers to its cost spreadsheets developed as part of its recommendation that states follow the EPA's Control Cost Manual "to facilitate apples-to-apples comparisons of different controls options for the same source, and comparisons across different sources."[146] EPA does not require vendor-generated cost assessments for making regional haze control decisions.[147] EPA also cautions against relying solely on vendor cost estimates that are not sufficiently documented and without verifying that the vendor followed the costing principles of the EPA's Control Cost Manual.[148] The Washington refineries relied on the EPA SCR cost calculation spreadsheet for SCR cost analyses for at least some refinery emission units, although the refineries did not generally document its decisions to use higher retrofit factors or higher costs for items such as ammonia reagent as is discussed further below.[149] Thus, Ecology should not discount its cost effectiveness analyses of SCR for refinery emission units as not sufficiently accurate to determine that SCR is cost effective for an emission unit at a refinery.

SCR systems have been retrofit to many refinery emission units over the years, including at fluid catalytic cracking units (FCCUs). A paper from 2002 discusses the success of SCR retrofit at an FCCU at the BP Whiting Refinery and refers to SCR installations at FCCUs dating back to 1986.[150] SCR has also been used on refinery boilers and heaters, including at some Washington refineries,[151] and can achieve in excess of 95% NOx control from the NOx emitted from the heaters.[152] Experience using SCRs in the refinery industry shows the controls are reliable and have low operational and maintenance costs.[153]

For all of these reasons, Ecology is justified to use the EPA SCR cost spreadsheet to determine cost effectiveness of SCR at the heaters, boilers and FCCUs for the five refineries it evaluated for controls for its regional haze plan.

In its draft regional haze plan, Ecology identified the emission units listed in Table 4 for which SCR would be a cost effective regional haze control. The cost effective controls identified by

---

[146] *See* U.S. EPA, Guidance on Regional Haze Plans for the Second Implementation Period, August 20, 2019, at 31.
[147] *Id.* at 32.
[148] *Id.*
[149] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P at P-173 to P-194 (Shell Four-Factor Analysis), P-229 to P-283 (Tesoro Four-Factor Analysis), and P-334 to P-336 (U.S. Oil Four-Factor Analysis).
[150] *See* Bouziden, Gerald, K. Gentile and R.G. Kunz, Selective Catalytic Reduction of NOx from Fluid Catalytic Cracking Case Study: BP Whiting Refinery, National Environmental & Safety Conference, April 23-24, 2002, New Orleans, LA, at 1, available at https://www.cormetech.com/wp-content/uploads/2018/05/env-03-128-kunz-0-Whiting-Refinery-FCC.pdf.
[151] For example, BP Cherry Point has installed SCR on its #2 hydrogen plant SMR furnace, its #6 and #7 boilers, according to its August 26, 2014 Air Operating Permit #015R1M1 on the Northwest Clean Air Agency's (NWCAA's) website at https://nwcleanairwa.gov/?wpdmdl=981.
[152] *See*, e.g., Jensen-Holm, Hans et al., Haldor-Topsoe, Combating NOx from refinery sources using SCR, available at http://www.topsoe.com/sites/default/files/combating_nox_from_refinery_sources_using_scr.ashx_.pdf; LaPlante, Marie P. et al., How Low Can You Go? Catalytic NOx Reduction in Refineries, available at http://nawabi.de/project/hrsg/Topsoe.pdf.
[153] *Id.*

Ecology and listed in Table 4 below would reduce NOx emissions from the refineries by a total of 3,803 tons per year (based on Ecology's assumed NOx emissions reduced with SCR), reflecting a 64.5% reduction in the total 2014 annual NOx emissions from the five refineries

Table 4. Ecology's Identification of Cost Effective SCR Determinations at the Petroleum Refineries[154]

Plant	Emission Unit	Cost Effectiveness, $/ton	NOx Reduced, tons per year
BP Cherry Point	#1 Reformer Heaters	$3,101/ton	304 tpy
	Crude Heater	$2,051/ton	393 tpy
	Reforming furnace #1 (N H2 Plant)	$6,161/ton	262 tpy
	Reforming furnace #2 (S H2 Plant)		
Phillips 66 Ferndale	Crude Heater 1F-1	$2,640/ton	166 tpy
	FCCU/CO Boiler/Wet Gas Scrubber 4F-101	$3,954/ton	247 tpy
Shell Puget Sound	Boiler #1 Erie City – 31G-F1	$2,441/ton	179 tpy
	FCCU Regenerator Unit	$1,948/ton	521 tpy
	CRU #2 HTR, INTERHTR—10H-101, 102, 103	$6,346/ton	69 tpy
Marathon Petroleum Company (Tesoro) Anacortes Refinery	FCCU	$1,159/ton	843.3 tpy
	F 102 Crude Heater	$2,962/ton	147.6 tpy
	F 201 Vacuum Flasher Heater	$7,589/ton	57.6 tpy
	F 6650 CAT Reformer Heater	$3,736/ton	117 tpy
	F 6651 CAT Reformer Heater	$3,520/ton	124.2 tpy
	F 751 Main Boiler	$2,159/ton	202.5 tpy
	F 752 Main Boiler	$2,570/ton	170.1 tpy

Ecology evaluated SCR to achieve 90% NOx removal and assumed a 3.25% interest rate and a 25-year life in amortizing capital costs of control. Ecology's assumptions are defensible. EPA's Control Cost Manual states that, while in theory, SCR can achieve close to 100% NOx removal,

[154] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, at 188 (finding SCR at BP Cherry Point units was cost effective), at 192 (finding SCR at Phillips 66 units was cost effective), at 194 (finding SCR at Shell units was cost effective), and at 198 (fining SCR at Marathon Petroleum Company (Tesoro) units was cost effective). Appendix J at J-1.

in practice, SCRs are routinely designed to achieve 90% or greater NOx removal.[155] Ecology's use of a 3.25% interest rate is justified, as the Federal Reserve Prime Rate has been at 3.25% since March 2020.[156] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[157] A 25-year life of an SCR system is also justifiable as discussed in EPA's Control Cost Manual,[158] as long as the remaining useful life of the emission unit in question is not restricted to a shorter time period. None of the refineries indicated a restricted remaining useful life of any of the above units in the company four-factor analyses.

For those refinery units for which SCR was not determined to be cost effective, Ecology should evaluate SNCR as a NOx control. The McIlvaine Company indicates that urea-based SNCR used at refinery process units and boilers has generally achieved 50-70% NOx reduction.[159]

In addition, Ecology should not limit evaluation of LNB/ULNBs for units greater than 40 MMBtu/hour capacity, as such burners are available for smaller units.[160] The California Air Resources Board (CARB) determined as far back as 1991 that heaters and boilers as small as 5 MMBtu/hour or greater could meet NOx "best available retrofit control technology" (BARCT) limits of 30 ppmv (or about 0.036 lb/MMBtu).[161] However, more recently, California's South Coast Air Quality Management District (AQMD) concluded that even lower NOx limits, as low as 9 ppm, could be met with ULNB at boilers and process heaters as small as 2 MMBtu/hr.[162] This was based on actual ULNB retrofit experience at boilers and heaters in the San Joaquin Unified Air Pollution Control District (SJVAPCD).[163] The Ventura County Air Pollution Control District in California also found that boilers and process heaters as small as 2 MMBtu/hr could meet NOx limits of 9 ppm with ULNB.[164] Thus, Ecology should not limit the evaluation of reasonable progress controls to only heaters and boilers greater than 40 MMBtu/hr.

For companies demonstrating that the retrofit of ULNBs is not technically feasible and for which SNCR or SCR are truly not cost effective, Ecology should evaluate the costs of replacing an existing boiler or heater with a new unit equipped with state-of-the-art ULNBs. If a unit is near the end of its useful life, this could be a very cost effective and readily implementable approach to reducing NOx emissions.

---

[155] *See* U.S. EPA, Control Cost Manual, Section 4, Chapter 2, at pdf page 5, available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[156] https://fred.stlouisfed.org/series/DPRIME.
[157] U.S. EPA, Control Cost Manual, Section 1, Chapter 2 (November 2016) at 16, available at https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf.
[158] *See* U.S. EPA, Control Cost Manual, Section 4, Chapter 2, at pdf page 80, available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[159] *See* http://www.mcilvainecompany.com/industryforecast/refineries/background1/text/Chapter%20X/Chapter%20X.htm.
[160] *See*, e.g., BP Cherry Point Refinery Regional Haze Four Factor Analysis, April 2020, in Appendix P of Public Review Draft Regional Haze Plan, October 2021, at P-3.
[161] As discussed in Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, March 6, 2020 at 120 (attached as Ex. 10).
[162] *Id.* at 121.
[163] *Id.*
[164] *Id.* at 121-122.

For those units listed in Table 4 above that Ecology found SCR to be a cost effective control, Ecology should adopt requirements for the companies to install SCR as part of its current regional haze action. Ecology has shown that SCR is cost effective for those units, and Ecology's review of the other three factors do not provide a reason to exclude any of the emission units in Table 4 above from requirement to install SCR requirement to achieve reasonable progress towards the national visibility goal.

Instead of adopting SCR control requirements for the emission units listed in Table 4 above, Ecology states that it will conduct a more extensive cost evaluation of SCR. Yet, the cost algorithms of the EPA SCR cost spreadsheet are already based on numerous SCR cost evaluations. Further, Ecology already requested four-factor analyses of potential regional haze controls from the refineries include for SCR, and Ecology determined that the company analyses were not well documented or justified.[165] In most cases, the cost analyses submitted by the refineries overstate costs and understate emissions reductions, and so the cost effectiveness numbers should not be relied upon by Ecology. In the sections that follow, more specific concerns with each company's four-factor analyses of NOx controls are provided along with a discussion of the four-factor analyses provided by Ecology in its current draft regional haze plan.

2. BP Cherry Point Refinery

Ecology calculated a Q/d value for the BP Cherry Point facility of 36.4, and it is ranked 5th highest Q/d on Ecology's list of sources it evaluated.[166] NPCA data shows that the facility impacts regional haze at 14 Class I areas.[167] BP Cherry Point submitted a four-factor analysis for nine emission units at the refinery:

- Crude Charge Heater;
- South Vacuum Heater;
- #1 Reformer Heaters;
- #2 Reformer Heaters;
- Naphtha HDS Charger Heater;
- Naphtha HDS Stripper Reboiler;
- Hydrocracker R-4 Heater;
- #1 Hydrogen Plant (North and South Furnaces);
- #5 Boiler.

[165] *Id.* at 190, 192, 195, 196, 199, and 202 (Ecology stating that the various refinery companies provided limited supporting data for their cost analyses).
[166] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 161.
[167] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.

BP states that Ecology narrowed the request to only LNB/ ULNB and SCR. BP analyzed the cost effectiveness of LNB/ULNB and SCR for these units and found that no controls were cost-effective. The following provides comments on BP's cost effectiveness analyses in its Four-Factor submittal.

Issues with Four-Factor Analyses for BP Cherry Point

1. One of the deficiencies in BP Cherry Point's cost analyses is that it used a 5% interest rate in amortizing capital costs.[168] BP claimed that this interest rate was based on the past Federal Reserve Prime Rate, but the Federal Reserve Prime Rate has been at 3.25% since March 2020.[169] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[170] In a cost effectiveness analyses being done today, even a 5.0% interest rate is unreasonably high, given the current bank prime lending rate of 3.25%. Use of a higher interest rate results in higher annualized capital costs.

2. For all of the units except the #5 boiler and the #3 reformer heater, BP used cost estimates that were previously done in 2010 and which reflected a 2007 dollar basis.[171] BP scaled those costs up from 2007 dollars to 2020 dollars using the Nelson Farrar Refinery Construction cost index, which increased capital costs by 41%.[172] EPA's Control Cost Manual cautions against attempting to escalate costs more than five years from the original cost analysis.[173] EPA states that "[e]scalation with a time horizon of more than five years is typically not considered appropriate as such escalation does not yield a reasonably accurate estimate."[174] Further, the prices of an air pollution control do not always rise at the same level as price inflation rates. As an air pollution control is required to be implemented more frequently over time, the costs of the air pollution control often decrease due to improvements in the manufacturing of the parts used for the control or different, less expensive materials used, etc. Notably, for SCR, EPA's SCR cost effectiveness spreadsheet can be used to estimate costs of SCR, as was used by Ecology for the #1 reformer heaters, the crude heater, the reforming furnace #1 (N H2 Plant), and for the reforming furnace #2 (S H2 plant).[175]

3. BP Cherry Point stated that LNBs/ULNBs were not technically feasible on the crude charge heater, the naphtha HDS charge heater, the naphtha HDS stripper reboiler, and the

---

[168] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P-6.

[169] https://fred.stlouisfed.org/series/DPRIME.

[170] EPA, Control Cost Manual, Section 1, Chapter 2 (November 2016) at 16, available at https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf.

[171] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses) at P-10 to P-13.

[172] *Id.* at P-13.

[173] EPA Control Cost Manual, Section 1, Chapter 2 Cost Estimation: Concepts and Methodology, November 2017, at 19.

[174] *Id.*

[175] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 189-191.

hydrocracker R-4 heater due to flame impingement and that they would need to rebuild the heater to accommodate the burner retrofit.[176] A review of the air operating permit for BP Cherry Point shows that most of these heaters and boilers were installed fifty years ago in 1970. Given the age of the heaters, it could be more economical to replace the heaters and boilers with new heaters equipped with state-of-the-art ultra-low NOx burners. The heaters could also be retrofitted with SCR, which Ecology found to be cost effective.[177]

4. BP Cherry Point Assumed that LNB and ULNB could only achieve NOx emission rates of 0.055 to 0.060 lb/MMBtu for forced and balanced draft heaters with air preheaters.[178] The company provided no citation or support for that statement. NOx emission limits for refinery heaters and boilers reflective of LNB/ULNB are typically set at 0.040 lb/MMBtu or lower.[179] Tesoro evaluated LNB/ULNB to meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.[180]

5. BP applied retrofit factors to the costs of SCR which would increase the capital costs due to purported retrofit difficulty, but BP provided no justification for the use of retrofit factors. For the one unit for which BP utilized EPA's SCR cost spreadsheet, it must be noted that the cost algorithms in EPA's SCR cost spreadsheet are based on the average SCR retrofit costs for utility boilers, which often have retrofit difficulties and additional costs. Thus, some retrofit difficulty is already built into the costs of EPA's SCR cost spreadsheet. Ecology must request justification and documentation for use of any SCR retrofit factors.

6. BP assumed a cost for ammonia reagent in the SCR systems of $0.33/lb, or $660/ton, which is unreasonably high.[181] No basis was cited for this cost. EPA's SCR Control Cost Manual chapter assumes a much lower cost for 29% aqueous ammonia of $0.293/gallon, based on the average cost for ammonia for 2016 from the U.S. Geological Survey's Minerals Commodities Summaries for which EPA provided a weblink.[182] The U.S. Geological Survey Minerals Commodities Report currently lists the 2020 average cost for ammonia at $220/ton.[183] Thus, BP's costs of ammonia reagent were greatly overstated. Use of anhydrous ammonia is the least expensive form of the reagent and is commonly

[176] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses), at P16-P18.
[177] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 189-191.
[178] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses), at P-8.
[179] *See* Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, at 139-144, Attached as Ex. 10.
[180] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses), at P-20.
[181] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses) at Attachment B.
[182] See EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[183] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 116, available at https://www.usgs.gov/centers/nmic/mineral-commodity-summaries.

used at utility installations. The State must ensure that the most cost-effective approaches to controlling NOx emissions with SCR and also that wholly unjustified and unreasonably high costs for ammonia are not used. Notably, Ecology used EPA's default cost for 29% aqueous ammonia in its SCR cost calculations.[184]

7. BP assumed an SCR would operate 8,784 hours per year (i.e., the total number of hours in a leap year) in estimating the reagent costs for SCR at the South Vacuum Heater, which clearly is in error as that could only occur once every four years. BP also assumed 8,760 hours of operation for estimating reagent costs for SCR at the #1 Hydrogen Plant North and South Reforming Furnaces. Ecology must ensure that the assumed operating hours for estimating reagent costs are consistent with the baseline emissions and baseline capacity factor assumed in each SCR cost analysis.

8. With respect to non-air quality impacts of SCR controls, BP has indicated that spent catalyst will require off-site disposal or recycling.[185] However, EPA's Control Cost Manual states that use of rejuvenated and regenerated catalyst can both reduce catalyst replacement costs and eliminate catalyst disposal costs. Ecology must ensure that the SCR cost analyses assume the most cost-effective options for catalyst replacement.

9. BP assumed it would take 7 to 10 years to implement additional NOx control strategies.[186] The company states that it would need to follow the refinery maintenance turnaround (TAR) schedule, which is 5 to 6 years per unit, but it seems very unlikely that each unit is on the same maintenance schedule and instead the maintenance schedules are likely staggered.

In its public review draft regional haze plan, Ecology presented SCR cost effectiveness evaluations for the reformer heaters, the crude heater, and the hydrogen plant (North and South furnaces).[187] Ecology's cost effectiveness analyses were based on EPA's SCR cost spreadsheet, and it appears Ecology relied on the default cost assumptions of the EPA spreadsheet (such as the cost of ammonia and catalyst replacement cost).[188] Ecology assumed 90% NOx reduction with SCR, and Ecology assumed a 25 year life and a 3.25% interest rate in amortizing capital costs of control. The cost differences between Ecology's cost estimates based on EPA's Control Cost Manual Spreadsheet and BP's are very significant, as shown in the table below. This information is from Ecology's discussion in the narrative section of the draft regional haze SIP, and additional information on Ecology's costs are included in a spreadsheet printout in Appendix P of its draft plan.

---

[184] WDOE, Public Review Draft, Regional Haze Plan for the Second Implementation Period, October 2021, Appendix P at P357.
[185] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P (BP Cherry Point Four-Factor Analyses) at P-14.
[186] *Id.*
[187] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 189.
[188] Based on a review of the tables with heading "EPA Cost Control Estimates Compared to Refinery Estimates for SCR 8/18/2020, Refineries Regional Haze Review – BP Cherry Point" in Appendix P of the WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at P-355 to P-361.

Table 5. Summary from Draft Washington Regional Haze SIP: Comparison of BP's Cost Analysis to Ecology's Cost Analysis for SCR at Certain BP Cherry Point Emission Units[189]

BP's Capital Cost	BP's Annual Maintenance Cost	BP's Cost Effectiveness, $/ton	WDOE's Capital Cost	WDOE's Maintenance Cost	WDOE's Cost Effectiveness	NOx Reduced, tpy
Reformer Heaters						
$94,809,582	$420,048	$24,378/ton	$9,929,730	$49,649	$3,101/ton	304 tpy
Crude Heater						
$94,809582	$420,048	$24,378/ton	$9,325,358	$46,627	$2,051/ton	425 tpy
Hydrogen Plant Reforming Furnaces						
$143,325,183	$479,126	$78,065/ton	$9,325,358	$46,627	$6,161/ton	141 tpy

BP's cost estimates are almost ten times as high as the SCR cost estimates for the same units calculated by Ecology with EPA's SCR cost spreadsheet. Ecology's analysis clearly shows that SCR at these BP Cherry Point units would be cost effective and would reduce NOx emissions by a total of 870 tons per year. Ecology states that BP did not provide the data it used to scale the cost data.[190] Thus, Ecology has found BP did not adequately support its SCR cost calculations.

Ecology did not find that the energy and non-air quality impacts of compliance with SCR should be an impediment to implementation of SCR, because the costs for the additional power needed to drive exhaust fans is included in the EPA Control Cost Manual SCR cost estimate.[191] Ecology also states that BP Cherry Point did not indicate that any equipment had a limited lifetime.[192] Ecology did state that the time necessary for compliance needed to accommodate installation during a planned shutdown to ensure reasonable costs, and Ecology states that installation of controls would likely occur in the next implementation period.[193] However, BP indicated in its four-factor submittal that currently scheduled cycle ending turnarounds for the emission units affected, which BP states vary from 2021 to 2026.[194] Thus, Ecology could ensure installation of SCR during the second implementation period and coordinate the installation with planned shutdowns at BP Cherry Point.

Ecology points out in its draft plan that the National Park Service has issued a finding to Ecology stating that emissions from BP Cherry Point "were adversely impacting air quality related values at North Cascades and Olympic National Parks."[195] Thus, Ecology should prioritize regional haze controls at the BP Cherry Point refinery to not only address regional haze but also to address visibility impairment at these parks which the National Park Service has reasonably attributed to the BP Cherry Point refinery. Ecology has found that SCR is cost effective for the

---

189 Data from WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 189-190 (Tables 7-8, 7-9, and 7-10).
190 WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 191.
191 *Id.*
192 *Id.*
193 *Id.*
194 *Id.*, Appendix P at P-12 (BP Cherry Point Four-Factor Submittal).
195 *Id.* at 188.

reformer heaters, crude heater, and the hydrogen plant reforming furnaces to reduce NOx emissions by 90% from these emission units. Ecology should include these control requirements in its regional haze plan for the second implementation period.

3. Marathon Petroleum Company (MPC) Anacortes Refinery (Formerly Tesoro Refinery)

The Anacortes Refinery is currently owned by Marathon Petroleum Company (MPC) and was previously owned by Tesoro Refining & Marketing Company LLC (Tesoro, which Ecology also refers to as "Tesoro Northwest Company"[196]). Ecology calculated a Q/d value for the Tesoro Anacortes Refinery of 30.7, and it is ranked 6th highest Q/d on Ecology's list of sources it evaluated.[197] NPCA data shows that the facility likely impacts regional haze at 10 Class I areas.[198] Tesoro submitted a four-factor analysis of controls for the Anacortes facility on April 29, 2020.[199] In Ecology's review of NOx emission rates per 1,000 barrels per day (bpd) production rate at refineries nationwide, the Anacortes refinery formerly owned by Tesoro was at the highest emitter of NOx at 16.12 tons per year per 1,000 bpd production, which was two to five times as high as the NOx emissions per 1,000 bpd at all other refineries in the United States that Ecology reviewed.[200]

Tesoro submitted a four-factor analysis for FCCU and boilers and heaters greater than 40 MMBtu/hr. Specifically, Tesoro submitted a four-factor analysis for the following emission units at the refinery:

- Crude Heater 2
- Vacuum Flasher Heater
- CCU Feed Heater
- DHT Feed Heater
- Boiler 1
- Boiler 2
- Boiler 3
- NHT Feed Heater
- NHT Column C-6600 Reboiler
- CR Feed Heaters
- CO Boiler 2
- FCCU.

Tesoro only evaluated controls for NOx. The company stated that Ecology only requested evaluations of low NOx burners/ultra-low NOx burners and SCR. The following provides comments on Tesoro's cost effectiveness analyses in its Four-Factor submittal.

---

[196] *Id.* at 185.
[197] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 161.
[198] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.
[199] *Id.*, Appendix P at P-199 through P-291.
[200] *Id.* at 185-186 (Table 7-6).

Issues with Four-Factor Analyses for Boilers and Heaters at Tesoro Refinery

1. Tesoro did not conduct four-factor analyses for any heaters or boilers that had installed NOx controls since 2005.[201] However, none of Tesoro's heaters or boilers that it exempted from a four-factor analysis have installed controls to reduce NOx emissions. Those units that it exempted include Crude Heater 1 (Unit F-101), Crude Heater 3 (Unit F-103), CGS Column C C-113 Reboiler (Unit F-104), BenSat Column C – 6601 Reboiler (Unit F-6602), and Carbon Monoxide Boiler 2 (Unit F-302).[202] Given that SCR is such a highly effective NOx control, the state should require SCR installation for these units.

2. Tesoro used 2014 as the baseline year for cost effectiveness analysis for the various emission units, but it did not provide any analysis to show that 2014 emissions were reflective of emissions expected in 2028. EPA's regional haze guidance for the second implementation period provides that the cost effectiveness analyses for pollution controls evaluated in four-factor analyses should be based on current emissions or projected 2028 emissions.[203] The use of emissions from over six years ago needs to be justified. For example, Tesoro assumed the CCU Feed Heater, Unit F-301, only operated 839 hours per year.[204] The Crude Heater 2 (Unit F-102) and the Vacuum Flash Heater (F-201) were evaluated at operational levels over 8,000 hours per year, whereas most other units were evaluated at lower operating hours in the range of 4,600-5,500 hours per year.[205] The annual hours of operation define how much pollution is emitted in a year and thus how much pollution can be decreased with a particular control being evaluated, which can greatly impact the cost effectiveness of a pollution control. Thus, the state should ensure that the assumptions are reasonable projections of emissions in 2028.

3. In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate. The current bank prime rate is 3.25%. Yet, much higher interest rates were used in amortizing capital costs of controls evaluated in the four-factor analyses. Tesoro used an interest rate of 5.5%. In a cost effectiveness analyses being done today, even a 5.5% interest rate is unreasonably high, given the current bank prime lending rate of 3.25%. Use of a higher interest rate results in higher annualized capital costs.

4. In the SCR cost analyses, a very high and unjustified cost of ammonia was assumed of $900/ton.[206] No basis was cited for this cost. The company calculated a cost per gallon for 19.5% aqueous ammonia of $3.513 per gallon.[207] Yet, EPA's SCR Control Cost Manual chapter assumes a much lower cost for 29% aqueous ammonia of $0.293/gallon, based on the average cost for ammonia for 2016 from the U.S. Geological Survey's

---

[201] *Id.*, Appendix P at P-207 (Tesoro Four-Factor Analysis).
[202] *Id.*
[203] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[204] Tesoro Four-Factor Analysis at pdf page 39 (Appendix A at F-301).
[205] WDOE, Public Review Draft, Second Regional Haze Plan, Appendix P, Tesoro Four-Factor Analysis at Appendix A in SCR cost spreadsheets for Units F-652, F-751, F-752, F-753, F-6600, F-6650/1/2/3, F-6601, and F-304.
[206] *Id.* at P-224 (Tesoro Four-Factor Analysis, Appendix A at F-102)
[207] *Id.*

Minerals Commodities Summaries for which EPA provided a weblink.[208] The U.S. Geological Survey Minerals Commodities Report currently lists the 2020 average cost for ammonia at $220/ton.[209] Thus, Tesoro's costs of ammonia reagent were greatly overstated. It is also not clear why only 19.5% aqueous ammonia was considered as a reagent. EPA's Control Cost Manual states that 29% aqueous ammonia is the more commonly used form of aqueous ammonia.[210] Use of anhydrous ammonia is the least expensive form of the reagent and is commonly used at utility installations.[211] The State must evaluate the most cost-effective approaches to controlling NOx emissions with SCR and must not use a wholly unjustified and very high cost for ammonia of $900/ton.

5. Tesoro's cost effectiveness evaluations of SCR used the EPA SCR cost spreadsheet that has been made available with its SCR Control Cost Manual chapter for all units except for the FCCU for which Tesoro used a cost estimate from a similar installation.[212] For the FCCU, only a one-page printout of an apparent spreadsheet was provided for review. The State should not accept cost effectiveness calculations without the underlying data and assumptions, so it can ensure that the cost analysis is consistent with the methodology of EPA's Control Cost Manual and that the assumptions for items such as reagent and catalyst costs are reasonable. In addition, EPA states "[i]f a cost quote or opinion prepared for one source is adopted or adapted to another source, EPA recommends the state explain in its SIP submittal how the source for which the original cost estimate was made is relevant to estimating the cost of compliance for the source in question."[213]

6. With respect to the use of EPA's cost spreadsheet for SCR, there is one entry made by Tesoro into the EPA cost spreadsheet that ultimately defines the size of the SCR reactor, and that is the "base case fuel gas volumetric flow rate factor" which is in units of ft^3/min-MMBtu/hr. These numbers seem very high in comparison to the values EPA uses for coal-fired boilers for which EPA defines as a constant for fuel type regardless of unit size or actual gas throughput.[214] Tesoro's fuel gas volumetric flow rate factors for each combustion turbine are roughly a factor of 100 higher than the fuel gas volumetric flow rate factors of 484-547 cubic ft^3/min-MMBtu/hour (depending on coal type) used by EPA in its SCR cost spreadsheet for coal-fired boilers.[215] If the state may rely on that information, Ecology must request documentation and justification for the base case fuel gas volumetric flow rate factors used by Tesoro.

7. Tesoro assumed NOx control efficiencies across the SCRs of 90%-96% for most boilers and heaters, with the exception of Boiler 3 (F-753) for which Tesoro only assumed a

[208] See EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[209] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 116, available at https://www.usgs.gov/centers/nmic/mineral-commodity-summaries.
[210] EPA, Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 15.
[211] *Id.* at pdf page 5.
[212] Tesoro Four-Factor Analysis at Appendix A.
[213] U.S. EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, August 20, 2019, at 32.
[214] EPA Control Cost Manual, Section 4, Chapter 2 Selective Catalytic Reduction at pdf page 59, Table 2.6.
[215] Compare values used for flue gas volumetric flow rate factors in Draft Washington Regional Haze Plan, Appendix P, in Appendix A of Tesoro's Four-Factor Analyses to Table 2.6 of EPA's Control Cost Manual, Section 4, Chapter 2 Selective Catalytic Reduction.

control efficiency of 75%.[216] No justification was provided for assuming a much lower than typical NOx removal rate across the SCR.

8. With respect to the cost evaluations for ULNB for the heaters and boilers, Tesoro only assumed a 20-year life of controls in determining the amortizing the capital costs of control.[217] There was no basis provided for only assuming a 20-year life of ULNB.[218] If ULNB only have a life of 20-years, then the State should not exempt any boiler or heater from a four-factor analysis if it has installed controls by 2005 as claimed by Tesoro,[219] because the low NOx burners installed at Crude Heater 1 (F-101), Crude Heater 3 (F-103), CGS Column C-113 Reboiler (F-104), BenSat Column C-6601 Reboiler (F-6602), and Carbon Monoxide Boiler 1 (F-302)[220] will be at the end of their useful lives during the second planning period. Ultra-low NOx burners should have a useful life 25-30 years or more. In evaluations of BART for natural gas and oil-fired utility boilers, EPA evaluated combustion controls such as low NOx burners and SCR at lifetimes of 30 years.[221] In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR.[222] Thus, the State should not allow the use of a useful life of an ULNB any less than 25 years for the Tesoro units.

9. Tesoro did not provide justification for the NOx emission rate for the ULNBs. For most units, Tesoro assumed a 0.04 lb/MMBtu achievable NOx rate with ULNB.[223] Yet, the CGH Heater F-104, which has ULNBs,[224] is subject to a NOx limit of 0.035 lb/MMBtu.[225] The State should thus require an evaluation of ULNBs to meet a similar 0.035 lb/MMBtu NOx rate. For Units F-751 and F-752 which are boilers, a much higher NOx rate of 0.11 lb/MMBtu was assumed for ULNB.[226] Yet, Unit F-753 which is also a boiler of similar size to Units F-751 and F-752 but which has been retrofitted with low NOx burners and internal flue gas recirculation (IFGR),[227] Tesoro assumed a NOx rate of 0.04 lb/MMBtu in its evaluation of SCR cost effectiveness[228] which presumably reflects its current emission rate. Thus, Tesoro's evaluation of ULNBs for Units F-751 and F-752

---

[216] WDOE, Public Review Draft, Second Regional Haze Plan, Appendix P, Tesoro Four Factor Analysis, Appendix A, SCR spreadsheet printouts.
[217] *Id.* at P-284 to P-291.
[218] *Id.* at P-219.
[219] *Id.* at P-207.
[220] *Id.*
[221] *See*, e.g., EPA's proposed action on Arkansas' Regional Haze Implementation Plan in which EPA assumed a 30-year life for combustion controls including LNB, SNCR, and SCR at a 30-year life for a natural gas- and oil-fired power plant, Bailey Unit 1, and the natura gas- and oil-fired McClellan power plant. 80 Fed. Reg. 18944 at 18953, 18960 (Apr. 8, 2015).
[222] WDOE, Public Review Draft, Second Regional Haze Plan, Appendix P, at P-15 (BP Cherry Point Four-Factor Analysis).
[223] *Id.,* Appendix P at P-284 to P-291 (Tesoro Four-Factor Analyses).
[224] *Id.* at P-207 to P-208.
[225] January 26, 2010 Air Operating Permit #013R1 for Tesoro Refining and Marketing Company at 72 (Permit Term 5.2.13).
[226] WDOE, Public Review Draft, Second Regional Haze Plan, Appendix P at P-287 to P-288 (Tesoro Four-Factor Analyses).
[227] *Id.* at P-211.
[228] *Id.*at P-262.

should have evaluated cost effectiveness to meet a similar NOx rate as has been achieved at Unit F-753 with a similar control.

10. Tesoro did not evaluate the cost effectiveness of the most effective control – ULNB plus SCR.

In its public review draft regional haze plan, Ecology presented SCR cost effectiveness evaluations for seven emission units at the Anacortes refinery (FCCU, F102 Crude Heater, F201 Vacuum Flasher Heater, F6650 CAT Reformer Heater, F751 Main Boiler, and F752 Main Boiler).[229] Ecology's cost effectiveness analyses were based on EPA's SCR cost spreadsheet, and it appears Ecology relied on the default cost assumptions of the EPA spreadsheet (such as the cost of ammonia and catalyst replacement cost).[230] Ecology assumed 90% NOx reduction with SCR, and Ecology assumed a 25 year life and a 3.25% interest rate in amortizing capital costs of control. The cost differences between Ecology's cost estimates based on EPA's Control Cost Manual Spreadsheet and Tesoro's are very significant, as shown in the tables below. Note that Ecology refers to the cost estimates as "MPC" cost estimates, but the cost estimates are from Tesoro's April 20, 2020 Four-Factor Analysis of controls, which is in Appendix P of Ecology's draft regional haze plan.

Table 6 shows the differences in Tesoro's and Ecology's calculated capital costs and annual maintenance costs for SCRs at the FCCU and at the F102 Crude Heater, to show how significant the cost differences are between Tesoro and Ecology. This information was provided in and discussed in Ecology's draft regional haze plan.[231] Note that Ecology states that Tesoro's (MPC's) cost is based on SNCR controls at 60% NOx removal efficiency.[232] However, that appears to be in error. A review of Tesoro's four-factor analysis shows that the Tesoro cost numbers (labeled as MPC cost numbers in the draft plan) are reflective of SCR costs (not SNCR) to achieve 89.7% NOx control (not 60% control) and 833.10 tons per year of NOx reduction.[233]

Table 7 further below shows the difference in cost of SCR per ton of NOx removed between Tesoro and Ecology's cost analyses for all other units for which Ecology evaluated SCR costs. The differences in capital costs and maintenance costs of the units other than the FCCU and the F102 Crude Heater were not discussed in the narrative section of Ecology's draft plan but are provided in Appendix P of Ecology's draft second regional haze plan.[234] The differences in calculated SCR costs/ton of NOx removed make clear that Tesoro's costs are significantly higher than the costs calculated by Ecology using the EPA SCR cost spreadsheet provided with EPA's Control Cost Manual.

---

[229] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 199.
[230] Based on a review of the tables with heading "EPA Cost Control Estimates Compared to Refinery Estimates for SCR 8/18/2020, Refineries Regional Haze Review – Tesoro" in Appendix P of the WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at P-347 to P-354.
[231] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021 at 199-200.
[232] *Id.* at 200.
[233] *Id.*, Appendix P at P-223.
[234] Ecology's specific cost data in Appendix P is difficult to ascertain from what appear to be printed tables from a spreadsheet that span several pages.

Table 6. Summary from Draft Washington Regional Haze SIP, SCR Cost Analysis for the FCCU and the F102 Crude Heater at the Anacortes Refinery – Comparison of Tesoro's (MPC's) Cost Analysis to Ecology's Cost Analysis[235]

Tesoro's Capital Cost	Tesoro's Maintenance Costs ($/yr)	Tesoro's Cost Effectiveness, $/ton	WDOE's Capital Cost	WDOE's Maintenance Costs ($/yr)	WDOE's Cost Effectiveness	NOx Reduced, tpy
FCCU						
$114,030,975	$570,155	$14,381/ton	$10,286,436	$51,432	$1,159/ton	843.3 tpy
F102 Crude Heater						
$20,876,000	$104,380	$16,086/ton	$5,084,927	$25,425	$2,962/ton	147.6 tpy

Table 7. Comparison of SCR Cost Effectiveness as Calculated by Tesoro to SCR Cost Effectiveness Calculated by Ecology for Certain Emission Units at the Anacortes Refinery[236]

Anacortes Refinery Emission Unit	Tesoro's Cost Effectiveness, $/ton	WDOE's Cost Effectiveness, $/ton	NOx Reduced with SCR, tpy
FCCU	$14,381/ton	$1,159/ton	843.3 tpy
F102 Crude Heater	$16,086/ton	$2,962/ton	147.6 tpy
F201 Vacuum Heater	$35,276/ton	$7,589/ton	57.6 tpy
F6650 CAT Reformer Heater	$21,196/ton	$3,736/ton	117 tpy
F6651 CAT Reformer Heater	$21,196/ton	$3,520/ton	124.2 tpy
F751 Main Boiler	$10,060/ton	$2,159/ton	202.5 tpy
F752 Main Boiler	$10,513/ton	$2,570/ton	170.1 tpy

For SCR at the FCCU, Tesoro's cost estimates are roughly ten times as high as the SCR cost estimates for the same units calculated by Ecology with EPA's SCR cost spreadsheet. Ecology's analysis clearly shows that SCR at the FCCU would be cost effective at $1,159/ton and would reduce NOx emissions by 843 tons per year. For the F102 Crude heater, Ecology states that MPC (Tesoro) "incorrectly changed the default value for the Ft^3/min-MMBtu/hr input to the EPA Control Cost manual for all their determinations other than the FCCU."[237] That issue is discussed in Comment 6 above. Thus, Ecology has found Tesoro (MPC) did not adequately support its SCR cost calculations. Ecology's SCR cost estimates are much lower than Tesoro's (MPC's) for all of the emission units listed in Table 6 above. Assuming Ecology is using a $6,300/ton cost effectiveness threshold for refineries as it has proposed for the pulp and paper

[235] Data from WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 189-190 (Tables 7-8, 7-9, and 7-10).
[236] *Id.* at 199.
[237] *Id.* at 200.

industry,[238] SCR must be considered a cost effective control for all units listed in Table 6 above except the F201 Vacuum Heater. Those cost effective SCR installations could collectively reduce NOx emissions from the Anacortes Refinery by 1,604.7 tons per year.

Ecology did not find that the energy and non-air quality impacts of compliance with SCR should be an impediment to implementation of SCR, because the costs for the additional power needed to drive exhaust fans is included in the EPA Control Cost Manual SCR cost estimate.[239] Ecology also states that MPC (Tesoro) did not indicate that any equipment had a limited lifetime.[240] Ecology did state that the time necessary for compliance needed to accommodate installation during a planned shutdown to ensure reasonable costs, and Ecology states that installation of controls would likely occur in the next implementation period.[241] However, if Ecology met the requirements of EPA's regional haze regulations and included final determinations to require SCR in this regional haze plan for the second implementation period, many of these SCR installations could occur during the second implementation period and be coordinated with maintenance outages at the Anacortes refinery.

Ecology points out in its draft plan that the Federal Land Managers have "made comments regarding the impacts to the Olympic [National Park] Class I area" in the context of commenting on a PSD permit for the Tesoro Anacortes Refinery.[242] Indeed, the National Park Service's 2017 comments stated that Tesoro Anacortes refinery contributed significantly to visibility impairment at North Cascades National Park and at Olympic National Park, and the Park Service noted that the refinery should be considered for controls in the next regional haze plan.[243] It is not clear whether these comments constituted a determination of reasonably attributable visibility impairment. Nonetheless, Ecology should prioritize regional haze controls at the MPC Anacortes refinery to not only address regional haze but also to address visibility impairment at Olympic National Park attributable to the refinery. Ecology has found that SCR is cost effective for the FCCU, CAT reformer heaters, main boilers, and the F102 crude heater. Ecology should include these control requirements in its regional haze plan for the second implementation period.

4. Shell Puget Sound Refinery

The Shell Puget Sound Refinery is another refinery located near Anacortes, Washington. Ecology calculated a Q/d value for the BP Cherry Point facility of 24.5.[244] NPCA data shows that the facility can potentially impact regional haze at 8 Class I areas.[245] Shell submitted a four-factor analysis evaluating NOx controls for its FCCU and boilers and heaters greater than 40

---

[238] *Id.* at 182.
[239] *Id.* at 201.
[240] *Id.*
[241] *Id.*
[242] *Id.* at 198.
[243] April 27, 2017 Letter from the National Park Service to the Washington Department of Ecology at 4, attached as Ex. 11.
[244] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 161.
[245] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.

MMBtu/hr. The company stated that Ecology only requested evaluations of LNB/ULNB and SCR.[246] The units that Shell evaluated NOx controls for include the following:

- Vacuum Pipe Still (VPS) Charge Heater 1
- VPS Charge Heater 2
- Vacuum Tower Heater
- Delayed Coking Unit (DCU) Charge Heater
- Hydrotreater Unit 1 (HTU1) Charge Heater
- HTU1 Fractionator Reboiler
- HTU2 Stripper Reboiler
- Hydrotreater Unit 2 (HTU2) Fractionator Reboiler
- Catalytic Reforming Unit #2 (CRU2) Charge Heater
- CRU2 Interheater #1
- CRU2 Stabilizer Reboiler
- Erie City Boiler #1
- Cogen Gas Turbine Generator (GTG) Heat Recover Steam Generator (HRSG) with duct burners (GTG1, GTG2, and GTG3)

Shell states that Ecology narrowed the request to only LNB/ ULNB and SCR. Shell analyzed the cost effectiveness of LNB/ULNB and SCR for these units.

Shell concludes that SCR is not a cost-effective control for NOx emissions at the refinery.[247] Shell indicates that the cost-effectiveness of LNB is much lower than those of SCR. However, Shell argues that a more thorough, unit-specific evaluation by vendors will be required to determine if the installation of low-NOx is technically feasible and cost-effective.[248] It must be noted that several of the units listed above already have LNBs installed, as do some additional units at the Shell refinery which were not evaluated in the four-factor analysis. The following provides comments on Shell's cost effectiveness analyses in its Four-Factor submittals.

Issues with Four-Factor Analyses for Shell Puget Sound Refinery

1. Shell used 2019 emissions as baseline and stated that 2019 "is representative of the anticipated actual emissions in the near future."[249] Shell identifies the 2019 baseline emissions for NOx as 592.6 tons per year for "all applicable units."[250] It is not clear whether this includes all NOx emissions at the source, but emissions data provided in Ecology's draft second regional haze implementation plan for the years 2011 through 2018 show much higher NOx emissions, ranging from 1,054 tons per year to 1,409 tons per year.[251] EPA states that generally, baseline emissions for pollution control analyses should be based on a recent period of historical emissions. If a company is proposing that 2028 emissions will be significantly lower than past historical emissions, there must be a documented basis for that assumption such as enforceable requirements or a

[246] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P-138 (Shell Puget Sound Refinery Four-Factor Analysis).
[247] *Id.* at P-148.
[248] *Id.*
[249] *Id.* at P-142.
[250] *Id.*
[251] *Id.* at 84 (Table 4-8).

documented commitment to participate in energy efficiency or renewable energy programs.[252] Ecology has indicated that 2014 emissions of 1,230 tons per year are the representative baseline NOx emissions and the expected 2028 emissions for the Shell refinery.[253] Given that Shell has not provided documentation to indicate that the much lower NOx baseline of 592.6 tons per year that it relied on as reflective of 2028 emissions is based on enforceable limits or other documented and verifiable commitments, the state is justified in assuming 2014 NOx emissions are reflective of 2028 emissions for the Shell Puget Sound Refinery.

2. In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate. The current bank prime rate is 3.25%. Yet, much higher interest rates were used in amortizing capital costs of controls evaluated in the four-factor analyses. Shell used an unreasonably high interest rate of 7%.[254] In a cost effectiveness analyses being done today, an interest rate of 3.25% must be used to be consistent with EPA's Control Cost Manual. Use of a higher interest rate results in significantly higher annualized capital costs.

3. For all units except the Erie City Boiler, the Shell cost effectiveness analyses assumed a 20-year life of controls.[255] No justification has been included in Shell's four-factor analysis for only assuming a 20-year life of controls in the cost-effectiveness analyses. As previously stated, in evaluations of BART for natural gas and oil-fired utility boilers, EPA evaluated combustion controls such as low NOx burners and SCR at lifetimes of 30 years.[256] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years.[257] In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR.[258] Thus, the State should not allow the use of a 20-year useful life of a LNB or an SCR to be assumed in the cost effectiveness analyses for any of the Shell units, with one possible exception being the Erie City Boiler 1 (ECB1).

4. With respect to the remaining useful life of the Erie City Boiler 1, Shell provided brief information for this boiler that "substantial upgrades will be required to replace the boiler's refractory and the boiler skin" and that "the remaining useful life of the unit is

[252] *See* U.S. EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, August 20, 2019, at 29.
[253] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 84 (Table 4-8).
[254] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P-146.
[255] *Id.* at P-196.
[256] *See*, e.g., EPA's proposed action on Arkansas' Regional Haze Implementation Plan in which EPA assumed a 30-year life for combustion controls including LNB, SNCR, and SCR at a 30-year life for a natural gas- and oil-fired power plant, Bailey Unit 1, and the natura gas- and oil-fired McClellan power plant. 80 Fed. Reg. 18944 at 18953, 18960 (Apr. 8, 2015).
[257] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[257] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 80.
[258] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P4, P-15, and Attachment B of the BP Cherry Point Four-Factor Analysis.

expected to be less than 10 years."[259] The company assumed 8 years in its four-factor analysis for the Erie City Boiler.[260] Importantly, Shell did not indicate that it would be retiring Erie City Boiler 1. If Shell plans on these substantial upgrades to the boiler, then Ecology should not consider this boiler as having a shortened remaining useful life in the NOx control cost effectiveness analyses. If the company is planning to retire and replace the boiler within the next 8 years, then Ecology should impose an enforceable retirement date for the boiler.[261] Ecology should also require that any replacement boiler should, at the very least, be equipped with state-of-the-art NOx controls. The Erie City Boiler 1 currently has no controls and, at 182.4 tons per year, has the highest emissions of NOx of any of the units evaluated in Shell's four-factor analysis. Ecology should not allow this unit or its replacement to avoid controls because it is either going to be reconstructed or removed from service in the next 8-10 years.

5. In its four-factor analysis, Shell assumed that LNB would only achieve a NOx emission rate of 0.06 lb/MMBtu. Shell provided no justification for assuming such a high NOx emission rate with LNB. As was discussed above, NOx emission limits for refinery heaters and boilers reflective of LNB/ULNB are typically set at 0.040 lb/MMBtu or lower.[262] In fact, one unit at the Shell Puget Sound refinery, the 95 MMBtu/hour CDHDS Heater in the Hydrotreater Unit #3, which was constructed in 2003, is subject to a NOx limit of 0.035 lb/MMBtu with an LNB for NOx control.[263] It is also worth noting that Tesoro evaluated LNB/ULNB to meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.[264]

6. For SCR, Shell used the EPA SCR cost spreadsheet made available with EPA's recent update to its SCR chapter of the Control Cost Manual. However, Shell applied a very high retrofit factor of 1.5 to each SCR evaluation, without providing any justification for any retrofit factor much less a retrofit factor that increases SCR costs by 50%. The cost algorithms in EPA's SCR cost spreadsheet are based on the average SCR retrofit costs for utility boilers, which often have retrofit difficulties and additional costs. Thus, some retrofit difficulty is already built into the costs of EPA's SCR cost spreadsheet. Ecology must scrutinize the use of any retrofit factor. EPA's SCR cost spreadsheet already adds a retrofit factor of 20% compared to the cost of SCR installation at a new unit for SCR retrofits at existing units.[265] EPA's Control Cost Manual states that higher retrofit factors than 1 can be used "provided the reasons for using a higher retrofit factor are appropriate <u>and fully documented</u>."[266] No unit-specific documentation of the justification for higher SCR retrofit factors was included in Shell's four-factor submittal.

---

[259] *Id.* at P-148 (Shell Four-Factor Analyses).
[260] *Id.*
[261] *See* EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 20, which states that a state "may be able to justify not selecting a source for analysis of control measures because there is an enforceable requirement for the source to cease operation by a date after 2028."
[262] *See* Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, at 139-144. (Ex. 10.)
[263] May 5, 2015 Air Operating Permit AOP 014R1M1 for Shell Puget Sound Refinery at 13 and 127.
[264] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P-222 to P-291 (Appendix A of Tesoro Four-Factor Analysis).
[265] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 66.
[266] *Id.* (emphasis added)

7. Shell appears to have assumed that that the gas stream of each heater/boiler would need to be reheated to accommodate SCR.[267] However, Shell did not provide any data on each of the units for which these costs were included in the SCR cost effectiveness to indicate that reheating the gas stream to accommodate SCR operation is necessary. Ecology must request further information before it can justify the inclusion of these costs for reheating the gas stream for each of the emission units at the Shell refinery.

In its public review draft regional haze plan, Ecology presented SCR cost effectiveness evaluations for three emission units at Shell Puget Sound Refinery (Boiler #1 Erie City- 31G-F1, FCCU Regenerator Unit, and CRU2 Heater and Interheaters).[268] Ecology's cost effectiveness analyses were based on EPA's SCR cost spreadsheet, and it appears Ecology relied on the default cost assumptions of the EPA spreadsheet (such as the cost of ammonia and catalyst replacement cost).[269] Ecology assumed 90% NOx reduction with SCR, and Ecology assumed a 25 year life and a 3.25% interest rate in amortizing capital costs of control. The cost differences between Ecology's cost estimates based on EPA's Control Cost Manual Spreadsheet and Shell's are significant, as shown in the table below.

Table 8 shows the differences in Shell's and Ecology's calculated capital costs and annual maintenance costs for SCRs at the Boiler #1 Erie City, FCCU Regenerator Unit, and the CRU2 Heater, to show how significant the cost differences are between Shell and Ecology. This information was provided in and discussed in Ecology's draft regional haze plan.[270]

Table 8. Comparison of SCR Cost Effectiveness as Calculated by Shell to SCR Cost Effectiveness Calculated by Ecology for Certain Emission Units at the Shell Puget Sound Refinery[271]

Puget Sound Refinery Emission Unit	Shell's Cost Effectiveness, $/ton	WDOE's Cost Effectiveness, $/ton	NOx Reduced with SCR, tpy
Erie City Boiler 1	$12,511/ton	$2,441/ton	179 tpy
FCCU Regenerator Unit	Not Evaluated	$1,948/ton	521 tpy
CRU2 Charge Heater/Interheaters	$10,813/ton	$6,346/ton	69 tpy

For SCR at Erie City Boiler 1, Shell's cost estimates are more than five times as high as the SCR cost estimates for the same units calculated by Ecology with EPA's SCR cost spreadsheet.

---

[267] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P Shell Four-Factor Analysis at Appendix B.
[268] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 195.
[269] Based on a review of the tables with heading "EPA Cost Control Estimates Compared to Refinery Estimates for SCR 8/18/2020, Refineries Regional Haze Review – Tesoro" in Appendix P of the WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at P-347 to P-354.
[270] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021 at 195-196.
[271] *Id.* at 195.

Ecology did not take into account a shortened remaining useful life of the boiler in its SCR cost effectiveness analysis, as Shell did. Ecology states "With an eight-year lifetime, a requirement for the boiler to be retired after this period would be justified and the boiler should be required to decommission. Any new boiler brought in to replace it would need to go through the permitting process as a new source."[272] Ecology stated in the draft regional haze plan that it will work with the Northwest Clean Air Agency "to have a regulatory order on the boiler to shut down by January of 2028."[273] It is not clear why such a regulatory order has not been established and included as part of this regional haze plan. Ecology should not allow the Erie City boiler to avoid regional haze controls without making the decommissioning and the requirement to obtain a permit for any replacement boiler as a new source (meaning not allowing a replacement boiler to "net out" of permitting review) enforceable requirements.

Shell did not evaluate controls for the FCCU regenerator unit, but Ecology did and found that SCR at that unit would be cost effective at $1,948/ton and would reduce NOx by 521 tpy. Ecology's analysis clearly shows that SCR at the FCCU would be cost effective. Ecology's analysis of SCR cost effectiveness at the CRU#2 heater and interheaters also shows that the cost effectiveness is reasonable.

Ecology did not find that the energy and non-air quality impacts of compliance with SCR should be an impediment to implementation of SCR, because the costs for the additional power needed to drive exhaust fans is included in the EPA Control Cost Manual SCR cost estimate.[274] Ecology did not indicate that Shell had stated that any equipment had a limited lifetime other than Erie City Boiler 1.[275] Ecology did state that the time necessary for compliance needed to accommodate installation during a planned shutdown to ensure reasonable costs, and Ecology states that installation of controls would likely occur in the next implementation period.[276] However, if Ecology met the requirements of EPA's regional haze regulations and included final determinations to require SCR in this regional haze plan for the second implementation period, these SCR installations could occur during the second implementation period and be coordinated with maintenance outages at the Shell Puget Sound refinery. Ecology found that the Shell Puget Sound Refinery had the second highest NOx emissions per 1,000 bpd production of all of the eighty-four refineries nationwide that it evaluated.[277] Ecology has found that SCR is cost effective for Erie City Boiler 1, the FCCU, regenerator unit, and the CRU #2 heater and interheaters. Ecology should include these control requirements (or, for Eric City Boiler 1, a requirement to be decommissioned by 2028) in its regional haze plan for the second implementation period.

---

272 *Id.* at 195-196.
273 *Id.* at 197.
274 *Id.* at 197.
275 *Id.*
276 *Id.*
277 *Id.* at 185.

5. Phillips 66 Ferndale Refinery

Ecology calculated a Q/d value for the BP Cherry Point facility of 10.9.[278] NPCA data shows that the facility impacts regional haze at 5 Class I areas.[279] Phillips 66 provided four-factor analyses of NOx controls for the following emission units at its Ferndale Refinery:[280]

- Crude Heater
- Crude Heater
- Alky Heater
- Reformer - Pretreater heater
- Reformer heater
- Reformer heater
- Reformer heater
- Reformer heater
- #1 Boiler
- #2 Boiler
- #3 Boiler
- DHT Heater
- S-Zorb Heater.

Phillips 66 states that Ecology narrowed the request to only LNB/ ULNB and SCR.[281] Phillips 66 analyzed the cost effectiveness of LNB/ULNB and SCR for these units and concluded that neither SCR nor LNB are cost-effective control for NOx emissions reductions at the refinery.[282] The following provides comments on the four-factor analyses submitted by Phillips 66.

Deficiencies and shortcomings in the Phillips 66 Analyses are as follows:

1. Phillips 66 used a five-year average of annual emissions from 2014-2018 as baseline emissions.[283] EPA's regional haze guidance for the second implementation period provides that the cost effectiveness analyses for pollution controls evaluated in four-factor analyses should be based on current emissions or projected 2028 emissions. Ecology has indicated that 2014 emissions of 723 tons per year are the representative baseline NOx emissions and the expected 2028 emissions for the Phillips 66 Ferndale

---

[278] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 161.
[279] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.
[280] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P37 to P-85 (Phillips 66 June 2020 Four-Factor Analysis). Note that Phillips 66 originally submitted its four-factor analysis in April of 2020 (also in Appendix P), but it revised the analysis in June 2020 because it claimed that "the burners currently in operation for the alkylation heater (17F-1) and the DHT heater (33F-1) are considered low-NOx burners," and thus Phillips 66 excluded LNBs as a control to be evaluated for these units. *See* June 29, 2020 cover letter to Phillips 66 June 2020 Four-Factor Analysis.
[281] *Id.* at P-43.
[282] *Id.*
[283] *Id.* at P-49.

refinery.[284] The state should ensure that the emission assumptions are reasonable projections of emissions in 2028.

2. In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate. The current bank prime rate is 3.25%. Yet, much higher interest rates were used in amortizing capital costs of controls evaluated in the four-factor analyses. Phillips 66 used an unreasonably high interest rate of 7%. In a cost effectiveness analyses being done today, an interest rate of 3.25% must be used to be consistent with EPA's Control Cost Manual. Use of a higher interest rate results in significantly higher annualized capital costs.

3. For all units, the Phillips 66 cost effectiveness analyses assumed a 20-year life of controls.[285] No justification has been included in Phillip 66's four-factor analysis for only assuming a 20-year life of controls in the cost-effectiveness analyses. As previously stated, in evaluations of BART for natural gas and oil-fired utility boilers, EPA evaluated combustion controls such as low NOx burners and SCR at lifetimes of 30 years.[286] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years. In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR. Thus, the State should not consider a useful life of a LNB or an SCR to be less than 25 years in the cost effectiveness analyses for any of the Phillips 66 units.

4. Phillips 66 assumed high NOx rates with LNB in the range of 0.09 to 0.23 lb/MMBtu.[287] As was discussed above, NOx emission limits for refinery heaters and boilers reflective of LNB/ULNB are typically set at 0.040 lb/MMBtu or lower.[288] In fact, one unit at the Shell Puget Sound refinery, the 95 MMBtu/hour CDHDS Heater in the Hydrotreater Unit #3, which was constructed in 2003, is subject to a NOx limit of 0.035 lb/MMBtu with an LNB for NOx control.[289] It is also worth noting that Tesoro evaluated LNB/ULNB to meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.[290] Moreover, the #1 boiler, the DHT Heater, and the S-Zorb heater at the Phillips 66 refinery, which all have LNB, have baseline NOx emission rates in the range of 0.031 to 0.042 lb/MMBtu, per Phillips 66 SCR cost effectiveness analysis.[291]

---

[284] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, at 84 (Table 4-8).
[285] *Id.* at P-78 (Appendix B of Phillips 66 June 2020 Four-Factor Analysis).
[286] *See*, e.g., EPA's proposed action on Arkansas' Regional Haze Implementation Plan in which EPA assumed a 30-year life for combustion controls including LNB, SNCR, and SCR at a 30-year life for a natural gas- and oil-fired power plant, Bailey Unit 1, and the natural gas- and oil-fired McClellan power plant. 80 Fed. Reg. 18944, 18953, 18960 (Apr. 8, 2015).
[287] *Id.*
[288] *See* Stamper, V. & M. Williams, Oil and Gas Sector, Reasonable Progress Four-Factor Analysis of Controls for Five Source Categories: Natural Gas-Fired Engines, Natural Gas-Fired Turbines, Diesel-Fired Engines, Natural Gas-Fired Heaters and Boilers, Flaring and Incineration, at 139-144. (Ex. 10).
[289] May 5, 2015 Air Operating Permit AOP 014R1M1 for Shell Puget Sound Refinery at 13 and 127, available at https://nwcleanairwa.gov/?wpdmdl=6716.
[290] WDOE, Public Review Draft, Regional Haze Plan for Second Implementation Period, October 2021, Appendix P at P-222 to P-291 (Appendix A of Tesoro Four-Factor Analysis).
[291] *Id.* at P-78 to P-84.

5. Phillips 66 assumed continual operation every hour of the year (i.e., 8,760 hours per year – 100% capacity factor) in assessing reagent and other operational expenses of SCR.[292] Unless the company demonstrates that its emitting units operated 8,760 hours per year during the baseline period, this assumption results in overstated operational costs.

6. Phillips 66 included the same dollar amount for construction and management costs, contingencies, and escalation for every SCR cost analysis. Specifically, the company included costs of $3,841,150 for construction and management, $1,323,000 for contingencies, and $168,300 for escalation for each SCR cost analysis.[293] These were all identified as "indirect capital costs."[294] Such costs are typically scaled to the size of the unit, but these costs clearly have not been scaled. For many units, these costs exceed the costs of the SCR and the direct installation costs. In addition, to the extent these costs include owner's costs, such as the costs for owner activities to oversee the project regarding engineering, management, and procurement, or to fund the project, such costs must be excluded from the cost effectiveness analysis. EPA does not allow owner's costs to be included in cost effectiveness analyses under the Control Cost Manual.[295]

In its public review draft regional haze plan, Ecology presented SCR cost effectiveness evaluations for two emission units at Phillips 66 Refinery (Crude Heater 1F-1 and the FCCU/CO Boiler).[296] Ecology's cost effectiveness analyses were based on EPA's SCR cost spreadsheet, and it appears Ecology relied on the default cost assumptions of the EPA spreadsheet (such as the cost of ammonia and catalyst replacement cost).[297] Ecology assumed 90% NOx reduction with SCR, and Ecology assumed a 25 year life and a 3.25% interest rate in amortizing capital costs of control. The cost differences between Ecology's cost estimates based on EPA's Control Cost Manual Spreadsheet and Phillips 66's cost estimates are significant, as shown in the table below.

Table 9 shows the differences in Phillip 66's and Ecology's calculated capital costs and annual maintenance costs for SCRs at the Crude Heater 1F-1, demonstrating how significant the cost differences are between Shell and Ecology. Table 9 also shows Ecology's cost effectiveness for SCR at the FCCU/CO Boiler. Phillips 66 did not evaluate any additional controls for the FCCU because in 2006, the company modified the unit to install enhanced selective noncatalytic reduction (ESNCR).[298] Ecology evaluated SCR for the FCCU because "FCC units are a large

[292] *Id.* at P-78 to P-84.
[293] *Id.* at P-81.
[294] *Id.*
[295] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 65.
[296] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 192-193.
[297] Based on a review of the tables with heading "EPA Cost Control Estimates Compared to Refinery Estimates for SCR 8/18/2020, Refineries Regional Haze Review – Phillips 66" in Appendix P of the WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at P-369 to P-375.
[298] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, at 193

source of NOx emissions at refineries that have them."[299] Further, the addition of a catalytic reactor would work in concert with the ammonia injection system of the existing SNCR, and thus SCR would not be incompatible with the existing ESNCR system.

Table 9. Comparison of SCR Cost Effectiveness as Calculated by Phillips 66 to SCR Cost Effectiveness Calculated by Ecology for Certain Emission Units at the Phillips 66 Refinery[300]

Phillips 66 Refinery Emission Unit	Phillips 66's Cost Effectiveness, $/ton	WDOE's Cost Effectiveness, $/ton	NOx Reduced with SCR, tpy
Crude Heater 1F-1	$12,225/ton	$2,640/ton	166 tpy
FCCU/CO Boiler	Not Evaluated	$3,954/ton	247 tpy

For SCR at Crude Heater 1F-1, Phillips 66's cost estimates are more than five times as high as the SCR cost estimate for the same unit calculated by Ecology with EPA's SCR cost spreadsheet. Ecology commented that Phillips 66 did not supply the data they used to scale the SCR cost data.[301] Thus, Ecology has found BP did not adequately support its SCR cost calculations.

Phillips 66 did not evaluate controls for the FCCU/CO Boiler, but Ecology did and found that SCR at that unit would be cost effective at $3,954/ton and would reduce NOx by 247 tpy. Ecology's analysis of SCR cost effectiveness at the Crude Heater 1F-1 also shows that the control is cost effective.

Ecology did not find that the energy and non-air quality impacts of compliance with SCR should be an impediment to implementation of SCR, because the costs for the additional power needed to drive exhaust fans is included in the EPA Control Cost Manual SCR cost estimate.[302] Ecology did not indicate that Phillips 66 had stated that any equipment had a limited lifetime.[303] Ecology did state that the time necessary for compliance needed to accommodate installation during a planned shutdown to ensure reasonable costs, and Ecology states that installation of controls would likely occur in the next implementation period.[304] However, if Ecology met the requirements of EPA's regional haze regulations and included final determinations to require SCR in this regional haze plan for the second implementation period, these SCR installations could occur during the second implementation period and be coordinated with maintenance outages at the Phillips 66 refinery. Ecology found that the Phillips 66 Refinery had the fifth highest NOx emissions per 1,000 bpd production of all of the eighty-four refineries nationwide that it evaluated.[305] Ecology has found that SCR is cost effective for Crude Heater 1F1 and the

---

[299] *Id.*
[300] *Id.* at 192-193.
[301] *Id.* at 193.
[302] *Id.* at 193.
[303] *Id.*
[304] *Id.*
[305] *Id.* at 185.

FCCU/CO boiler. Ecology should include these control requirements in its regional haze plan for the second implementation period.

6. U.S. Oil & Refining Company – Tacoma Refinery

U.S. Oil & Refining (U.S. Oil) owns a refinery in Tacoma. According to Ecology, the facility has a Q/d value of 3.2.[306] U.S. Oil submitted a four-factor analysis of NOx controls for the following emission units:[307]

- Package Steam Boiler B-4
- Package Steam Boiler B-5
- Process Heater H-11.

U.S. Oil states that Ecology narrowed the request to only LNB/ ULNB and SCR.[308] U.S. Oil analyzed the cost effectiveness of LNB/ULNB and SCR for these units and concluded that neither SCR nor LNB are cost-effective control for NOx emissions reductions at the refinery.[309]

Deficiencies and shortcomings in the U.S. Oil Four-Factor Analyses are as follows:

1. Rather than using a level of baseline emissions based on historical emissions at the emission units of the Tacoma refinery, U.S. Oil states that it is "implementing changes during the refinery's upcoming turnaround in early 2021 that will add significantly to heat recovery, thereby reducing the fired duties of these sources."[310] Specifically, the baseline NOx emissions assumed for the three emission units evaluated are as follows:

Unit B-4 (Package Steam Boiler)	24.96 tpy NOx
Unit B-5 (Package Steam Boiler)	10.39 tpy NOx
Unit H-11 (Process Heater)	31.56 tpy NOx[311]

Ecology should request or make public how U.S. Oil's projection of future NOx emissions from these units compares to recent annual NOx emissions from these emission units.

EPA's regional haze guidance states with respect to the baseline control scenario for the control analysis that:

> Generally, the estimate of a source's 2028 emissions is based at least in part on information on the source's operation and emissions during a representative historical period. However, there may be circumstances under which it is reasonable to project that 2028 operations will differ significantly from historical emissions. Enforceable requirements are one

[306] *Id.* at 162 (Table 7-1).
[307] *Id.*, Appendix P at P-292 to P-339 (U.S. Oil Four-Factor Analysis).
[308] *Id.* at P-297.
[309] *Id.* at P-297 to P-298.
[310] *Id.* at P-303.
[311] *Id.*

> reasonable basis for projecting a change in operating parameters and thus emissions; energy efficiency, renewable energy, or other such programs where there is a documented commitment to participate and a verifiable basis for quantifying any change in future emissions due to operational changes may be another.[312]

Ecology should thus require that U.S. Oil identify the details of its changes, including providing verifiable information to quantify its projection of the future NOx emissions of these units. Further, Ecology must evaluate whether the changes at the refinery should be made into enforceable requirements, so as to ensure the refinery's continued operation at these emission rates throughout the second planning period and beyond.

2. In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate. The current bank prime rate is 3.25%. Yet, much higher interest rates were used in amortizing capital costs of controls evaluated in the four-factor analyses. U.S. Oil used an unreasonably high interest rate of 7%.[313] In a cost effectiveness analyses being done today, an interest rate of 3.25% must be used to be consistent with EPA's Control Cost Manual. Use of a higher interest rate results in significantly higher annualized capital costs.

3. For all units, the U.S. Oil cost effectiveness analyses assumed a 20-year life of controls.[314] No justification has been included in U.S. Oil's four-factor analysis for only assuming a 20-year life of controls in the cost-effectiveness analyses. As previously stated, in evaluations of BART for natural gas and oil-fired utility boilers, EPA evaluated combustion controls such as low NOx burners and SCR at lifetimes of 30 years.[315] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years. In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR. Thus, the State should not allow the use of a useful life of a LNB or an SCR to be assumed in the cost effectiveness analyses for any of the U.S. Oil units.

4. U.S. Oil assumed NOx rates with LNB in the range of 0.060 to 0.072 lb/MMBtu. As was discussed above, NOx emission limits for refinery heaters and boilers reflective of LNB/ULNB are typically set at 0.040 lb/MMBtu or lower. In fact, one unit at the Shell Puget Sound refinery, the 95 MMBtu/hour CDHDS Heater in the Hydrotreater Unit #3, which was constructed in 2003, is subject to a NOx limit of 0.035 lb/MMBtu with an LNB for NOx control. It is also worth noting that Tesoro evaluated

---

[312] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[313] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P at P-337.
[314] *Id.* at P-308.
[315] *See*, e.g., EPA's proposed action on Arkansas' Regional Haze Implementation Plan in which EPA assumed a 30-year life for combustion controls including LNB, SNCR, and SCR at a 30-year life for a natural gas- and oil-fired power plant, Bailey Unit 1, and the natura gas- and oil-fired McClellan power plant. 80 Fed. Reg. 18944 at 18953, 18960 (Apr. 8, 2015).

LNB/ULNB to meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.

5. U.S. Oil applied a 1.5 retrofit factor to the costs for both ULNB and for SCR.[316] This is a very high retrofit factor which essentially increases the capital costs of controls by 50%. Yet, U.S. Oil did not provide unit-specific information to justify the 1.5 retrofit factor applied to each ULNB and each SCR evaluation. With respect to SCR, it must be noted that the cost algorithms in EPA's SCR cost spreadsheet are based on the average SCR retrofit costs for utility boilers, which often have retrofit difficulties and additional costs. Thus, some retrofit difficulty is already built into the costs of EPA's SCR cost spreadsheet. Ecology must scrutinize the use of any retrofit factor in U.S. Oil's SCR cost estimates using EPA's SCR cost spreadsheet. EPA's SCR cost spreadsheet already adds a retrofit factor of 20% compared to the cost of SCR installation at a new unit for SCR retrofits at existing units. EPA's Control Cost Manual states that higher retrofit factors than 1 can be used "provided the reasons for using a higher retrofit factor are appropriate and fully documented." No unit-specific documentation of the justification for higher SCR retrofit factors was included in U.S. Oil's four-factor submittal. With respect to the 1.5 retrofit factor applied to the cost effectiveness evaluation of ULNBs, U.S. Oil states this factor was included "to account for the additional challenges of retrofitting a low-NOx burner in an existing heater."[317] This is not sufficient documentation to justify a retrofit factor, especially such a high retrofit factor.

6. U.S. Oil states that SCR will require flue gas reheating.[318] However, U.S. Oil did not provide any data on each of the units for which these costs were included in the SCR cost effectiveness to indicate that the current exhaust gas stream would necessitate reheating to accommodate effective SCR operation. Ecology must request further information to justify the inclusion of these costs for reheating the gas stream for each of the emission units at the Tacoma refinery before it takes such costs into consideration.

As it did with the other refineries, Ecology evaluated SCR cost effectiveness using EPA's SCR cost calculation spreadsheet made available with its Control Cost Manual for the Heater H-11. Ecology found that cost effectiveness of SCR would be $15,612/ton, which was lower than U.S Oil's calculated cost effectiveness of $18,649/ton, but Ecology still found that SCR was not cost effective for this heater.[319] However, as discussed in Comment 1 above, U.S. Oil assumed a lower baseline for its cost analysis because it is "implementing changes during the refinery's upcoming turnaround in early 2021 that will add significantly to heat recovery, thereby reducing the fired duties of these sources."[320] Ecology should require that U.S. Oil identify and verify the details of its changes, and Ecology should determine if it is necessary to make such changes in emissions into enforceable requirements.

---

[316] WDOE, Public Review Draft, Second Regional Haze Plan, October 2021, Appendix P at P-307 and at P-337 (Table B-2).
[317] *Id.* at P-337 (Table B-2).
[318] *Id.* at P-308.
[319] *Id.* at 202.
[320] *Id.* at P-303.

B. Four-Factor Analyses for the Pulp and Paper Mills

Ecology requested four-factor controls analyses for seven pulp and paper mills. The Northwest Pulp & Paper Association (NWPPA) submitted four-factor analyses for several emission units associated the following six pulp and paper mills:

- Nippon Dynawave Packaging Company Longview
- Georgia-Pacific Consumer Operations, LLC (GP Camas)
- WestRock Longview, LLC
- WestRock PC, LLC Tacoma
- Port Townsend Paper Corporation
- Packaging Corporation of America (PCA) Wallula.[321]

Cosmo Specialty Fibers submitted a separate four-factor analysis of controls.[322]

It appears that Ecology did not request or conduct a four-factor analysis for the McKinley Paper Plant which is a pulp and paper plant and for which it identified a Q/d value of 83.1, which was the second highest Q/d value of all facilities evaluated by Ecology.[323] Ecology must conduct a four-factor analysis of controls for this facility, as it greatly exceeded Ecology's Q/d threshold of 10.

Ecology states in its draft regional haze plant that the pulp and paper mills are a lower priority than refineries because they "are not located as close to each other as the refineries so they do not have as great of a cumulative effect."[324] Ecology also states that the potential reduction in regional haze emissions from pulp and paper mills is "vastly less than the potential refinery emission reductions."[325] However, the McKinley Paper Company (for which Ecology inexplicably did not conduct a four-factor analysis of controls) has the second highest Q/d value (83.1) of any facility for which Ecology requested four-factor analyses.[326] Three other pulp and paper mills are in the top ten highest Q/d values as calculated by Ecology – the WestRock Tacoma facility, the Nippon Dynawave Packaging Company in Longview, and the Pt Townshend Paper Corporation.[327] While these facilities may not all be located nearby each other, these four facilities along with Cosmo Specialty Fibers, WestRock Longview, and Georgia Pacific Consumer Operations all have Q/d values that are greater than or equal to the Q/d

---

[321] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, Appendix O at O1 through O-190 (Reasonably Available Control Technology Analysis for Washington Pulp and Paper Mills, December 2019, Northwest Pulp & Paper Association).
[322] *Id.* At O-282 to O-311 (Cosmo Specialty Fibers Four-Factor Analysis, December 2019).
[323] *Id.* at 162.
[324] WDOE Public Review Draft, Second Regional Haze Plan, October 2021, at 166.
[325] *Id.* at 167.
[326] *Id.* at 161.
[327] *Id.* at 160-161.

threshold of 10 that Ecology set for selecting sources for review. Thus, the decision to defer controls on any of these pulp and paper mills must be based on a four-factor analysis of controls, not a determination that the facilities might not have as great of a cumulative effect on regional haze as the refineries.

1. Comments on Ecology's Determination of Cost Effective Controls for the Pulp and Paper Mills

The pulp and paper mill four-factor analyses submitted by NWPPA and by Cosmo Specialty Fibers did not propose to find that any controls were cost effective. Ecology "evaluated and adjusted" these companies' cost information and provided a summary of its revised costs/ton in Appendix J of the draft regional haze SIP. Ecology's adjustments primarily included using a 3.25% interest rate for amortizing capital costs, adjusting the useful life of controls for some sources, and adjusting SNCR NOx control efficiency to 35% for some sources.[328] As will be discussed further below, further adjustments should have been made to the control cost assessments, but even with these changes, Ecology found the following controls would be cost effective based on Ecology's reasonableness cost thresholds. Ecology is assuming a NOx cost reasonableness threshold of $6,300/ton and a PM10 cost reasonableness threshold of $7,800/ton.[329] Ecology must provide justification for its cost reasonableness thresholds. Oregon has adopted a much higher regional haze control cost threshold of $10,000/ton.[330] Colorado is also using a reasonableness cost threshold of $10,000/ton.[331] New Mexico is using a reasonableness cost effectiveness threshold of $7,000/ton.[332]

[328] *Id.*, Appendix J at J-1 to J-3.
[329] *Id.* at 182-183.
[330] *See* Oregon Regional Haze State Implementation Plan for the Period 2018-2028, Aug. 27, 2021 Public Notice Draft, at 35, 45.
[331] *See* Colorado Department of Public Health and Environment, In the Matter of Proposed Revisions to Regulation No. 23, November 17 to 19, 2021 Public Hearing, Prehearing Statement, at 7, available at https://drive.google.com/drive/u/1/folders/1TK41unOYnMKp5uuakhZiDK0-fuziE58v.
[332] *See* NMED and City of Albuquerque, Regional Haze Stakeholder Outreach Webinar #2, at 12, available at https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2017/01/NMED_EHD-RH2_8_25_2020.pdf.

Table 9. Ecology's Identification of Cost Effective Regional Haze Controls at Pulp and Paper Mills[333]

Plant	Emission Unit	Control	Cost Effectiveness, $/ton	RH Pollution Reduced, tons per year
Nippon Dynawave	Hog Fuel Boiler #11	SCR	$5,466/ton	NOx -1,025 tpy
Nippon Dynawave	Hog Fuel Boiler #11	SNCR	$5,413/ton	NOx - 500 tpy
Nippon Dynawave	Boiler #9	SCR	$6,041/ton	NOx - 175 tpy
Nippon Dynawave	Boiler #9	LNB	$2,754/ton	NOx - 97 tpy
Packaging Corp. of America (PCA)	Boiler #1	LNB	$5,893/ton	NOx - 26 tpy
PCA	Boiler #2	LNB	$4,834/ton	NOx - 30 tpy
West Rock Longview	Hog Fuel Boiler 20	SNCR	$6,245/ton	NOx – 115 tpy
WestRock Tacoma	Lime Kiln #1	Wet ESP	$6,964/ton	PM10 – 33 tpy

All of the above-listed emission units and controls were identified as cost effective controls in Ecology's draft SIP narrative except SNCR at WestRock Longview's Hog Fuel Boiler 20 at a cost effectiveness of $6,245/ton based on a 20-year life (which was provided in the Appendix J "snapshot summary" of Ecology's revised cost calculations of the draft regional haze plan). However, based on Ecology's $6,300/ton NOx cost effectiveness reasonable threshold, SNCR at West Rock Longview's Hog Fuel Boiler 20 should also have been listed as a cost effective control. Assuming, as Ecology has, that SNCR would only reduce NOx emissions by 35%, SNCR at the West Rock Longview Hog Fuel Boiler 20 would reduce NOx by 115 tons per year.[334]

A longer life than the 20-year life Ecology assumed for LNBs, SNCR, and wet ESPs should have been used in its revised cost effectiveness analysis. For example, in its proposed regional haze review for SO2, NOx, and PM controls at a fuel oil and natural gas-fired boiler at the AECC Carl E. Bailey Generating Station in Arkansas, EPA assumed a 30-year life of combustion controls (including LNB), SNCR, WESPs, and wet scrubbers in the cost effectiveness evaluation for these controls.[335]

[333] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, at 183 and Appendix J at J-1.
[334] Based on a 35% NOx reduction from reported 2017 emissions of 328 tons per year, as identified in WDOE, Public Review Draft, Regional Haze Plan for the Second Implementation Period, Appendix O at O-190.
[335] 80 Fed. Reg. 18944 at 18955 (Apr. 8, 2015).

With respect to SNCR, there is also ample support for assuming a useful life of 25-30 years. While EPA states in the SNCR Control Cost Manual chapter that it is assumed than an SNCR would have a life of 20 years, EPA also states that "[a]s mentioned earlier in this chapter, SNCR control systems began to be installed in Japan the late 1980's. Based on data EPA collected from electric utility manufacturers, at least 11 of approximately 190 SNCR systems on utility boilers in the U.S. were installed before January 1993. In responses to another ICR, petroleum refiners estimated SNCR life at between 15 and 25 years."[336] Therefore, based on a 1993 SNCR installation date, these SCNR systems that EPA refers to are at least 28 years old which, all other considerations aside, strongly argues for a 30-year equipment life. Furthermore, an SNCR system is much less complicated than a SCR system, for which EPA clearly indicates the life should be 25 years for industrial units. In an SNCR system, the only parts exposed to the exhaust stream are lances with replaceable nozzles. The injection lances must be regularly checked and serviced, but this can be done relatively quickly, if necessary, is relatively inexpensive, and should be considered a maintenance item. In this regard, the lances are analogous to SCR catalyst, which is not considered when estimating equipment life. All other items, which comprise the vast majority of the SNCR system capital costs, are outside the exhaust stream and should be considered to last the life of the facility or longer. For all of these reasons, Ecology should not have assumed a life of SNCR of any shorter than 25 years, similar to what it assumed for SCR, and a similar lifetime of LNBs should also have been assumed.

In addition, Ecology states that it evaluated SNCR at a removal efficiency of 35% at the Cosmo hog fuel boiler to be consistent with what was assumed for SNCR at the other pulp and paper mills.[337] However, EPA's Control Cost Manual indicates NOx removal efficiencies for SNCR used at boilers in the pulp and paper industry can achieve a median NOx removal efficiency of 50% with urea used as the reagent with a range of 20-62%, and EPA states that the median NOx removal efficiencies with ammonia-based systems at such boilers range from 61-65%.[338] Ecology should not have assumed any lower NOx removal efficiency than 50% with SNCR, assuming use of urea as a reagent. Assuming only 35% NOx removal with SNCR understates the emission reductions achievable with SNCR at boilers used in the pulp and paper industry.

Had Ecology assumed a 25-year life for SNCR and a NOx removal efficiency 50%, it is very likely that SNCR would be cost effective at the West Rock Tacoma Boiler #6, West Rock Tacoma Hog Fuel Boiler 7, PCA's Hog Fuel Boiler, and at the Cosmo Hog Fuel Boiler, based on how close Ecology's SNCR cost effectiveness numbers for these units were to Ecology's $6,300/ton reasonableness threshold. Thus, Ecology should revise the SNCR cost effectiveness

---

[336] EPA Control Cost Manual, Section 4, Chapter 1 Selective Noncatalytic Reduction, revised 4/25/2019, at 1-54, available at https://www.epa.gov/sites/default/files/2017-12/documents/sncrcostmanualchapter7thedition20162017revisions.pdf.
[337] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, Appendix J at J-1.
[338] EPA, Control Cost Manual, Section 4, Chapter 1 Selective Non-Catalytic Reduction, 4/25/2019, at 1-1 to 1-2, available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.

analyses for these units to take into account a higher NOx removal efficiency and a longer life of the controls.

With respect to the WestRock Tacoma Hog Fuel Boiler 7, Ecology calculated cost effectiveness of SCR for this boiler at $6,508/ton and SNCR at $6,634/ton which is very close to Ecology's $6,300/ton cost threshold.[339] Ecology stated in its Statement of Basis for the 2011 Air Operating Permit for the facility that the owner of the Tacoma plant requested an increase in the 0.20 lb/MMBtu NOx limit for the boiler and stated that "the 0.20 lb/MMBtu limit was established based on the usage of proper combustion control and previously approved overfire air improvement (OFA) to the power boiler, but the assumptions about the degree of NOx reduction from OFA were wrong."[340] The Statement of Basis further states that the boiler could not meet both the carbon monoxide limit and the NOx limit. The owner of the plant at that time apparently requested a higher NOx limit of 0.30 lb/MMBtu and a higher annual NOx limit of 782 tons per year, which would be a significant increase above the 0.20 lb/MMBtu and 522 ton per 12-month NOx limits that currently apply to the unit.[341] If NOx emissions are going to be allowed to be higher in a subsequent permit action, then both SCR and SNCR would readily be under Ecology's $6,300/ton NOx threshold using Ecology's assumed 20-year life. Further, just changing the SNCR equipment life to 25 years and the interest rate to 3.25% brings the cost effectiveness of SNCR at 35% control at Hog Fuel Boiler 7 to $6,269/ton, which is under Ecology's $6,300/ton cost threshold. For these reasons, Ecology should include the WestRock Tacoma Hog Fuel Boiler 7 in its list of emission units with cost effective NOx controls for at least SNCR. Also, Ecology should disclose the details of the Agreed Order 7688 that was apparently entered into for resolution of the NOx noncompliance issues.[342]

With respect to the Georgia Pacific (GP) Camas plant, Ecology states the plant is "no longer operating as a chemical pulp mill and the emissions will change."[343] According to NWPPA's four-factor report, the GP Camas facility still has some units that are operating , such as the No. 5 Power Boiler and the No. 11 Paper Machine, but it has shut down the Kraft mill, bleach plant, No. 4 Lime Kiln and the No. 4 Recovery Furnace.[344] To the extent that these changes impact Ecology's review of controls for the facility, Ecology must make these changes into enforceable requirements (which could be accomplished by no longer including the units in the facility's operating permit and making clear that any restart of these units would be permitted as new emission units).

Despite Ecology finding that NOx controls at five units and PM10 controls at one unit would be cost effective, Ecology has not proposed any controls for these facilities. Ecology states that "[a]fter we complete the reasonability analysis and determination for the refinery facilities, we

---

[339] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, Appendix J at J-1.
[340] *See* WDOE, Statement of Basis, Air Operating Permit 000085-0, December 12, 2011, at 24, available at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits/WestRock-Tacoma.
[341] *Id.* at 7-8.
[342] *Id.* at 24.
[343] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, at 183.
[344] *Id.*, Appendix O at page O-14.

plan to conduct a reasonability analysis at pulp and paper facilities. This will be included in a SIP revision or the next implementation period, depending on the timing."[345] Ecology states that it decided that pulp and paper mills are not their first priority for implementation because the pulp and paper mills do not have as much of a cumulative effect on Class I areas as the refineries, because the pulp and paper mills are not in close proximity.[346] Unless the close proximity of the refineries makes regional haze controls more cost effective (for example, if emission units might share pollution controls) or otherwise justifies controls under a four-factor analysis, Ecology's proposed approach is not consistent with the regional haze rules or guidance.

Ecology also lists two other reasons for prioritizing the oil refineries for controls over the pulp and paper mills for controls, including that the potential reduction in regional haze emissions from the pulp and paper mills is much lower than the potential reduction in refinery emissions from controls and that the PCA Wallula mill is generally downwind from the nearest Class I areas.[347] However, the four-factor analysis of the regional haze does not include visibility impacts of a source or source category. For the pulp and paper mills, Ecology is essentially using visibility impacts to reject otherwise cost effective emission controls, by claiming a lower cumulative impact from the pulp and paper industry and/or by claiming the emission reductions (and thus regional haze improvement) won't be as significant as it could be with controls at the refineries. Yet, Ecology decided to evaluate regional haze controls for all sources with a Q/d value greater than or equal to 10. All of the pulp and paper mills evaluated by Ecology have Q/d values that range between 15.6 (West Rock Longview) to 27.9 (WestRock Tacoma),[348] thus the facilities all have Q/d values well over Ecology's threshold level. Further, according to NPCA's analysis, the Nippon Dynawave facility likely affects regional haze in 21 Class I areas, the West Rock Tacoma and West Rock Longview facilities each potentially affect regional haze in 10 Class I areas, and the Port Townshend facility and Cosmo Specialty Fibers facility each likely affect regional haze in 5 Class I areas.[349] Thus, from a regional haze perspective, the decision to evaluate controls for these pulp and paper mills is justified and warranted.

Ecology did not evaluate the other three factors of the four-factor analysis for the sources and emission units for which it found cost effective controls, and thus that analysis is presented here. In terms of energy and non-air environmental impacts, the main issue raised by NWPPA is the cost of power to run the controls,[350] which is taken into account in the cost effectiveness analysis (including for SNCR and SCR) and thus has been addressed. NWPPA stated that all boilers and lime kilns have a remaining useful life of 20 years or more,[351] so the remaining life would not be reason to exclude controls from the regional haze plan. In terms of the time necessary for compliance, NWPPA states that it would take at least four years for compliance if additional

---

[345] *Id.* at 184.
[346] *Id.*
[347] *Id.*
[348] *Id.* at 161.
[349] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.
[350] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period, Appendix O-58 to O-62.
[351] *Id.* at O-63.

controls were ultimately required.[352] NWPPA discusses the need to stagger installation of controls if multiple units at a facility required controls,[353] but that does not need to be considered an impediment to for implementing the controls that Ecology has found to be cost effective for the pulp and paper mills. Ecology has found that SCR is cost effective at Hog Fuel Boiler #11 and at Boiler #9 of the Nippon Dynawave facility,[354] LNB is cost effective at PCA Boilers #1 and #2, and that a wet ESP is cost effective at West Rock Tacoma Lime Kiln #1. In addition, Ecology also should have identified SNCR as cost effective WestRock Longview's Hog Fuel Boiler 20, for which it calculated revised cost effectiveness of $6,245/ton. At the minimum, Ecology should include these emission units control requirements in its regional haze plan for the second implementation period. Ecology should also re-evaluate costs of SNCR to take into account at least a 50% NOx removal efficiency and a 25-year life, which more realistically reflects the useful life of an SNCR system and which reflects the capabilities of an SNCR system at a pulp and paper mill unit. That analysis will likely result in SNCR being cost effective at additional emission units.

In the following sections, more specific comments on the four-factor analyses submitted for each pulp and paper mill are provided.

2. *Deficiencies that Appear in All of the NWPPA Pulp and Paper Mill Four-Factor Analyses*

The following provides general comments on the control evaluations and cost-effectiveness analyses that appear to apply to all of the NWPPA four-factor analyses.

NWPPA used an interest rate of 4.8% in amortizing capital costs of most of the controls evaluated.[355] For the evaluation of low NOx burners at the power boilers, NWPPA assumed a much higher interest rate of 7%.[356] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[357] The current bank prime rate is 3.25%.[358] In a cost effectiveness analyses being done today, interest rates in the range of 4.8% to 7% are unreasonably high, given the current bank prime lending rate of 3.25%. Use of a higher interest rate results in higher annualized capital costs.

1. NWPPA assumed too short of a life of pollution controls in amortizing capital costs of controls. For example. NWPPA assumed 20 years for the life of particulate matter (PM) and NOx controls, such as a WESP, improvements to existing ESPSs, and combustion

---

[352] *Id.* at O262.
[353] *Id.* at O-62 to O-63.
[354] Ecology also found that SNCR is cost effective at these emission units, but SCR will result in much greater NOx reductions and has a similar cost effectiveness value as SNCR. See Table 9 above.
[355] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-86 to O-116 (Tables B-1 through Table B-31).
[356] *Id.*, Appendix O at O-159 to O-163 (Tables B-57 through Table B-61).
[357] EPA, Control Cost Manual, Section 1, Chapter 2 (November 2016) at 16, available at: https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf.
[358] https://fred.stlouisfed.org/series/DPRIME.

control upgrades. Further, NWPPA only assumed a 15-year life for the SO2 control of the addition of a caustic scrubber at lime kilns and for the addition of a wet scrubber to boilers. NWPPA only assumed a 10-year life for LNBs. ESPs, WESPs, scrubbers, LNBs and other combustion controls should all be considered to have a life of at least 25 years. For example, in its proposed regional haze review for SO2, NOx, and PM controls at a fuel oil and natural gas-fired boiler at the AECC Carl E. Bailey Generating Station in Arkansas, EPA assumed a 30-year life of combustion controls, SNCR, WESPs, and wet scrubbers in the cost effectiveness evaluation for these controls.[359] One just needs to evaluate how long existing controls have been in place at some of the emission units at the pulp and paper mills to know that a 25-30 year life (or more) is a much more reasonable assumption than a 15-20 year life. For example, in the Statement of Basis for the WestRock Longview Tacoma Mill, Ecology states as a description of a 2007 permitting action for replacement of a wet scrubber that the "[e]xisting scrubber is 30 years old and nearing end of service life."[360] As another example, Recovery Furnace 22 at the WestRock Longview Tacoma Mill was constructed in approximately 1990 and equipped with an ESP, which was about 30 years ago.[361] In addition, the Georgia Pacific Camas Mill installed an ESP at Power Boiler #3 in 1992, approximately 29 years ago,[362] which is still in operation although NWPPA has indicated that the Camas Mill "does not plan to operate Boiler No. 3 going forward."[363] Thus, there are several examples of pollution controls having useful lives in the range of 25-30 years at pulp and paper mills. It is important for Ecology to require use of a realistic cost of pollution controls in amortizing capital costs of controls because the life of controls assumed has a significant impact on the annualized costs of controls, as does the interest rate.

2. NWPPA appears to use a $3,400/ton threshold to define whether pollution controls were cost-effective.[364] However, no justification has been provided for use of this cost threshold or any cost threshold for defining measures necessary to make reasonable progress, other than that NWPPA cites to the $3,400/ton cost threshold used in the Cross State Air Pollution Rule (CSAPR) for non-electrical generating units.[365] For any cost threshold selected by a state, EPA's regional haze guidance requires that the State Implementation Plan (SIP) "explain why the selected threshold is appropriate for that purpose and consistent with the requirements to make reasonable progress."[366] With respect to determining whether a pollution control is cost effective for a recovery furnace,

---

359 80 Fed. Reg. 18944 at 18955 (Apr. 8, 2015).
360 *See* Washington Department of Ecology, Statement of Basis, Air Operating Permit 0000078, WestRock Longview, LLN, December 15, 2020, at 12, available at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits/WestRock-Longview.
361 *Id.* at 10.
362 *See* Southwest Clean Air Agency, Title V Basis Statement, SW20-24-R0-A, Georgia-Pacific Consumer Operations LLC, December 17, 2020, at 7, available at https://www.swcleanair.gov/docs/permits/TitleV/SW20-24-R0-ABAS.PDF.
363 *See* December 2019 NWPPA Report at 1-5.
364 *Id.* at 2-12 and at 3-16.
365 *Id.*
366 EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 39.

lime kiln, or power boiler, it is important to consider the costs that similar sources have had to bear to meet Clean Air Act requirements.

The NWPPA Four-Factor Report identifies several examples of pollution controls being installed at the pulp and paper mills evaluated in its report. For example, the burner at the lime kiln at Nippon Dynawave Packaging Company was replaced with a staged combustion natural gas burner in 2017 and the kiln no long fires fuel oil.[367] As another example, an SNCR system was installed at Power Boiler No. 20 of the WestRock Longview Mill in 2012.[368] At the WestRock Tacoma Mill, Power Boiler No. 7 has a spray tower wet scrubber installed on Power Boiler No. 7 in 2017 and low-NOx burners were installed on Power Boiler No. 6 in 2018.[369] The package boiler at Pt Townshend Paper was converted to fire only natural gas using a low-NOx burner in 2016.[370] The hogged fuel boiler at the PCA Wallula Mill had an overfire air system and a WESP installed in 2016.[371] Regardless of the reasons that these controls were installed, the fact that the controls were installed by the companies is indicative of the cost-effectiveness of the controls.

3. NWPPA estimated costs for certain controls based on a report from 2003. Specifically, NWPPA used cost information from the May 1, 2003 report from the National Economic Research Associates (NERA) entitled "Evaluation of Air Pollution Control Costs for the Pulp and Paper Industry."[372] NWPPA used the cost estimates from this report to develop scaled capital cost estimates for WESPs, upgrades to ESPs, and for wet scrubbers.[373] NWPPA escalated costs from the 2003 cost basis of the NERA report to 2018 dollars using the Chemical Engineering Plant Index (CEPCI).[374] However, EPA's Control Cost Manual cautions against attempting to escalate costs more than five years from the original cost analysis.[375] EPA states that "[e]scalation with a time horizon of more than five years is typically not considered appropriate as such escalation does not yield a reasonably accurate estimate."[376] Further, the cost of an air pollution control does not always rise at the same level as price inflation rates. As an air pollution control is required to be implemented more frequently over time, the costs of the air pollution control often decrease due to improvements in the manufacturing of the parts used for the control or different, less expensive materials used, etc.

---

367 WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-12 to O-13.
368 *Id.* at O-13.
369 *Id.*
370 *Id.*
371 *Id.* at O-14.
372 *Id.* at O-164 through O-189.
373 *Id.*
374 *Id.*, at O-86 through O-90, O-110 through O-113, O-116 (Appendix B at Tables B-1 through B-5, B-8, B-25 through B-28, and B-31).
375 EPA Control Cost Manual, Section 1, Chapter 2 Cost Estimation: Concepts and Methodology, November 2017, at 19.
376 *Id.*

4. NWPPA included costs for sales taxes, property taxes and insurance in its capital costs of controls for several controls evaluated.[377] Yet, in many cases, property taxes do not apply to capital improvements made such as air pollutant controls, and pollution controls are not necessarily considered as increasing risks to necessitate higher insurance costs.[378] In addition, it appears that air pollution controls would be exempt from Washington sales taxes.[379] Ecology must not allow NWPPA to artificially inflate costs by items that likely would not apply to pollution control installations and upgrades.

5. NWPPA somewhat readily dismissed switching/converting to less polluting fuels, stating such fuel switches were too costly without providing sufficient detail for the assumptions of its cost analyses. Specifically, for SO2 control at recovery furnaces, NWPPA stated that the cost of switching to low sulfur No. 2 fuel oil was $12,000/ton based on a 10% capacity factor.[380] It is not clear why the assumption of only a 10% capacity factor is justified for all recovery furnaces that could switch to lower polluting fuels. NWPPA did state that "some recovery furnaces are limited by their air permit to an annual heat input of less than 10% fossil fuel…for avoidance of additional NSPS requirements."[381] However, NWPPA did not identify which of those recovery furnaces had capacity factor limitations, nor did NWPPA explain how those NSPS requirements that the facilities were avoiding with capacity factor limitations might differ if the units utilized a less polluting fuel. Yet, several units have switched from No. 6 fuel oil to No. 2 fuel or from fuel oil to natural gas, as discussed in the NWPPA report in Section 1.2.1 "Summary of Recent Emissions Reductions." Switching to lower sulfur fuel provides the least capital-intensive approach to significantly lowering SO2 emissions, and thus Ecology should not allow such fuel switches to be so readily dismissed as not cost effective without adequate documentation and justification. Indeed, other benefits of switching to less polluting fuels should also be considered in the four-factor analysis. For example, burning of natural gas requires less maintenance than the burning of fuel oil. Thus, Ecology must require that switching to less polluting fuels be more thoroughly evaluated and that any cost effectiveness evaluations be documented with data specific to each furnace or boiler for which this control is evaluated.

In addition to these general concerns that apply to NWPPA's cost effectiveness analyses, the following provides more specific comments to the cost effectiveness evaluations for lime kilns and for power boilers.

---

[377] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-86 to O-116 (Appendix B at Table B-1 through B-31).
[378] *See*, e.g., EPA Control Cost Manual, Section 4, Chapter 2, at pdf page 80 (Equation 2.69). See also EPA Control Cost Manual, Section 4, Chapter 1 (SNCR), at 1-54.
[379] WAC 458-20-242A.
[380] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-23.
[381] *Id.*

3. Comments on SO2 Controls for Lime Kilns

NWPPA states that all lime kiln SO2 emissions are low, "meaning that installing additional SO2 controls would not be cost effective."[382] The emissions presented to make this argument for each facility's lime kilns are from 2017, but NWPPA has not provided any analysis to indicate that operations and SO2 emissions from the lime kilns in 2017 are indicative of typical operating emissions. EPA's regional haze guidance for the second implementation period provides that the cost effectiveness analyses for pollution controls evaluated in four-factor analyses should be based on current emissions or projected 2028 emissions.[383] Ecology should obtain more information to ensure that these emissions are reflective of typical operations.

EPA stated in a 2014 document that nearly 70% of lime kilns in the pulp and paper industry are equipped with wet scrubbers.[384] Of the lime kilns that NWPPA evaluated, the WestRock Longview Mill Lime Kiln 5 had the highest SO2 emissions in 2017 and is not equipped with a wet scrubber, according to NWPPA's Four-Factor Report. Ecology should evaluate whether this lime kiln's emissions are properly characterized by 2017 data and consider evaluating the addition of a wet scrubber for SO2 control and also PM control.

4. Comments on of NOx Controls Evaluations for Power Boilers

NWPPA evaluated NOx controls for several power boilers at the six pulp and paper mills. The controls to be evaluated differed based on the fuel utilized and presumably the boiler type and existing controls. Generally, SNCR and SCR were evaluated for all boilers, and LNB were evaluated for several boilers. The following provides comments on deficiencies noted in NWPPA's NOx cost effectiveness analyses.

1. For SNCR cost evaluations, NWPPA assumed 35% control of NOx, regardless of the NOx inlet rate to the SNCR system.[385] NWPPPA did not provide any justification for that assumption. EPA's Control Cost Manual indicates NOx removal efficiencies for SNCR used at boilers in the pulp and paper industry as achieving a median NOx removal efficiency of 50% with urea used as the reagent with a range of 20-62%.[386] EPA also stated that median NOx reductions with ammonia-based SNCR systems are 61-65% and that most boilers with ammonia-based SNCR systems that are solid fuel-fired are fired

[382] *Id.* at O-24.
[383] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[384] U.S. EPA, Universal Industrial Sectors Integrated Solutions Model for Pulp and Paper Manufacturing Industry – Universal ISIS-PNP, November 2014, at 2-40, available at https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=311359.
[385] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-43 and O-45.
[386] EPA, Control Cost Manual, Section 4, Chapter 1 Selective Non-Catalytic Reduction, 4/25/2019, at 1-2, available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.

with wood or municipal solid waste.[387] Thus, NWPPA has greatly underestimated the NOx reduction capabilities and cost effectiveness of SNCR by only assuming 35% NOx control. Ecology should consider SNCR to achieve at least 50% NOx control at power boilers used in the pulp and paper industry if urea is the reagent.

2. NWPPA used EPA's SNCR cost calculation spreadsheet made available with its Control Cost Manual.[388] For the SNCR control evaluations, NWPPA assumed a 1.5 retrofit factor, which essentially increases capital costs by a factor of 1.5. NWPPA states that "the costs algorithms [of EPA's cost spreadsheet] were developed based on project costs for large coal-fired utility boilers" and assumed, without providing any further justification that EPA's cost algorithms "likely underestimate costs for smaller industrial boilers." Thus, NWPPA applied a retrofit factor of 1.5 "to account for the need to add multiple levels of injectors and perform additional tuning of the system across loads."[389] This was not a justified cost increase. EPA's Control Cost Manual chapter on SNCR costs states there is very little difference in the costs to retrofit SNCR to existing boilers compared to new boilers.[390] EPA's SCNR cost spreadsheet states that it can be used for industrial boilers with maximum heat input capacities of 250 MMBtu/hour or greater and, while EPA has acknowledged that capital costs increase for smaller boilers, the costs do not increase by 50% except for very small boilers.[391] Thus, Ecology should not allow use of any retrofit factor for SNCR costs at any of the power boilers without sufficient documentation from NWPPA or the facility owners to justify the use of a retrofit factor.

3. NWPPA used EPA's SCR cost calculation spreadsheet made available with its Control Cost Manual.[392] EPA's SCR cost spreadsheet already provides a 20% retrofit factor for SCR retrofits as compared to SCR installation costs on a new facility.[393] In addition, the cost algorithms in EPA's SCR cost spreadsheet are based on the average SCR retrofit costs for utility boilers, which often have retrofit difficulties and additional costs, especially due to the large sizes of the SCR reactors and the need for specialized cranes to maneuver large SCR reactors into tight or elevated spaces. Thus, some retrofit difficulty is already built into the costs of EPA's SCR cost spreadsheet. NWPPA did not provide adequate justification for its application of a 1.5 retrofit factor to SCR cost analyses for power boilers. NWPPA simply said "[a] retrofit factor of 1.5 was applied to all industrial boilers since the EPA cost equations were developed based on utility boiler applications and to account for space constraints, additional ductwork, and the likelihood of needing a

[387] *Id.* at 1-1.
[388] Available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[389] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-55.
[390] EPA, Control Cost Manual, Section 4, Chapter 1 Selective Non-Catalytic Reduction, 4/25/2019, at 1-6.
[391] *Id.* at 1-7 (Figure 1.2).
[392] Available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[393] This is evident by the fact that if one enters in the Data Inputs tab that the SCR is for a new boiler, the retrofit factor drops from 1 to 0.8.

new ID fan to account for increased pressure drop."[394] Ecology must not allow use of retrofit factors in the SCR cost analyses unless justified based on the specific situation for a particular power boiler.

4. NWPPA did not provide data on the assumptions that went into the cost effectiveness of SCR or SNCR for the power boilers. For example, NWPPA's four-factor submittal does not identify the baseline NOx emissions and emission rates of each boiler in tons per year and lb/MMBtu. It also did not identify the operating hours and/or operating capacity factor of each power boiler used in estimating the operational expenses of these controls. In addition, NWPPA did not identify specific costs assumed for the SNCR and SCR reagent (including what type of reagent was assumed) or the electricity costs. It also is not clear what unit characteristics and fuel characteristics were assumed in the cost spreadsheets for each boiler. Had NWPPA provided a printout of all pages of EPA's SNCR and SCR spreadsheets in its four-factor report, this information could be evaluated. Ecology must ask NWPPA to make all of the pages of the SNCR and SCR spreadsheets available for review for the power boilers.

   It must be noted that the calculated NOx emission reductions for SNCR and SCR seem inconsistent with the baseline emissions assumed for the boilers evaluated for LNB control. Specifically, one can back-calculate the assumed uncontrolled emissions for a boiler by dividing the NOx reductions presented in the spreadsheet printouts for SNCR and SCR by the assumed 35% (for SNCR) and 90% (for SCR) NOx removal efficiency. When we back-calculated those uncontrolled NOx emission rates for the five power boilers that were evaluated for LNB controls (i.e., Nippon Dynawave Boilers 6, 7, and 9 and PCA Wallula Boilers 1 and 2), we found the resulting "uncontrolled NOx emissions" assumed in the SNCR and SCR analyses for these boilers were about 55% higher than the uncontrolled NOx emissions assumed for these units in the LNB cost analyses.[395] Ecology should further evaluate these emission calculations to ensure consistency across all analyses, and to ensure that the baseline NOx emissions truly reflect actual baseline emissions for the power boilers. Having NWPPA submit the entire spreadsheets for these cost calculations would greatly help in ensuring consistency and accuracy of the cost effectiveness calculations.

5. For the analysis of LNBs, NWPPA used a John Zink cost analysis from 2016 for a 99 MMBtu/hr gas-fired boiler.[396] For this analysis, NWPPA inexplicably assumed a 7% interest rate rather than the 4.7% interest rate it assumed for its other cost analyses.[397] As discussed above, there is no justification for such a high interest rate, and Ecology should make sure the current prime rate be used in cost analyses, to be consistent with EPA's

[394] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-57.
[395] *Id.*, Appendix O at O-159 to O-163 (Tables B-57 through Table B-61). The LNB cost analyses for these power boilers identify baseline NOx emissions.
[396] *Id.* at O-57.
[397] *Id.* At O-159 to O-163 (Tables B-57 through Table B-61).

Control Cost Manual. In addition, NWPPA's cost effectiveness analyses of LNB for power boilers assumed LNBs would only have a life of 10 years.[398] Low NOx burners should have a useful life of 25-30 years or more. In evaluations of BART for natural gas and oil-fired utility boilers, EPA evaluated combustion controls such as low NOx burners and SCR at lifetimes of 30 years.[399] Thus, NWPPA was not justified in assuming such a short lifetime of LNB and such a high interest rate, and these invalid assumptions improperly made LNB appear to be less cost effective.

It is also questionable whether NWPPA's assumption of only 50% NOx reductions with LNB is a reasonable estimate of achievable emission reductions with LNB. EPA states that NOx emission reductions of 40 to 85% are achievable with low NOx burners.[400] In addition, NWPPA did not evaluate flue gas recirculation (FGR) in combination with LNB. EPA states that these controls are normally used together to reduce NOx, and emission reductions of 60 to 90% are achievable.[401] Indeed, the No. 5 Power Boiler at the Georgia Pacific Camas Mill is equipped with these controls.[402] Ecology must ensure that NWPPA evaluates the most effective combustion controls for the power boilers.

It is important to note that just revising the annualized capital costs of LNBs using NWPPA's cost numbers but using a capital recovery factor reflective of a 3.25% interest rate and a 25-year life makes a significant difference in the cost effectiveness of LNBs at the power boilers, as the table below demonstrates.

---

[398] *Id.*

[399] *See*, e.g., EPA's proposed action on Arkansas' Regional Haze Implementation Plan in which EPA assumed a 30-year life for combustion controls including LNB, SNCR, and SCR at a 30-year life for a natural gas- and oil-fired power plant, Bailey Unit 1, and the natura gas- and oil-fired McClellan power plant. 80 Fed. Reg. 18944 at 18953, 18960 (Apr. 8, 2015).

[400] EPA, AP-42 Emission Factor Documentations, Section 1.4 Natural Gas Combustion, at Section 1.4.4, available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-1-external-0.

[401] *Id.*

[402] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-48.

Table 10. Revisions to NWPAA's Cost Effectiveness of LNBs at Power Boilers to Use a Lower Interest Rate and a More Realistic Life of LNB Controls (3.25% Interest Rate, 25-Year Life of LNB)

Plant-Unit	Total Annualized Costs (at 3.25% Interest and 25 Year Life)	NOx reductions (per NWPPA), tpy	Revised Cost Effectiveness (at 3.25% Interest Rate and 25-Year Life)	NWPPA's Cost Effectiveness (at 7% Interest Rate and 10-Year Life)
Nippon Dynawave Boiler 6	$141,708	18.55	$7,639	$12,093
Nippon Dynawave Boiler 7	$168,795	28	$6,028	$9,543
Nippon Dynawave Boiler 9	$250,813	97.3	$2,578	$4,081
PCA Wallula Boiler 1	$142,579	25.85	$5,516	$8,732
PCA Wallula Boiler 2	$136,856	30.3	$4,517	$7,162

As the Table 10 demonstrates, the use of an unreasonably high interest rate and an unreasonably low useful life of controls can greatly distort the cost effectiveness of controls. Not only do revisions to the cost effectiveness analyses to reflect appropriate interest rates and life of controls improve the cost effectiveness of LNB, but such revisions would also improve the cost effectiveness of SNCR and SCR for the power boilers. Moreover, if more realistic levels of NOx reduction were assumed with LNB and also with SNCR, those controls would likely be more cost effective. Further, as previously stated, no retrofit factor was justified to the SNCR costs or the SCR costs and revising the costs to eliminate the retrofit factor applied would also make those controls more cost effective. Indeed, with these revisions made, it is likely that LNB and/or SNCR would be considered very cost effective for several of the power boilers at the pulp and paper mills. Further, a review of the cost inputs used in the SCR cost analyses is imperative to ensure that costs for items such as reagent, electricity, or catalysts were not overstated in those analyses.

5. Comments on Four-Factor Analyses for the Cosmo Specialty Fibers Mill

Cosmo Specialty Fibers (Cosmo) operates a sulfite pulp mill located in Cosmopolis, Washington. A four-factor analysis was submitted for controls at one emissions unit at the plant: the hog fuel boiler at the facility.[403] Cosmo did not provide four-factor analyses for the recovery boilers at the facility (Recovery Boiler 1, 2, and 3), nor did Cosmo provide four-factor analyses for the hogged fuel dryer at the facility.

Cosmo relied on Ecology's 2016 analysis entitled "Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills" dated November 2016 to justify no additional regional haze controls for its recovery boilers.[404] However, the November 2016 Ecology RACT analyses was focused on whether the visibility benefits of pollution controls evaluated justified the costs of the pollution controls. As previously discussed, the visibility benefits of controls are not part of the Clean Air Act's four-factor analysis; thus, Ecology's determination should not add an additional factor to the four statutory factors. It must also be pointed out that Ecology's 2016 RACT analysis was based on emission inventories between 2003 to 2011 and, as noted in the 2016 RACT analysis, Cosmo did not operate from 2007-2010.[405] In fact, a support document for a Title V permit for the Cosmo facility states that when the Cosmo mill restarted in 2011, it had eliminated two processes (cellophane and paper grade production) and only produced dissolving pulp.[406] That basis statement also stated that "[p]roduction varies upon market demand."[407] Thus, Ecology's 2016 report did not have much emissions data reflective of the new operations at the Cosmo facility to base a cost effectiveness analysis of pollution controls on, and a revised analysis of pollution controls must be done for these emission units reflective of current emissions that reflect expected operations in 2028. For these reasons, Ecology's 2016 RACT analysis must not exempt a facility from evaluating pollution controls for any part of its facility.

Cosmo evaluated SCR and SNCR for NOx controls at the hog fuel boiler and evaluated use of an ESP to reduce PM emissions from the hog fuel boiler. Cosmo determined that no additional controls are required at the hog fuel boiler to address regional haze requirements.[408]

Deficiencies in Cosmo's cost effectiveness analyses

1. Cosmo assumed a 4.75% interest rate in amortizing capital costs of the controls evaluated.[409] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[410] The current bank prime

---

[403] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-278 to O-312 (December 2019 Four-Factor Analysis for Cosmo Specialty Fibers).
[404] *Id.* At O-288.
[405] Washington Department of Ecology, Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills, November 2016, at 34.
[406] Support Document for the Air Operating Permit issued to Cosmo Specialty Fibers, [undated], at 4, available at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits/Cosmo-Specialty-Fibers.
[407] *Id.*
[408] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-285.
[409] *Id.* at O-306 to O-308 (Appendix B, Tables 1b, 2b, and 3b).
[410] EPA, Control Cost Manual, Section 1, Chapter 2 (November 2016) at 16, available at: https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf.

rate is 3.25%.[411] I n a cost effectiveness analyses being done today, an interest rate of 4.75% is unreasonably high, given the current bank prime lending rate of 3.25%. Use of a higher interest rate results in higher annualized capital costs.

2. Cosmo assumed too short of a life of pollution controls in amortizing capital costs of controls. Cosmo only assumed a 20-year life in its cost effectiveness evaluations for SCR, SNCR, and ESP.[412] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years.[413] As stated above in the comments on the NWPPA facilities, a simple review of pollution controls at existing boilers and furnaces in the pulp and paper industry shows that pollution controls like ESPs are in place for 25 to 30 years or more. For example, Recovery Furnace 22 at the WestRock Longview Tacoma Mill was constructed in approximately 1990 and equipped with an ESP, which was about 30 years ago.[414] Further, the Georgia Pacific Camas Mill installed an ESP at Power Boiler #3 in 1992, approximately 29 years ago.[415] Thus, a 25-30 year life is likely a more appropriate life of controls to use in amortizing capital costs of a pollution control for the hog fuel boiler. In its proposed regional haze review for SO2, NOx, and PM controls at a fuel oil and natural gas-fired boiler at the AECC Carl E. Bailey Generating Station in Arkansas, EPA assumed a 30-year life of combustion controls, SNCR, WESPs and wet scrubbers.[416] It is important for Ecology to use of a realistic life of pollution controls in amortizing capital costs of controls, because the life of controls assumed has a significant impact on the annualized costs of controls, as does the interest rate.

3. In the evaluation of SNCR for NOx control, Cosmo only assumed 25% NOx control would be achieved.[417] Cosmo stated this lower NOx control efficiency was applied due to the "load-swing nature of the Hog Fuel Boiler as well as low NOx concentration…."[418] Ecology should request more information from Cosmo on the load-swing nature of the boiler and how that could impact NOx removal efficiency with SNCR. The hog fuel boiler does appear to run throughout the year, as Cosmo stated the typical operating level of the unit was 357 days per year at 24 hours per day.[419]

---

411 https://fred.stlouisfed.org/series/DPRIME.
412 WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-306 to O-308 (Appendix B, Tables 1b, 2b, and 3b).
413 EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
413 U.S. Geological Survey, Minerals Commodities Summaries 2020, at 80.
414 *Id.* at 10.
415 *See* Southwest Clean Air Agency, Title V Basis Statement, SW20-24-R0-A, Georgia-Pacific Consumer Operations LLC, December 17, 2020, at 7, available at https://www.swcleanair.gov/docs/permits/TitleV/SW20-24-R0-ABAS.PDF.
416 80 Fed. Reg. 18944 at 18955 (Apr. 8, 2015).
417 WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-295.
418 *Id.*
419 *Id.* at O-295 (Table 4-2).

4. In the evaluation of SCR for the hog fuel boiler, Cosmo assumed that the flue gas would need to be reheated and Cosmo took into account estimated costs to reheat the flue gas in the SCR cost effectiveness analysis.[420] The cost for reheating the flue gas reflects 85 to 88% of Cosmo's total annual costs of SCR.[421] Cosmo did not provide the detailed calculations to verify the costs for reheating the flue gas stream, and Ecology must request that data.

5. Cosmo did not evaluate the cost effectiveness of a high dust SCR system which would eliminate any need for flue gas reheating, thus reducing Cosmo's annual cost estimates of SCR significantly. Cosmo's justification for not evaluating a high dust SCR was concerns about particulate emissions poisoning the SCR catalyst.[422] However, there are options to reduce or slow down catalyst deactivation that should have been considered. One study on this issue states that SCR catalyst deactivation in biomass fired plants is mostly due to high potassium content in biomass and that one method to deal with that is potassium removal by adsorption.[423] This paper states that addition of alumino silicates, in the form of coal fly ash, is an "industry proven method of removing [potassium] aerosols from flue gases."[424] Other options to address this concern (aside from tail-end SCR that requires reheating of the flue gas) include the coating SCR monoliths with a protective layer and the use of potassium tolerant SCR catalysts.[425] Ecology must evaluate these other options to accommodate a high dust SCR configuration, which could ultimately end up being a very cost effective and highly effective NOx control.

6. For the ESP evaluated by Cosmo for the hog fuel boiler, Cosmo included costs for property taxes and insurance.[426] Yet, as discussed above, in many cases, property taxes do not apply to capital improvements made such as air pollutant controls, and pollution controls are not necessarily considered as increasing risks to necessitate higher insurance costs.[427] Ecology must not allow NWPPA to artificially inflate costs by items that likely would not apply to pollution control installations and upgrades.

There are examples of similar emission units in the pulp and paper industry in Washington that have installed both NOx and PM controls. For example, the hogged fuel boiler at the PCA

---

[420] *Id.* at O-295.
[421] *Id.*
[422] *Id.*
[423] *See* Schill, Leonhard and Rasmus Fehrmann, Strategies of Coping with Deactivation of NH3-SCR Catalysts Due to Biomass Firing, March 30, 2018, available at https://www.mdpi.com/2073-4344/8/4/135/htm and attached as Ex. 12.
[424] *Id.*
[425] *Id.*
[426] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-310 (Appendix B, Table 3a).
[427] *See*, e.g., EPA Control Cost Manual, Section 4, Chapter 2, at pdf page 80 (Equation 2.69). *See also* EPA Control Cost Manual, Section 4, Chapter 1 (SNCR), at 1-54.

Wallula Mill had a WESP installed in 2016.[428] In addition, an SNCR was installed at the WestRock Longview Power Boiler 20,[429] which appears to be a similar boiler to the hog fuel boiler at the Cosmo plant, in that the WestRock Longview Power Boiler 20 burns wood fuels (hog fuel, forest biomass, urban wood) and oil (including reprocessed fuel oil), as well as burning paper recycling residuals, primary/secondary sludge from the process wastewater treatment plant, and natural gas.[430] WestRock Power Boiler 20 is described as a "hybrid suspension grate boiler designed to fire wet biomass…."[431] Ecology should further evaluate the SNCR installed at the WestRock Longview Power Boiler 20 to determine the percent NOx removal being achieved at that unit to assess SNCR NOx removal capabilities for the hog fuel boiler at the Cosmo facility. Because a similar source has found it cost effective to install SNCR to reduce NOx emissions, that provides a strong basis to consider SNCR as a cost-effective control for the Cosmo hog fuel boiler. Note that the Title V statement of basis for the WestRock Longview plant indicates that the SNCR was installed at the WestRock Longview Power Boiler 20 to reduce NOx emissions as part of Order 8429 which allowed for higher solid fuel firing rate.[432] Thus, the SNCR was likely installed to allow the increased solid fuel firing rate at WestRock Longview Boiler 20 to "net out" of major source permitting requirements. Controls installed to net out of major source permitting requirements should be considered controls required under the Clean Air Act. Such controls provide a relevant example of a source determining it was cost-effective to install the pollution control, even if the reasoning was to avoid a more substantive Clean Air Act requirement.

IV. Additional Facility that Ecology Should Evaluate for Regional Haze Controls

One additional facility that Ecology should evaluate for regional haze controls is the Ardagh Glass plant in Seattle, Washington. According to NPCA analysis, the Ardagh Glass facility potentially affects regional haze in 2 Class I areas.[433] NPCA previously submitted to Ecology a four-factor analysis of regional haze controls for the Ardagh Glass Plant with its February 16, 2021 comment letter to Ecology for the informal comment period,[434] but Ecology has not responded to those comments in the public review draft regional haze plan for the second implementation period.

---

[428] WDOE, Public Review Draft, Washington Regional Haze Plan for the Second Implementation Period Appendix O at O-14.

[429] *Id.*

[430] Washington Department of Ecology, Statement of Basis for Air Operating Permit 0000078, WestRock Longview, December 15, 2020, at 42, available at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits/WestRock-Longview.

[431] *Id.*

[432] *Id.* at 43.

[433] NPCA, Clear Solutions for Parks, Regional Haze Fact Sheet, Washington, available at https://drive.google.com/file/d/1TKDIvvNwQ6LnVlVjzq4FYoQIOOlPyFmp/view.

[434] *See* NPCA, Comments Submitted for Informal comment period: Regional Haze SIP Revision - 2nd 10-Year Plan, February 16, 2021, at 11.

Ecology's air emissions inventory for the Ardagh Glass Plant identifies the following emissions for 2014-2019 at the plant.

Table 11. Ardagh Glass Plant Emissions, 2014 to 2019[435]

Year	NOx, tpy	SO2, tpy	PM10, tpy
2014	172.1	105.9	73.2
2015	Not reported	Not Reported	Not Reported
2016	153.7	98.7	95.3
2017	153.3	98.7	88.2
2018	167.6	89.9	82.2
2019	172.7	56.7	66.5

The largest sources of emissions at a glass plant are the fossil fuel-fired furnaces which melt glass. At the Ardagh plant, there are five furnaces. No. 1 is an all-electric furnace; No. 2, No. 3 and No. 5 furnaces are oxy-fuel fired; and No. 4 is an end-port regenerative furnace. The Furnace No. 1 does not have reported emissions. Furnaces Nos. 2, 3 and 5 are oxy-fuel fired. This combustion technique should reduce the formation of NOx. Furnace No. 5 is equipped with a Tri-Mer Cloud Mist Scrubber, which should capture the SO2 and PM emissions.

At the request of NPCA, Steve Klafka of Wingra Engineering, evaluated the use of ceramic catalytic filtration systems at Furnaces 2, 3, 4, and 5 of the Ardagh Glass Plant.[436] This is the same pollutant control technology discussed in Section II.C. above for the Ash Grove Cement Plant. The Klafka Report discusses how ceramic catalytic filtration systems have been used at existing glass plants as a highly effective multi-pollutant control technology.[437] The Klafka Report included a cost analysis for ceramic catalytic filtration systems at the Ardagh Glass Plant furnaces to reduce NOx and also SO2 and PM10. Table 12 below summarizes the results of his analysis.

[435] Data from Ecology's Point Source Emissions Inventory available at https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-emissions-inventory.
[436] *See* January 27, 2021 Four-Factor Reasonable Progress Analysis for the Ardagh Glass plant in Seattle, Washington, done by Wingra Engineering, S.C., attached as Ex. 9.
[437] *Id.* at 9.

Table 12 - Cost Effectiveness for a Catalytic Ceramic Filter System to Control Actual and Potential Emissions from the Ardagh Glass Plant Furnaces[438]

Basis	Based on 2014 Actual Emissions	Based on Potential Emissions
Capital Costs	$11,866,967	$16,468,204
Annual Operating Costs	$330,980	$700,622
Annual Capital and Operating Costs	$1,451,222	$2,255,220
NOx Removed (tpy)	155	618
SO2 Removed (tpy)	79	217
PM Removed (tpy)	70	173
Total NOx, SO2 and PM Removed (tpy)	304	1,008
Cost Effectiveness ($ per Total Tons Removed)	$4,766	$2,238

The Klafka Report indicated that it would take twelve months to construct and install a ceramic catalytic filtration system at Ardagh Glass.[439] The Klafka Report did not identify issues with energy or non-air environmental impacts of the control because the cost analysis took into account the costs of electricity, assumed use of aqueous ammonia, and the cost for 100% of the dust due to the use of hydrated lime for SO2 control.[440] The Klafka report did discuss how glass furnaces need to be rebuilt every 10-20 years, but it did not find such a rebuilding of the furnace would limit the remaining useful life of the glass plant because it has been in that location since 1931.[441] The Klafka Report concluded that it is technically feasible to add a catalytic ceramic filtration system to the glass furnaces at Ardagh Glass and that it would be very cost effective to do so, at a cost per total tons of pollutant removed of $4,766/ton based on emission reductions from 2014 actual emissions and at a cost of $2,238/ton based on emission reductions from potential emissions.[442]

Thus, a ceramic catalytic filtration system is a very cost effective control that can significantly reduce emissions from the Ardagh Glass Plant, and Ecology should strongly consider this control at Ardagh Glass as part of its regional haze control strategy.

---

[438] *Id.* at 11.
[439] *Id.* at 10.
[440] *Id*. at 11.
[441] *Id.* at 11-12.
[442] *Id.* at 12. Note that the narrative discussion of the Klafka report indicates lower cost effectiveness numbers of $3,768/ton for reductions from 2014 emissions and $1,819/ton from reductions in potential emissions, but Table 5 of the report indicates a higher cost per ton of pollutants removed. The Table 5 data of the Klafka Report is included in Table 12 of this report as the data are assumed to be the more accurate numbers.