February 16, 2021, *Submitted with correction on February 19, 2021*[1]

Philip Gent
Air Quality Program
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Submitted via email to: philip.gent@ecy.wa.gov

Re: NPCA Comments Submitted for Informal comment period: Regional Haze SIP Revision - 2nd 10-Year Plan

Dear Mr. Gent:

The National Parks Conservation Association (NPCA), Sierra Club, the Duwamish River Cleanup Coalition (DRCC), Puget Soundkeeper Alliance (PSK), and Waste Action Project (WAP) ("Conservation Organizations") submit the following and attached comments regarding the Washington Department of Ecology's ("Ecology, DOE") informal comment period for its Regional Haze SIP Revision - 2nd 10-Year Plan.[2] We greatly appreciate Ecology's time and

[1] This corrected version of the comment letter includes four paragraphs that were inadvertently omitted from Section XI. on Environmental Justice, which are inserted at pages 55-56, starting with the paragraph "There are additional legal grounds…"

[2] "The Four-Factor Reasonable Progress Analysis for Ardagh Glass," was prepared for NPCA by Steven Klafka, P.E. BCEE, Environmental Engineer, Wingra Engineering, S.C. (Jan. 27, 2021) (This Analysis is referenced in Section III of these comments and attached as "Exhibit 1"). Sections III through IX were prepared for NPCA by Victoria Stamper, Boise, Idaho. Ms. Stamper is an independent air quality consultant and engineer with extensive experience in the regional haze program. Also enclosed are NPCA's comments submitted on the Draft Air Quality Agreed Orders for Alcoa Wenatchee Agreed Order 18100 (Chelan County), Intalco Agreed Order 18216 (Whatcom County), which included proposed source-specific amendments for Ecology's Regional Haze SIP Revision, (Dec. 3, 2020). ("Exhibit 2").

efforts to provide for an inclusive early stakeholder engagement and comment on the four factor analysis reasonable progress (RP) reports submitted by the sources. Additionally, we commend Ecology for approaching its RP analysis by evaluating the industrial source categories, which provides for efficiencies in SIP development and public involvement, and equities in evaluating RP emission controls across each source category.

NPCA is a national organization whose mission is to protect and enhance America's National Parks for present and future generations. NPCA performs its work through advocacy and education. NPCA has over 1.4 million members and supporters nationwide with its main office in Washington, D.C. and 24 regional and field offices. NPCA's regional Northwest office is located in Seattle working on a variety of issues affecting Northwest national parks such as North Cascades, Olympic, and Mt. Rainier National Parks. NPCA is active nation-wide in advocating for strong air quality requirements in our parks, including submission of petitions and comments relating to visibility issues, regional haze State Implementation Plans, global warming and mercury impacts on parks, and emissions from individual power plants and other sources of pollution affecting National Parks. NPCA's members live near, work at, and recreate in all the national parks of the Northwest, including those directly affected by emissions from Washington's sources.

The Sierra Club is a national nonprofit organization with 67 chapters and about 830,000 members dedicated to exploring, enjoying, and protecting the wild places of the earth; to practicing and promoting the responsible use of the earth's ecosystems and resources; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out these objectives. The Sierra Club has long participated in Regional Haze rulemaking and litigation across the country in order to advocate for public health and our nation's national parks. The Washington Chapter of the Sierra Club has approximately 32,000 members.

Waste Action Project (WAP) has been around since 1994. WAP focuses on advocacy and education, and the Clean Water Act and has also provided technical and other support for communities for issues around the Clean Water Act, Superfund, Resource Conservation Recovery Act, and Model Toxics Control Act. WAP are a co-founder of Duwamish River Cleanup Coalition, and for the first few years oversaw DRCC's EPA Technical Assistance Grant for the Lower Duwamish Waterway Superfund Site. WAP has worked with impacted communities around the state to better understand their rights to clean water, and implementation of restoration and water quality improvement projects.

Puget Soundkeeper Alliance (PSK) is a regional organization whose mission is to protect and enhance the waters of Puget Sound for the health and restoration of our aquatic ecosystems and the communities that depend on them. PSK conducts outreach via stewardship, advocacy, monitoring and enforcement in order to achieve behavior change and systems change. PSK currently has 1,898 members who live, work, play, and worship all round Puget Sound and its tributaries, and have strong interests in protecting the waters from pollution and associated harms to community health. PSK is currently prosecuting Clean Water Act lawsuits against both Ardagh Glass and Ash Grove Cement for violations of National Pollution Discharge Elimination System (NPDES) permits. Though PSK is a water quality focused organization, it acknowledges and appreciates the undeniable intersectionality of water and air pollution with human health, and with racial and environmental justice.

PSK is also a coalition member of the Duwamish River Cleanup Coalition (DRCC/TAG). DRCC/TAG was founded in 2001 by ten non-profit organizations representing community, environmental, social justice, health, Tribal and small business stakeholders affected by the pollution and cleanup of Seattle's Duwamish River. Beyond monitoring the cleanup of Seattle's Duwamish River, we are a voice for the nearby community, which is negatively affected by the environmental, social and economic impacts of pollution. DRCC/TAG has worked closely with the affected communities in the Duwamish Valley for more than 18 years, including residents negatively impacted by Ardagh Glass legacy of frequent air pollution violations. The Duwamish Valley's riverfront neighborhoods Georgetown and South Park are situated within two miles of the Ardagh Glass facility and have long been disproportionately exposed to contamination, cumulative environmental injustices, and subsequent adverse health-related outcomes.

Residents who live in Georgetown and South Park have some of the highest health discrepancies in the City of Seattle. Childhood asthma hospitalization rates are the highest in the City. Heart disease death rates are 1.5 times higher than the rest of Seattle and King County. Life expectancy is 13 years shorter when compared to Laurelhust in North Seattle; one of Seattle's wealthiest neighborhoods.

Additionally, as you may know, in May 2020, NPCA shared the petition it submitted to the previous EPA Administrator - which sought reconsideration of the 2019 RH guidance[3] - alongside a cover letter to Washington.[4] In addition to NPCA, Sierra Club, Natural Resources Defense Council, Western Environmental Law Center, Appalachian Mountain Club, Coalition to Protect America's National Parks, and Earthjustice, signed the petition for reconsideration. As of the date of this comment letter, EPA has not responded to the Petition. Until the current EPA Administration withdraws the illegal approaches in the 2019 guidance, we trust states will not follow it, instead adhering closely to the regulation itself and working to achieve the Clean Air Act goal of Class I visibility restored to natural conditions.[5]

---

[3] EPA issued the Final Guidance on August 20, 2019 via Memorandum from Peter Tsirigotis, Director at EPA Office of Air Quality Planning and Standards to EPA Air Division Directors.

[4] "Petition for Petition for Reconsideration of Guidance on Regional Haze State Implementation Plans for the Second Implementation Period," submitted by National Parks Conservation Association, Sierra Club, Natural Resources Defense Council, Coalition to Protect America's National Parks, Appalachian Mountain Club, Western Environmental Law Center and Earthjustice, to former EPA Administrator Andrew Wheeler (May 8, 2020). ("Conservation Organizations Petition"). ("Exhibit 2," attached)

[5] The Petition explained that, as issued, the Final Guidance conflicts with this statutory objective, previous rulemaking and guidance; misdirects states as to how they can go about complying with their legal obligations to make reasonable progress towards restoring natural visibility to protected public lands; and otherwise fails to set expectations that comport with legal requirements for the second planning period. Further, we petitioned the prior Administrator to replace it with guidance that comports with the Clean Air Act ("CAA") and the Regional Haze Rule, 42 U.S.C. §§ 7491, 7492; 82 Fed. Reg. 3078 (Jan. 10, 2017); 71 Fed. Reg. 60,612 (Oct.13, 2006); 70 Fed. Reg. 39,104 (July 6, 2005); 64 Fed. Reg. 35,714 (July 1, 1999), and aids states in making progress towards achieving the national goal of natural visibility conditions at all Class I areas. Conservation Organizations Petition at 1-2. The Petition includes a detailed analysis of the issues. As of the date of this comment letter, EPA has not responded to our Petition. Until the current EPA withdraws the illegal approaches in the 2019 guidance, we trust states will not follow it instead adhering closely to the regulation itself and work to achieve the Clean Air Act goal of Class I visibility restored to natural conditions.

Our comments identify numerous issues and offer detailed suggestions to ensure that the four factor analyses Ecology proposes in the spring will be in line with the legal requirements of the Clean Air Act and federal regulations, and address visibility impairing emissions. Washington's regional haze plan presents a significant opportunity to not only improve the skies across the region's treasured public lands but also the air quality in communities across the state, including some of the most disproportionately affected by health harming pollution that can and must be abated.

We appreciate Ecology's consideration of these comments.

Conservation Organizations' Comments
Washington Department of Ecology's Informal Comment Period
Regional Haze SIP Revision: 2nd 10-Year Plan
February 16, 2021

Table of Contents

I. Introduction and Background

Washington is home to three national parks, Mount Rainier, Olympic, and North Cascades National Parks, and five wilderness areas, Alpine Lakes, Glacier Peak, Goat Rocks, Mount Adams, and Pasayten Wilderness Areas. Our national parks and wilderness areas are iconic, treasured landscapes and Washington is rich in national parks and natural areas.

Congress set aside these national parks and wilderness areas to protect our natural heritage for generations. Washington's protected areas also generate millions of dollars in tourism revenue, provide habitat for a range of species, and provide year-round recreational opportunities for residents. These special places are designated "Class I areas" under the Clean Air Act ("CAA") and as such, their air quality is entitled to the highest level of protection. Unfortunately, that requirement and promise is unfulfilled because the air in most Class I areas, including in Washington's most treasured natural areas, remains polluted by industrial sources, including the sources covered in our comments: Tesoro Refining (Anacortes Refinery); BP-Cherry Point Refinery; Phillips 66 Ferndale Refinery; U.S. Oil and Refining Company; Cardinal FG Winlock Glass Plant; Ardagh Glass Plant; 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.

To improve air quality in our most treasured landscapes, Congress passed the visibility protection provisions of the Clean Air Act in 1977, establishing "as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in the mandatory class I Federal areas which impairment results from manmade air pollution."[6] "Manmade air pollution" is defined as "air pollution which results directly or indirectly from human activities."[7] In order to protect Class I areas' "intrinsic beauty and historical and archeological treasures," the regional haze program establishes a national regulatory floor and requires states to design and implement programs to curb haze-causing emissions within their jurisdictions. Each state must submit for EPA review a SIP designed to make reasonable progress toward achieving natural visibility conditions.[8]

A regional haze SIP must provide "emissions limits, schedules of compliance and other measures as may be necessary to make reasonable progress towards meeting the national goal."[9] Two of the most critical features of a regional haze SIP are the requirements for installation of Best Available Retrofit Technology ("BART") limits on pollutant emissions *and a long-term strategy for making reasonable progress toward the national visibility goal*.[10] The haze requirements in the Clean Air Act present an unparalleled opportunity to protect and restore regional air quality by curbing visibility-impairing emissions from some of the nation's oldest and most polluting facilities.

---

[6] 42 U.S.C. § 7491(a)(1).
[7] *Id.* § 7491(g)(3).
[8] *Id.* § 7491(b)(2).
[9] 42 U.S.C. § 7491(b)(2).
[10] *Id.* § 7491(b)(2)(B); 40 C.F.R. § 51.308(d)(1)(i)(B).

Implementing the regional haze requirements promises benefits beyond improving views. Pollutants that cause visibility impairment also harm public health. For example, oxides of nitrogen (“NO_X”) are a precursor to ground-level ozone which is associated with respiratory disease and asthma attacks. NO_X also reacts with ammonia, moisture and other compounds to form particulates that can cause and/or worsen respiratory diseases, aggravate heart disease, and lead to premature death. Similarly, sulfur dioxide (“SO_2”) increases asthma symptoms, leads to increased hospital visits, and can also form particulates. NO_X and SO_2 emissions also harm terrestrial and aquatic plants and animals through acid rain as well as through deposition of nitrates (which in turn cause ecosystem changes including eutrophication of mountain lakes).

II. The Regional Haze Reasonable Progress Legal Requirements

A. Requirements for Periodic Comprehensive Revisions for Regional Haze SIPs

In developing its long-term strategy, a state must consider its anthropogenic sources of visibility impairment and evaluate different emission reduction strategies including and beyond those prescribed by the BART provisions.[11] A state should consider “major and minor stationary sources, mobile sources and area sources.”[12] At a minimum, a state must consider the following factors in developing its long-term strategy:

> (A) Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment;
> (B) Measures to mitigate the impacts of construction activities;
> (C) Emissions limitations and schedules for compliance to achieve the reasonable progress goal;
> (D) Source retirement and replacement schedules;
> (E) Smoke management techniques for agriculture and forestry management purposes including plans as currently exist within the State for these purposes;
> (F) Enforceability of emission limitations and control measures; and
> (G) The anticipated net effect on visibility due to projected changes in point, area, and mobile emissions over the period addressed by the long-term strategy.[13]

Additionally, a state

> Must include in its implementation plan a description of the criteria it used to determine which sources or groups of sources it evaluated and how the four factors were taken into consideration in selecting the measures for inclusion in its long-term strategy.[14]

In developing its plan, the state must document the technical basis for the SIP, including monitoring data, modeling, and emission information, including the baseline emission inventory upon which its strategies are based.[15] All of this information is part of a state’s revised SIP and

---

[11] 40 C.F.R. § 51.308(f).
[12] *Id.* § 51.308(f)(2)(i).
[13] *Id.* § 51.308(f)(2)(iv).
[14] 40 C.F.R. § 51.308(f)(2)(i).
[15] 40 C.F.R. § 51.308(f)(2)(i).

subject to public notice and comment. A state's reasonable progress analysis must consider the four factors identified in the Clean Air Act and regulations. *See* CAA 169A(g)(1); 40 C.F.R. 51.308(f)(2)(i) ("the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected anthropogenic source of visibility impairment.")

EPA's 2017, Regional Haze Rule Amendments made clear that states are to first conduct the required four-factor analysis for its sources, and then use the results from its four-factor analyses and determinations to develop the reasonable progress goals.[16] Specifically, EPA explained in its final notice that it proposed, took and responded to comments and amended 40 C.F.R. § 51.308(f) to eliminate the cross-reference to 40 C.F.R. §51.308(d) to "codify …[its] long-standing interpretation of the way in which the existing regulations were intended to operate" to track "the actual [SIP] planning sequence" as follows, thus, states are required to:

(1) [C]alculate baseline, current and natural visibility conditions, progress to date and the URP;
(2) [D]evelop a long-term strategy for addressing regional haze by evaluating the four factors to determine what emission limits and other measures are necessary to make reasonable progress;
(3) [C]onduct regional-scale modeling of projected future emissions under the long-term strategies to establish RPGs and then compare those goals to the URP line; [FN73] and
(4) [A]dopt a monitoring strategy and other measures to track future progress and ensure compliance.[17]

Thus, to the extent Ecology's draft long-term strategy uses reasonable progress goals developed by the Western Regional Air Partnership (WRAP) *before* conducting the required four-factor analysis – which as discussed in Section X of these comments it appears it has done - it has reversed the order of the requirements. Ecology must first conduct the four-factor analyses, determine measures for reducing visibility impairing emissions and then use the results to develop proposed revisions to the reasonable progress goals.

The state's SIP revisions must meet certain procedural and consultation requirements.[18] The state must consult with the Federal Land Manager(s) and look to the Federal Land Managers' expertise of the lands and knowledge of the way pollution harms them to guide the state to ensure SIPs do what they must to help restore natural skies.[19] The rule also requires that in "developing any implementation plan (or plan revision) or progress report, the State must include a description of how it addressed any comments provided by the Federal Land Managers."[20]

[16] 82 Fed. Reg. 3078, 3090-91 (Jan. 10, 2017).
[17] *Id.* at 3091.
[18] For example, in addition to the RHR requirements, states must also follow the SIP processing requirements in 40 C.F.R. §§ 51.104, 51.102.
[19] 40 C.F.R. § 51.308(i).
[20] *Id.* § 51.308(i)(3).

Finally, the duty to ensure reasonable progress requirements are met for purposes of the SIP rests with the state. While the WRAP plays an important role in providing support in regional haze planning, the state is ultimately accountable for preparing, adopting, and submitting a compliant SIP to EPA. Further, as discussed more fully in Section X of these comments, Ecology has an obligation to cite to the technical support documentation it proposes to rely on and use as part of its SIP revision.[21]

B. Requirements for Sources with Permits (and State "RACT") In Process: Four-Factor Analysis Required

We provide the following comments regarding RP requirements pertaining to sources with permits in process, which include the Cardinal FG Winlock Glass Plant. In addition to the requirements that apply to this source, we provide an analysis of potential controls for Cardinal FG Winlock Glass Plant in Section V, below. While the Company requested a permit to install emission controls, the permit does not exempt it from a four-factor analysis and establishment of emission limits to provide reasonable progress towards the national visibility goal. Ecology should conduct a proper four-factor analysis for the Cardinal FG Winlock Glass Plant and ensure that emission limits are imposed to address the facility's visibility impairing pollution.

For a source that is found subject to the required reasonable progress Four-Faction Analysis as a result of a state's reasonable progress screening process, the state must ensure the Analysis is conducted. Neither the Act nor EPA's rules provide an "off-ramp" for a source in this situation. A RACT analysis that Ecology may have gone through (or will go through in the future) for an individual source or source category is separate and distinct from the four-factor reasonable progress analysis requirement. The regional haze program includes identifying and issuing requirements to remedy *existing* impairment and also requirements necessary to prevent *future* impairment. The four-factor RP and RACT analysis apply different factors and consider different information because they are different programs with different objectives. A RACT analysis and controls must not be used as an offramp to the requirement to conduct the four-factor RP analysis and determine RP for the source. The regional haze four-factor RP analysis and determination applies *in conjunction with* other CAA programs. Therefore, as individual sources and source categories are modified and subject to emission controls (e.g., RACT), Ecology must take into consideration *all* requirements of the CAA (e.g., RP four-factor analysis and determination) and not make one decision in isolation, set aside distinct requirements or delay their implementation. A state's issuance of a permit does not replace its responsibility under the CAA to conduct the required RP four-factor analysis.

Additionally, since Ecology did not provide a Q/d value, as you'll see below in our comments, we provide that evaluation. Based on the Q/d value, it's clear that a Four-Factor Analysis is required for this source. The duty to ensure reasonable progress requirements are met for purposes of the SIP rests with the state, not the source. Therefore, if a source is unwilling to prepare the Analysis, Ecology must conduct the analyses to inform its reasonable progress determination. The lack of Ecology's analysis on this source appears to suggest that doing nothing to meet the reasonable progress requirements is justified because the source "proposes"

[21] *See, e.g.,* 40 C.F.R. §§ 51.100, 51.102, 51.103, 51.104, 51.105 and Appendix V to Part 51.

controls on "some" of the visibility impairing pollutants. Ecology fails to provide any authority or analysis for this "do nothing" approach.

Because the Q/d value for this source shows a Four-Factor Analysis is required, Ecology must conduct the required four-factor analysis for the source, including requirements for emission limitations and other measures based on the source's current operations. If the source elects some other emission controls, which are less stringent than what would be required under the Four-Factor Analysis, Ecology should further analyze the source to evaluate additional controls. Furthermore, since the source is subject to the reasonable progress requirements, Ecology must integrate the source into its regional haze plan and include provisions to ensure permit provisions are enforceable in the SIP.

Ecology cannot merely rely on the permit provisions for this source. The Clean Air Act requires states to submit implementation plans that "contain such emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress toward meeting the national goal" of achieving natural visibility conditions at all Class I Areas.[22] The Regional Haze Rule requires that states must revise and update its regional haze SIP, and the "periodic comprehensive revisions must include the "enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress as determined pursuant to [51.308](f)(2)(i) through (iv)."[23] At this point, as discussed above, the State's materials lack the required Four-Factor Analysis, emission limitations and other requirements necessary. Furthermore, EPA's Guidance further explains these requirements:

> This provision requires SIPs to include enforceable emission limitations and/or other measures to address regional haze, deadlines for their implementation, and provisions to make the measures practicably enforceable including averaging times, monitoring requirements, and record keeping and reporting requirements.[24]

Thus, EPA's Guidance recognizes EPA's long-standing position that while the SIP is the basis for demonstrating and ensuring state plans meet the regional haze requirements, state-issued permits must complement the SIP and SIP requirements.[25] State-issued permits must not frustrate SIP requirements.[26] For example, sources with PSD permits under Title I must not hold permits that allow emissions that conflict with SIP requirements.[27] Additionally, the Act's Title V operating permits collect and implement all the Act's requirements – including the

---

[22] 42 U.S.C. § 7491(a)(1), (b)(2).

[23] 40 C.F.R. § 51.308(f)(2); 40 C.F.R. § 51.308(d)(3)(v)(F) (Enforceability of emission limitations and control measures).

[24] "EPA Guidance on Regional Haze State Implementation Plans for the Second Implementation Period," at 42-43 (August 20, 2019), https://www.epa.gov/sites/production/files/2019-08/documents/8-20-2019_-_regional_haze_guidance_final_guidance.pdf. (While NPCA filed a Petition for Reconsideration regarding EPA's issuance of the 2019 Guidance, it does not dispute the information in the Guidance referenced here regarding enforceable limitations, which cite to the "General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990, 74 Fed. Reg. 13498 (April 16, 1992).

[25] 74 Fed. Reg. 13498, 13568 (April 16, 1992).

[26] Furthermore, to the extent stationary source are granted permits by rule or other mechanisms, these other categories that allow construction and operation must also complement SIP requirements.

[27] Additionally, the proposed SIP revisions fail to contain source-specific "measures to mitigate the impacts of construction activities." 40 C.F.R. § 51.308(d)(3)(v)(B).

requirements in the SIP – as applicable to the particular permittee. And sources with Title V permits must not hold such permits if they contain permit terms and conditions that conflict with the SIP and Clean Air Act SIP requirements.

C. It is Inconsistent with the CAA's Requirements to Use Air Quality Modeling to Decide Reasonable Process Controls

As explained above the reasonable progress four-factor analysis includes consideration of the following:

- Consider the costs of compliance,
- The time necessary for compliance,
- The energy and non-air quality environmental impacts of compliance, and
- The remaining useful life of any potentially affected sources.[28]

The four-factor analysis is clearly bounded by the information collected under each of the factors. Air quality impacts, modeling results, and emission inventories are not information collected pursuant to any of the four-factors. Therefore, to the extent a state adds an additional factor or factors to its four-factor analysis the state's analysis is inconsistent with the four-factor analysis requirement. As discussed in these comments, as part of its reasonable progress analysis Ecology uses visibility impacts to reject emission controls at several of the sources, and because visibility is not one of the four statutory factors, the State cannot rely on it to exclude emission reducing measures from a source that otherwise satisfies the four statutory factors.

III. Four-Factor Reasonable Progress Analysis Ardagh Glass Plant

Enclosed at Exhibit 1 is the "Four-Factor Reasonable Progress Analysis for Ardagh Glass, Inc. in Seattle, Washington, which evaluates the feasibility of installing emission control equipment for air pollutants that are precursors to regional haze.

IV. Comments on Four-Factor Analyses Submitted for the Oil Refineries

According to the four-factor submittals made for the refineries, Ecology requested four-factor analyses for each fluid catalytic cracking unit (FCCU), boiler with heat input greater than 40 MMBtu/hr, and heater with heat input greater than 40 MMBtu/hr that has not been retrofitted with NOx controls since 2005.[29] However, if any of these units have been retrofit with NOx controls since 2005, at most the units have been retrofitted with combustion controls. SCR should still be evaluated as an add-on control measure for units with LNB or ULNB or other combustion controls, even if installed in the past 15 years.

[28] CAA 169A(g)(1); 40 C.F.R. 51.308(f)(2)(i).
[29] *See*, e.g., BP Cherry Point Refinery Regional Haze Four Factor Analysis, April 2020 (hereinafter "BP Cherry Point Analysis") at 2.

Ecology apparently also limited the evaluation of NOx controls to low NOx burners (LNB), Ultra-low NOx burners (ULNB), and selective catalytic reduction (SCR).[30] It is not clear why Ecology did not also ask for a review of selective noncatalytic reduction (SNCR). McIlvaine Company indicates that urea-based SNCR used at refinery process units and boilers has generally achieved 50-70% NOx reduction.[31] In its AP-42 emission factor documentation for heaters and boilers from 1998, EPA stated that LNBs and FGR were the two most prevalent control techniques being used at gas-fired heaters and boilers.[32] Thus, if LNB or ULNB are truly not technically feasible for a heater or boiler, Ecology should at least require FGR be evaluated as a NOx control. In addition, LNBs plus FGR should also be evaluated as a control measure, which EPA states can reduce NOx by 60-90%.[33] Further, Ecology should require that combustion controls be evaluated in conjunction with SNCR and SCR to determine the most effective and the most cost-effective NOx emissions controls.

In addition, Ecology should not limit evaluation of LNBs and ULNBs for units greater than 40 MMBtu/hour capacity, as such burners are available for smaller units.[34] 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).[35] 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.[36] This was based on actual ULNB retrofit experience at boilers and heaters in the San Joaquin Unified Air Pollution Control District (SJVAPCD).[37] 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.[38] Thus, Ecology should not limit the evaluation of reasonable progress controls to only heaters and boilers greater than 40 MMBtu/hr. Ecology should also request companies demonstrating that the retrofit of ULNBs is not technically feasible and for which SNCR or SCR are truly not cost effective to 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.

None of the five refineries for which Ecology requested four-factor analyses found that 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

---

30 *Id.*
31 *See* http://www.mcilvainecompany.com/industryforecast/refineries/background1/text/Chapter%20X/Chapter%20X.htm.
32 EPA, AP-42, Section 1.4.4 (last revised 1998), available at: https://www.epa.gov/sites/production/files/2020-09/documents/1.4_natural_gas_combustion.pdf.
33 *Id.*
34 *See*, e.g., BP Cherry Point Refinery Regional Haze Four Factor Analysis, April 2020 (hereinafter "BP Cherry Point Analysis") at 2.
35 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, at 120. ("Exhibit 3," attached.)
36 *Id.* at 121.
37 *Id.*
38 *Id.* at 121-122.

boiler, or a company claimed that controls were not cost effective. Tesoro used a cost effectiveness threshold of $3,430/ton which the company claims is from the $3,400/ton used by EPA in 2011 for the Cross-State Air Pollution Rule scaled to today's dollars.[39] Based on this threshold, Tesoro found that no additional NOx controls (whether low NOx burners or SCR) would be cost effective for its heaters and boilers. However, no justification has been provided for use of this cost threshold or any cost threshold for defining measures necessary to make reasonable progress. 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."[40]

With respect to determining whether a NOx control is cost effective for a particular heater or boiler, 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 SNCR.[41] 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 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.[42] 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.[43] It is important to note that these cost effectiveness analyses were done using a higher interest rate of 5.5% than currently applies,[44] as the bank prime lending rate is currently 3.25%.

In determining cost effective controls for the heaters, boilers and FCCU's at the refineries selected for review, Ecology must consider the fact that other similar sources have been required to retrofit LNB/ULNB or similar combustion controls, or SCR/SNCR if combustion controls are not feasible to meet an emission limit. We encourage Ecology to review Table 42 of the attached March 6, 2020 report of four-factor analyses for the oil and gas industry,[45] 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,

---

[39] *Id.* at 10.
[40] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 39.
[41] 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. ("Exhibit 3," attached.)
[42] *Id.* at 125 (Table 36).
[43] *Id.* at 135 (Table 41).
[44] *Id.* at 125 (fn 568) and at 135 (fn 615).
[45] 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. ("Exhibit 3," attached.)

which most likely reflects use of SCR. The most stringent limits for smaller heaters and boilers between 2 to 75 MMBtu/hr range between 5 to 12 ppm, which reflect LNB/ULNB at the minimum, if not SNCR/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 these controls, LNB/ULNB at the minimum, to be cost effective for the heaters, boilers, and FCCUs evaluated in the refinery four-factor analyses. We urge Ecology to give preference to the most effective control that will remove the highest rate of NOx achievable and otherwise satisfy the Four-Factor reasonable progress analysis.

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 without significant revisions. More specific concerns with each company's four-factor analyses of NOx controls are provided below.

A. Tesoro Refining (Anacortes Refinery) Four-Factor Analyses

Tesoro Refining & Marketing Company LLC's (Tesoro's) Anacortes Refinery submitted a four-factor analysis for fluid catalytic cracking unit (FCCU) and boilers and heaters greater than 40 MMBtu/hr. Specifically, Tesoro submitted a four-factor analysis for 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.

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.[46] However, none of Tesoro's heaters or boilers that it exempted from a four-factor analysis have installed SCR to reduce NOx emissions. Given that SCR is such a highly effective NOx control, the state should require the evaluation of SCR installation at all boilers and heaters at the refinery.

[46] Tesoro Four-Factor Analysis at 3.

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.[47] 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.[48] 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.[49] 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.[50] No basis was cited for this cost. The company calculated a cost per gallon for 19.5% aqueous ammonia of $3.513 per gallon.[51] 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 Minerals Commodities Summaries for which EPA provided a weblink.[52] The U.S. Geological Survey Minerals Commodities Report currently lists the 2019 average cost for ammonia at $230/ton.[53] 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.[54] Use of anhydrous ammonia is the least expensive form of the reagent and is commonly used at utility installations.[55] The State must ensure that Tesoro

[47] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[48] Tesoro Four-Factor Analysis at pdf page 39 (Appendix A at F-301).
[49] *Id.* 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.
[50] *See*, e.g., Tesoro Four-Factor Analysis, Appendix A at F-102 (pdf page 26 of document).
[51] *Id.*
[52] See EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[53] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 116, available at https://www.usgs.gov/centers/nmic/mineral-commodity-summaries.
[54] EPA, Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 15.
[55] *Id.* at pdf page 5.

evaluates the most cost-effective approaches to controlling NOx emissions with SCR and also that Tesoro does 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 fluid catalytic cracking unit (CCU) for which Tesoro used a cost estimate from a similar installation.[56] For the CCU, only a one-page printout of an apparent spreadsheet was provided for review. The State should request the underlying calculations that went into the spreadsheet as well as the cost estimates from a planned SCR installation at an FCCU at the other Marathon refinery that Tesoro relied on. Without that data, it is not clear if the SCR cost analysis for the CCU complied with EPA's Control Cost Manual. In addition, the NOx control cost effectiveness of the SCR installation at the other Marathon facility should be made available and considered by the State, among other factors, in deciding whether SCR is cost effective at the CCU at the Tesoro refinery.

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.[57] 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.[58] The State should 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 control efficiency of 75%.[59] The State should request justification for only assuming 75% control for Boiler 3.

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.[60] There was no basis provided for only assuming a 20-year life of ULNB.[61] 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,[62] because the low NOx burners installed at Crude Heater 1 (F-101), Crude Heater 3 (F-

[56] Tesoro Four-Factor Analysis at Appendix A.
[57] EPA Control Cost Manual, Section 4, Chapter 2 Selective Catalytic Reduction at pdf page 59, Table 2.6.
[58] Compare values used for flue gas volumetric flow rate factors in Tesoro Four-Factor Analyses, Appendix A, to Table 2.6 of EPA's Control Cost Manual, Section 4, Chapter 2 Selective Catalytic Reduction.
[59] Tesoro Four Factor Analysis, Appendix A, SCR spreadsheet printouts.
[60] *Id.* at pdf pages 84-91.
[61] *Id.* at 15.
[62] *Id.* at 3.

103), CGS Column C-113 Reboiler (F-104), BenSat Column C-6601 Reboiler (F-6602), and Carbon Monoxide Boiler 1 (F-302)[63] 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 best available retrofit technology (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.[64] In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR.[65] 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.[66] Yet, the CGH Heater F-104, which has ULNBs,[67] is subject to a NOx limit of 0.035 lb/MMBtu.[68] 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.[69] 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),[70] Tesoro assumed a NOx rate of 0.04 lb/MMBtu in its evaluation of SCR cost effectiveness[71] which presumably reflects its current emission rate. Thus, Tesoro's evaluation of ULNBs for Units F-751 and F-752 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. Ecology must require Tesoro to evaluate this level of control for its heaters and boilers.

B. BP-Cherry Point Refinery Four-Factor Analyses

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;

[63] *Id.*
[64] *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).
[65] BP Cherry Point Four-Factor Analysis at 14.
[66] Tesoro Four-Factor Analyses, Appendix A, at pdf pages 84-91.
[67] *Id.* at 3-4.
[68] January 26, 2010 Air Operating Permit #013R1 for Tesoro Refining and Marketing Company at 72 (Permit Term 5.2.13).
[69] Tesoro Four-Factor Analyses, Appendix A, at pdf pages 87-88.
[70] *Id.* at page 7.
[71] *Id.,* Appendix A at F-753 (pdf page 61).

- Naphtha HDS Stripper Reboiler;
- Hydrocracker R-4 Heater;
- #1 Hydrogen Plant (North and South Furnaces);
- #5 Boiler.

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. BP used 2016 as the baseline year for cost effectiveness analysis for the various emission units, but it did not provide any analysis to show that 2016 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.[72] In addition, BP did not identify each units' baseline NOx emissions rates in terms of lb/MMBtu, nor did BP specify the baseline operating hours/capacity factor of each unit. Such information is necessary to review to ensure that the company selected a reasonable period of baseline emissions for its cost effectiveness analyses that reflects a reasonable projection of emissions in 2028, as required by EPA's regional haze guidance. Ecology must request that the company make that information available in BP Cherry Point's four-factor analysis. Ecology should also request that BP justify its year of baseline emissions as reflective of future operations in 2028.

2. One of the deficiencies in BP Cherry Point's cost analyses is that it used a 5% interest rate in amortizing capital costs.[73] 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.[74] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[75] 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.

3. 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.[76] 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%.[77] EPA's Control Cost

[72] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[73] BP Cherry Point Four-Factor Analyses at 5.
[74] https://fred.stlouisfed.org/series/DPRIME.
[75] 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.
[76] BP Cherry Point Four-Factor Analyses at 9-12.
[77] *Id.* at 12.

Manual cautions against attempting to escalate costs more than five years from the original cost analysis.[78] 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."[79] 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. Thus, Ecology should request that BP obtain current retrofit cost information for these units. Notably, for SCR, EPA's SCR cost effectiveness spreadsheet can be used to estimate costs of SCR, as was used by the Tesoro Refinery in its cost effectiveness analyses.

4. 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 hydrocracker R-4 heater due to flame impingement and that they would need to rebuild the heater to accommodate the burner retrofit.[80] 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. Ecology should request BP to evaluate the cost effectiveness of replacing the 50-year old heaters and boilers.

5. 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.[81] 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.[82] Tesoro evaluated LNB/ULNB to meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.[83]

6. 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 should request justification and documentation for any retrofit factors used in BP's cost analyses.

---

[78] EPA Control Cost Manual, Section 1, Chapter 2 Cost Estimation: Concepts and Methodology, November 2017, at 19.
[79] *Id.*
[80] BP Cherry Point Analysis at 15-17.
[81] BP Cherry Point Analysis at 7.
[82] *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. ("Exhibit 3," attached.)
[83] BP Cherry Point Analysis at 19.

7. BP assumed a cost for ammonia reagent in the SCR systems of $0.33/lb, or $660/ton, which is unreasonably high.[84] 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.[85] The U.S. Geological Survey Minerals Commodities Report currently lists the 2019 average cost for ammonia at $230/ton.[86] 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 used at utility installations. The State must ensure that BP evaluates the most cost-effective approaches to controlling NOx emissions with SCR and also that Tesoro does not use a wholly unjustified and very high cost for ammonia of $900/ton.

8. Ecology should ask BP to doublecheck and request documentation the number of operating hours assumed in the calculation of ammonia reagent costs for SCR. 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.

9. With respect to non-air quality impacts of SCR controls, BP has indicated that spent catalyst will require off-site disposal or recycling.[87] 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 BP's SCR cost analyses assumes the most cost-effective options for catalyst replacement.

10. BP assumed it would take 7 to 10 years to implement additional NOx control strategies.[88] Yet, the company has not proposed to install any control strategies in its four-factor submittal. The company states that it would need to follow the refinery maintenance 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. Ecology should request an evaluation of the time to install controls for each boiler and heater, the #1 reformer heaters, the #2 reformer heater, and Ecology should also evaluate how long it took BP to install controls adopted to meet BART which requires compliance within five years.

---

[84] BP Cherry Point Four-Factor Analysis at Attachment B.
[85] See EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[86] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 116, available at https://www.usgs.gov/centers/nmic/mineral-commodity-summaries.
[87] BP Cherry Point Four-Factor Analysis at 13.
[88] BP Cherry Point Four-Factor Analyses at 13.

C. Shell Puget Sound Refinery

The Shell Puget Sound Refinery is located near Anacortes, Washington. Shell submitted a four-factor analysis evaluating NOx controls for its FCCU and boilers and heaters greater than 40 MMBtu/hr. The company stated that Ecology only requested evaluations of LNB/ULNB and SCR.[89] 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.[90] 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.[91] 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. That fact is persuasive in that LNBs are widely used at refinery heaters and boilers, and thus at least that level of control should be required to meet reasonable progress. 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."[92] However, emissions data in the 2017 National Emission Inventory show that NOx emissions for the refinery were 1,054 tons per year, which is significantly higher than the 592.6 tons per year of NOx that Shell has indicated was emitted in 2019. Ecology must ensure that the year of emissions selected

[89] Shell Puget Sound Refinery Four-Factor Analysis at 2-1.
[90] *Id.* at 5-5.
[91] *Id.*
[92] *Id.* at 4-1.

by Shell does not reflect a period of lower levels of operation and that the 2019 baseline level operations and emissions are expected to continue at that rate.

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%.[93] 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.[94] 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.[95] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years.[96] In the four-factor submittals made to Ecology, BP Cherry Point assumed 25 years for LNB/ULNBs as well as SCR.[97] 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 expected to be less than 10 years."[98] The company assumed 8 years in its four-factor analysis for the Erie City Boiler.[99] 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.[100] Ecology should also require that any replacement boiler should, at the very least, be equipped with state-of-the-art ULNB. The Erie City Boiler 1 currently

---

[93] *Id.* at 5-3.
[94] *Id.* at 8-0.
[95] *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).
[96] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[96] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 80.
[97] BP Cherry Point Four-Factor Analysis at 3, 14 and at Attachment B.
[98] Shell Four-Factor Analyses at 5-5.
[99] *Id.*
[100] *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."

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 LNG 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.[101] 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.[102] 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.[103]

6. For SCR, Shell assumed a NOx removal efficiency of 90%. Yet, Tesoro and BP often assumed NOx removal efficiencies of 95% in their evaluation of SCR. BP assumed SCR would achieve 95% control or 5 ppm, whichever resulted in higher emissions.[104] A review of the printout of SCR cost spreadsheets provided in Appendix A of Tesoro's Four-Factor Analyses shows that the company assumed a controlled NOx rate of 0.01 lb/MMBtu with SCR for almost all units evaluated, which typically reflected a NOx control efficiency in excess of 90% for most units.[105] Ninety percent control is clearly not the maximum level of reduction that could be achieved with SCR, and Ecology should request Shell to evaluate NOx control at levels of NOx removal similar to what BP and Tesoro have assumed.

7. For SCR, Shell used the EPA SCR cost spreadsheet made available with EPA's recent updated 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%. 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 Shell'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.[106] 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

[101] *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. ("Exhibit 3," attached.)
[102] May 5, 2015 Air Operating Permit AOP 014R1M1 for Shell Puget Sound Refinery at 13 and 127.
[103] Tesoro Four-Factor Analysis at Appendix A (at pdf pages 84-91).
[104] BP Cherry Point Four-Factor Analysis at 8.
[105] Tesoro Four-Factor Analysis at Appendix A. Not that Tesoro only assumed 75% control across the SCR at its Boiler 3, which was not sufficiently documented or justified as discussed above.
[106] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 66.

and fully documented."[107] No unit-specific documentation of the justification for higher SCR retrofit factors was included in Shell's four-factor submittal.

8. Shell appears to have assumed that that the gas stream of each heater/boiler would need to be reheated to accommodate SCR.[108] 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 to justify the inclusion of these costs for reheating the gas stream for each of the emission units at the Shell refinery.

D. Phillips 66 Ferndale Refinery Four-Factor Analysis

Phillips 66 provided four-factor analyses of NOx controls for the following emission units at its Ferndale Refinery:[109]

- 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.[110] 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.[111] The following provides comments on the four-factor analyses submitted by Phillips 66.

---

[107] *Id.* (emphasis added)
[108] Shell Four-Factor Analysis at Appendix B.
[109] Regional Haze Four-Factor Analysis, Phillips 66 Ferndale, WA Refinery, June 2020 (hereinafter referred to as "Phillips 66 Four-Factor Analysis"). Note that Phillips 66 originally submitted its four-factor analysis in April of 2020, 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.
[110] Phillips 66 Four-Factor Analysis at 1-1.
[111] *Id.*

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.[112] 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 should request that Phillips 66 show each of the five years of emissions available for review so it can be determined if the average likely reflects expected emissions in 2028. The state should ensure that the 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.[113] 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.[114] 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 Phillips 66 units.

4. Phillips 66 assumed high NOx rates with LNB in the range of 0.09 to 0.23 lb/MMBtu.[115] 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.[116] 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.[117] It is also worth noting that Tesoro evaluated LNB/ULNB to

---

[112] *Id.* at 4-1.
[113] *Id.* at Appendix B.
[114] *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).
[115] *Id.*
[116] *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. ("Exhibit 3," attached.)
[117] May 5, 2015 Air Operating Permit AOP 014R1M1 for Shell Puget Sound Refinery at 13 and 127.

meet NOx emission rates of 0.040 lb/MMBtu in its four-factor analyses.[118] 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.[119]

5. Phillips 66 only assumed 90% control of NOx with SCR.[120] Yet, Tesoro and BP often assumed NOx removal efficiencies of 95% in their evaluation of SCR. BP assumed SCR would achieve 95% control or 5 ppm, whichever resulted in higher emissions.[121] A review of the printout of SCR cost spreadsheets provided in Appendix A of Tesoro's Four-Factor Analyses shows that the company assumed a controlled NOx rate of 0.01 lb/MMBtu with SCR for almost all units evaluated, which typically reflected a NOx control efficiency in excess of 90% for most units.[122] Ninety percent control is clearly not the maximum level of reduction that could be achieved with SCR, and Ecology should request Phillips 66 to evaluate NOx control at levels of NOx removal similar to what BP and Tesoro have assumed.

6. 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.[123] 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.

7. 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.[124] These were all identified as "indirect capital costs."[125] 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. Ecology must request further justification for these indirect capital costs to determine if identical costs are justified for each SCR installation. 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.[126]

---

[118] Tesoro Four-Factor Analysis at Appendix A (at pdf pages 84-91).
[119] Phillips 66 Four-Factor Analysis, Appendix B (at pdf page 44).
[120] *Id.* at 5-2.
[121] BP Cherry Point Four-Factor Analysis at 8.
[122] Tesoro Four-Factor Analysis at Appendix A. Not that Tesoro only assumed 75% control across the SCR at its Boiler 3, which was not sufficiently documented or justified as discussed above.
[123] Phillips 66 Four-Factor Analysis, Appendix B.
[124] *Id.* (at pdf page 45).
[125] *Id.*
[126] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 65.

E. U.S. Oil & Refining Company – Tacoma Refinery Four-Factor Analysis

U.S. Oil submitted a four-factor analysis of NOx controls for the following emission units:[127]

- 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.[128] 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.[129]

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."[130] 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[131]

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 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

[127] Regional Haze Four-Factor Analysis for U.S. Oil & Refining Co., Tacoma Refinery, April 2020 (hereinafter "U.S. Oil Four-Factor Analysis) at 3-2.
[128] *Id.* at 1-1.
[129] *Id.* at 1-1 to 1-2.
[130] *Id.* at 4-1.
[131] *Id.*

> basis for quantifying any change in future emissions due to operational changes may be another.

EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.

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 should 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%.[132] 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.[133] 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.[134] 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.

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

---

[132] *Id.* at B-2.
[133] *Id.* at 5-5.
[134] *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).

4. U.S. Oil only assumed 90% control of NOx with SCR. Yet, Tesoro and BP often assumed NOx removal efficiencies of 95% in their evaluation of SCR. BP assumed SCR would achieve 95% control or 5 ppm, whichever resulted in higher emissions. A review of the printout of SCR cost spreadsheets provided in Appendix A of Tesoro's Four-Factor Analyses shows that the company assumed a controlled NOx rate of 0.01 lb/MMBtu with SCR for almost all units evaluated, which typically reflected a NOx control efficiency of greater than 90% for most units. Ninety percent control is clearly not the maximum level of reduction that could be achieved with SCR, and Ecology should request U.S. Oil to evaluate NOx control at levels of NOx removal similar to what BP and Tesoro have assumed.

5. U.S. Oil applied a 1.5 retrofit factor to the costs for both ULNB and for SCR.[135] 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."[136] This is not sufficient documentation to justify a retrofit factor, especially such a high retrofit factor.

7. U.S. Oil states that SCR will require flue gas reheating.[137] 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.

V. Analysis of Potential Controls for 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 791.5 tons per year based on 2014

[135] *Id.* at 5-4 and at Table B-2 (pdf page 45).
[136] *Id.* at Table B-2.
[137] *Id.* at 5-5.

emissions.[138] In 2017, its NOx emissions were a bit higher at 809.1 tons per year.[139] Thus, the facility is a large source of NOx. Based on 2017 emissions and considering Class I areas in which the facility had a Q/d equal to or greater than 5, we calculate a cumulative Q/d of the Cardinal FG Winlock Glass Plant as 48.0. Therefore, the Cardinal Glass Plant is subject to the four-factor analysis. As discussed above in Section II.B. and in this section, the RH four-factor analysis applies to the Cardinal Glass Plant *in conjunction with* any other CAA requirements. That additional regulatory requirements also apply to this or any other sources does not obviate the need for the state to comply with reasonable progress requirements, nor excuse timely compliance.

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, remove existing NOx controls, and increase production of plate glass. However, the company is also planning on an increase in glass production capacity, from 650 tons per day to 750 tons per day. Ecology presented the difference in potential to emit based on the current emission limits and the permit modification limits in an attempt to focus on the reduction in potential emissions for NOx and the seemingly minor increases for PM10, PM2.5, and to a lesser extent SO2.[140] However, in conducting the required four-factor analysis, Ecology must present what the increase in emissions that could be allowed with the permitted increase in glass production capacity compared to current actual emissions. For example, the Cardinal FG Winlock Glass Plant's SO2 emissions in 2017 were 49 tons per year and the facility and the facility-wide potential to emit after the permit modification will be 114.21 tons per year.[141] Ecology must explain whether this means SO2 emissions could actually increase by the difference of these two values, or by 65.21 tons per year. Similarly, the 2017 actual PM10 emissions of the facility were 58 tons per year and the facility-wide potential to emit PM10 after the permit modification is 141.96 tons per year,[142] so does this mean with the glass plant capacity increase that PM10 could actually increase by 83.96 tons per year?

With respect to NOx, the facility-wide NOx emissions in 2017 were 723 tons per year, and the facility-wide potential to emit is 249.62 tons per year,[143] which only reflects a NOx reduction with SCR of 65.5% which is much lower than the 90%+ control efficiency that SCR is capable of achieving. In part, the higher annual NOx emissions after the capacity increase are because the exhaust gas is currently planned to be reheated to "raise the exhaust steam temperatures to the range required for proper SCR operation."[144] However, the increased exhaust temperature will "require the existing spray dryer and electrostatic precipitator (ESP) to operate at higher temperatures, reducing their collection efficiency."[145] Further, Ecology states

---

[138] *Id.*
[139] Data from EPA's National Emissions Inventory for 2017.
[140] WDOE Draft SIP Revision, Chapter 11, at 21 (Table 3).
[141] *Id.* at 12 and 21.
[142] *Id.*
[143] *Id.*
[144] *Id.* at 20.
[145] *Id.* at 21.

that the "increased temperature results in a greater fuel consumption and SO2 emissions."[146] Thus, the addition of the SCR, which the company is planning to install in lieu of, rather than in addition to, its existing combustion control system will not be utilized to its maximum emission reduction potential and will result in increases in other visibility-impairing pollutants.

Consistent with the four-factor analysis, Ecology must evaluate other options to accomplish the NOx emission reductions without increasing other visibility-impairing pollutants. First, Ecology must explain why it is justifiable 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. For example, if the company were required to add SCR along with the existing 3R process, which is currently required by the Cardinal FG Winlock's prevention of significant deterioration (PSD) permit,[147] it could operate SCR at a NOx removal efficiency that both reduced NOx emissions from current levels and ensured the same efficacy of PM and SO2 removal by not having to reheat the gas stream. In addition, the use of low temperature catalysts should have been evaluated for the SCR, to avoid having to heat the gas stream and reduce the effectiveness of the PM and SO2 controls. 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 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 1.

Ecology applies RACT and asserts that it need not also independently address reasonable progress requirements. Application of RACT, does not negate Ecology's obligation to comply with the RHR and evaluate reasonable progress requirements for a source the state identified in its RP screening process. This includes not only identifying and issuing requirements to remedy existing impairment but also requirements necessary to prevent future impairment. RACT and RP are not equivalent programs and do not host the same objectives. As such it is incumbent on the agency to conduct a reasonable progress analysis for Cardinal and determine RP for the source.

Ecology must also 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. 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

[146] *Id.* at 21-22.
[147] *See* PSD-03-03, Amendment 2, issued by WDOE to Cardinal FG Company on Dec. 13, 2010, at Condition 15.1.1.

> 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 in that the revised emission limits do not reflect the lowest emission limit for the spray dryer and electrostatic precipitator that are installed at the glass furnace.

VI. Comments on Four-Factor Analyses Submitted by the Northwest Pulp & Paper Association (NWPPA) for the Washington Pulp and Paper Mills

The Northwest Pulp & Paper Association (NWPPA) submitted four-factor analyses for several emission units associated the following five 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.[148]

The NWPPA report is organized by reviewing controls for similar emission units at each of the six pulp and paper mills. Specifically, NWPPA evaluated controls for the following recovery furnaces, controls for lime kilns, and controls for power boilers at each pulp and paper mill.

Figure 1. Recovery Furnaces Evaluated by NWPPA.

Facility Name	Emissions Unit Description	Fuels Currently Fired	Current Pollution Controls
Nippon Dynawave Packaging Company	Recovery Furnace No. 10	Black Liquor Solids, No. 6 Fuel Oil	Electrostatic Precipitator
WestRock Longview Mill	Recovery Furnace 19	Black Liquor Solids, Natural Gas, No. 2 and No. 6 Fuel Oil	Electrostatic Precipitator

[148] *See* Dec. 5, 2019 Reasonably Available Control Technology Analysis for Washington Pulp and Paper Mills, Northwest Pulp & Paper Association (hereinafter "December 2019 NWPPA Report").

WestRock Longview Mill	Recovery Furnace 22	Black Liquor Solids, Natural Gas, No. 2 and No. 6 Fuel Oil	Electrostatic Precipitator
WestRock Tacoma Mill	Recovery Furnace No. 4	Black Liquor Solids, No. 6 Fuel Oil*	Electrostatic Precipitator
Port Townsend Paper Corporation	Recovery Furnace	Black Liquor Solids, No. 2 Fuel Oil	Electrostatic Precipitator
PCA Wallula Mill	No. 2 Recovery Furnace	Black Liquor Solids, No. 2 Fuel Oil, Natural Gas	Electrostatic Precipitator
PCA Wallula Mill	No. 3 Recovery Furnace	Black Liquor Solids, No. 2 Fuel Oil, Natural Gas	Electrostatic Precipitator

Figure 2. Lime Kilns Evaluated by NWPPA.

Facility Name	Emissions Unit Description	Fuels Currently Fired	Current Pollution Controls
Nippon Dynawave Packaging Company	Lime Kiln	Natural Gas	Electrostatic Precipitator Staged Combustion
WestRock Longview Mill	Lime Kiln 3	Natural Gas, Fuel Oil	Scrubber
WestRock Longview Mill	Lime Kiln 4	Natural Gas, Fuel Oil	Scrubber
WestRock Longview Mill	Lime Kiln 5	Natural Gas, Fuel Oil	Electrostatic Precipitator
WestRock Tacoma Mill	Lime Kiln No. 1	Natural Gas, No. 6 Fuel Oil	Scrubber
WestRock Tacoma Mill	Lime Kiln No. 2	Natural Gas, No. 6 Fuel Oil	Scrubber
Port Townsend Paper Corporation	Lime Kiln	Natural Gas, No. 2 Fuel Oil	Scrubber
PCA Wallula Mill	Lime Kiln	Natural Gas, No. 2 Fuel Oil	Scrubber

Figure 3. Power Boilers Evaluated by NWPPA.

Facility Name	Emissions Unit Description	Fuels Currently Fired	Current Pollution Controls
Nippon Dynawave Packaging Company	Power Boiler 6	Natural Gas	N/A
Nippon Dynawave Packaging Company	Power Boiler 7	Natural Gas	N/A
Nippon Dynawave Packaging Company	Power Boiler 9	Natural Gas	N/A
Nippon Dynawave Packaging Company	Hogged Fuel Boiler No. 11	Hog fuel, Bituminous Coal, Sludge, ultra-low sulfur diesel	ESP, Multiclone, DSI System, Overfire Air System
GP Camas	No. 5 Power Boiler	Natural Gas	Flue Gas Recirculation, Low NOx Burners
WestRock Longview Mill	Power Boiler 20	Natural Gas, Fuel Oil, Biomass*	WESP, Scrubber, SNCR
WestRock Tacoma Mill	Power Boiler No. 6	Natural Gas, No. 6 Fuel Oil	Low NOx Burners
WestRock Tacoma Mill	Power Boiler No. 7	Natural Gas, Biomass	ESP, Scrubber
Port Townsend Paper Corporation	Power Boiler No. 10	Natural Gas, No. 2 Fuel Oil, Hog Fuel	WESP, Multiclone, Scrubber
Port Townsend Paper Corporation	Package Boiler	Natural Gas	Low NOx Burner
PCA Wallula Mill	No. 1 Power Boiler	Natural Gas	N/A
PCA Wallula Mill	No. 2 Power Boiler	Natural Gas	N/A

PCA Wallula Mill	Hogged Fuel Boiler	Natural Gas, Hog Fuel	WESP, Overfire Air

Despite evaluating pollution controls for 28 emission units at six pulp and paper mills, NWPPA did not find that any additional pollution controls were cost effective for these units.

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 and, further below, additional comments are provided that specifically apply to the controls evaluated for lime kilns and for power boilers.

Deficiencies that Appear in All Four-Factor Analyses

NWPPA used an interest rate of 4.8% in amortizing capital costs of most of the controls evaluated.[149] For the evaluation of low NOx burners at the power boilers, NWPPA assumed a much higher interest rate of 7%.[150] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[151] The current bank prime rate is 3.25%.[152] 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 wet electrostatic precipitator (WESP), improvements to existing ESPSs, and combustion control upgrades. Further, NWPPA only assumed a 15-year life for the sulfur dioxide (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 low NOx burners (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 and SNCR and a 30-year life for WESPs and wet scrubbers in the cost effectiveness evaluation for these controls.[153] 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

[149] *Id.,* Appendix B at Tables B-1 through Table B-31.
[150] *Id.*, Appendix B at Tables B-57 through Table B-61.
[151] 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.
[152] https://fred.stlouisfed.org/series/DPRIME.
[153] 80 Fed. Reg. 18944 at 18955 (Apr. 8, 2015).

years old and nearing end of service life."[154] 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.[155] In addition, the Georgia Pacific Camas Mill installed an ESP at Power Boiler #3 in 1992, approximately 29 years ago,[156] which is still in operation although NWPPA has indicated that the Camas Mill "does not plan to operate Boiler No. 3 going forward."[157] 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.[158] 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.[159] 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."[160] With respect to determining whether a pollution control is cost effective for a recovery furnace, 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.[161] As another example, an SNCR system was installed at Power Boiler No. 20 of the WestRock Longview Mill in 2012.[162] 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.[163] The package boiler at Port Townshend Paper was converted to fire only natural gas using a low-NOx burner in 2016.[164] The hogged fuel boiler at the PCA Wallula Mill had an overfire air system and a WESP installed in 2016.[165] Regardless of the reasons that these controls were installed, the fact

---

[154] *See* Washington Department of Ecology, Statement of Basis, Air Operating Permit 0000078, WestRock Longview, LLN, December 15, 2020, at 12.
[155] *Id.* at 10.
[156] *See* Southwest Clean Air Agency, Title V Basis Statement, SW20-24-R0-A, Georgia-Pacific Consumer Operations LLC, December 17, 2020, at 7.
[157] *See* December 2019 NWPPA Report at 1-5.
[158] *Id.* at 2-12 and at 3-16.
[159] *Id.*
[160] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period at 39.
[161] *See* December 2019 NWPPA Report at 1-7 to 1-8.
[162] *Id.* at 1-8.
[163] *Id.*
[164] *Id.*
[165] *Id.* at 1-9.

that the controls were installed by the companies is indicative of the cost-effectiveness of the controls. Ecology should gather cost data on these control installations as well as costs of controls at other pulp and paper mills, in developing a cost effectiveness threshold for emission units at these facilities.

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."[166] Specifically, NWPPA used the cost estimates from this report to develop scaled capital cost estimates for WESPs, upgrades to ESPs, and for wet scrubbers.[167] NWPPA escalated costs from the 2003 cost basis of the NERA report to 2018 dollars using the Chemical Engineering Plant Index (CEPCI).[168] However, EPA's Control Cost Manual cautions against attempting to escalate costs more than five years from the original cost analysis.[169] 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."[170] 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. Thus, Ecology should request that NWPPA obtain current retrofit cost information for these controls.

4. NWPPA included costs for sales taxes, property taxes and insurance in its capital costs of controls for several controls evaluated.[171] 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.[172] In addition, it appears that air pollution controls would be exempt from Washington sales taxes.[173] 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.[174] It is not clear why the assumption of only a 10% capacity factor is justified for all recovery furnaces that could switch to less polluting fuels. NWPPA did state that "some recovery furnaces are limited by their air permit to an annual heat input

[166] *Id.* at Appendix C.
[167] *Id.*
[168] *Id.*, Appendix B at Tables B-1 through B-5, B-8, B-25 through B-28, and B-31.
[169] EPA Control Cost Manual, Section 1, Chapter 2 Cost Estimation: Concepts and Methodology, November 2017, at 19.
[170] *Id.*
[171] *See* December 2019 NWPPA Report, Appendix B at Table B-1 through B-31.
[172] *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.
[173] WAC 458-20-242A.
[174] *See* December 2019 NWPPA Report at 2-8.

of less than 10% fossil fuel…for avoidance of additional NSPS requirements."[175] 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.

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."[176] 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.[177] Ecology should request more information from NWPPA or the facility owners 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.[178] 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.

[175] *Id.*
[176] *Id.* at 2-9.
[177] EPA, Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, at 29.
[178] 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.

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 low NOx burners (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.[179] 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%.[180] 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 with wood or municipal solid waste.[181] Thus, NWPPA has greatly underestimated the NOx reduction capabilities and cost effectiveness of SNCR by only assuming 35% NOx control.

2. NWPPA used EPA's SNCR cost calculation spreadsheet made available with its Control Cost Manual.[182] 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."[183] 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.[184] 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.[185] 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.

---

[179] *See* December 2019 NWPPA Report at 3-8 and 3-10.
[180] 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.
[181] *Id.* at 1-1.
[182] Available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[183] *See* December 2019 NWPPA Report at 3-20.
[184] EPA, Control Cost Manual, Section 4, Chapter 1 Selective Non-Catalytic Reduction, 4/25/2019, at 1-6.
[185] *Id.* at 1-7 (Figure 1.2).

3. NWPPA used EPA's SCR cost calculation spreadsheet made available with its Control Cost Manual.[186] EPA's SCR cost spreadsheet already provides a 20% retrofit factor for SCR retrofits as compared to SCR installation costs on a new facility.[187] 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 new ID fan to account for increased pressure drop."[188] 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. Thus, 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.[189] Ecology should further evaluate these emission calculations to ensure consistency across

[186] Available at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution.
[187] 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.
[188] *See* December 2019 NWPPA Report at 3-22.
[189] *Id.*, Appendix B at Tables B-57 through Table B-61. The LNB cost analyses for these power boilers identify baseline NOx emissions.

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.[190] For this analysis, NWPPA inexplicably assumed a 7% interest rate rather than the 4.7% interest rate it assumed for its other cost analyses.[191] 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 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.[192] Low NOx burners should have a useful life of 25-30 years or more. In evaluations of best available retrofit technology (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.[193] 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.[194] 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.[195] Indeed, the No. 5 Power Boiler at the Georgia Pacific Camas Mill is equipped with these controls.[196] 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.

[190] *Id.* at 3-22.
[191] *Id.*, Appendix B at Tables B-57 through Table B-61.
[192] *Id.*
[193] *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).
[194] 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.
[195] *Id.*
[196] *See* December 2019 NWPPA Report at 3-13.

Figure 4. 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 Figure 4 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 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. Ecology must thus obtain more information on the cost analyses done and require revisions to those analyses to address the above issues, before making a determining on the most cost-effective controls for the power boilers at the pulp and paper mills evaluated by NWPPA.

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

Cosmo Specialty Fibers (Cosmo) operated 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.[197] 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. Ecology should require that Cosmo provide a four-factor analysis of controls for those emission units.

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.[198] 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 discussed in Section I.C., 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.[199] 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.[200] That basis statement also stated that "[p]roduction varies upon market demand."[201] 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.[202]

Deficiencies in Cosmo's cost effectiveness analyses

1. Cosmo assumed a 4.75% interest rate in amortizing capital costs of the controls evaluated.[203] In its Control Cost Manual, EPA states that the interest rate used in cost effectiveness analyses should be the bank prime interest rate.[204] The current bank prime rate is 3.25%.[205] In a cost effectiveness analyses being done today, an interest rate of

[197] December 2019 Four-Factor Analysis for Cosmo Specialty Fibers (hereinafter referred to as "Cosmo Four-Factor Analysis").
[198] *Id.* at 3-1.
[199] Washington Department of Ecology, Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills, November 2016, at 34.
[200] Support Document for the Air Operating Permit issued to Cosmo Specialty Fibers, [undated], at 4.
[201] *Id.*
[202] *See* Cosmo Four-Factor Analysis at 1-1.
[203] *Id.*, Appendix B, Tables 1b, 2b, and 3b.
[204] 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.
[205] https://fred.stlouisfed.org/series/DPRIME.

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.[206] EPA's SCR chapter of its Control Cost Manual indicates that the life of SCR at industrial boilers would be 20-25 years.[207] 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.[208] Further, the Georgia Pacific Camas Mill installed an ESP at Power Boiler #3 in 1992, approximately 29 years ago.[209] 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 and SNCR and a 30-year life for WESPs and wet scrubbers.[210] 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.

3. In the evaluation of SNCR for NOx control, Cosmo only assumed 25% NOx control would be achieved.[211] 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…."[212] 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.[213]

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.[214] The cost for reheating the flue gas reflects 85 to 88% of Cosmo's total annual costs of SCR.[215] Cosmo did not provide the detailed

---

[206] Cosmo Four-Factor Analysis, Appendix B at Tables 1b, 2b, and 3b.
[207] EPA Control Cost Manual, Chapter 2, Selective Catalytic Reduction, June 2019, at pdf page 82.
[207] U.S. Geological Survey, Minerals Commodities Summaries 2020, at 80.
[208] *Id.* at 10.
[209] *See* Southwest Clean Air Agency, Title V Basis Statement, SW20-24-R0-A, Georgia-Pacific Consumer Operations LLC, December 17, 2020, at 7.
[210] 80 Fed. Reg. 18944 at 18955 (Apr. 8, 2015).
[211] Cosmo Four-Factor Analysis at 4-6.
[212] *Id.*
[213] *Id.* at 4-6 (Table 4-2).
[214] *Id.* at 4-6.
[215] *Id.*

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.[216] 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.[217] 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."[218] 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.[219] Ecology must request that Cosmo 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.[220] 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.[221] 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 Wallula Mill had a WESP installed in 2016.[222] In addition, an SNCR was installed at the WestRock Longview Power Boiler 20,[223] 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.[224] Power Boiler 20 is described as a "hybrid suspension grate boiler designed to fire wet biomass…."[225] Ecology should further evaluate the SNCR installed at the WestRock Longview Power Boiler 20 to determine the percent NOx removal being achieved

---

[216] *Id.*
[217] *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.
[218] *Id.*
[219] *Id.*
[220] *Id.* at Appendix B, Table 3a.
[221] *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.
[222] *See* December 2019 NWPPA Report at 1-9.
[223] *Id.*
[224] Washington Department of Ecology, Statement of Basis for Air Operating Permit 0000078, WestRock Longview, December 15, 2020, at 42.
[225] *Id.*

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.[226] 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.

VIII. Comments on Ecology's Proposed Recommendations for the Chemical Pulp & Paper Industry

For the pulp and paper facilities, Ecology found that some controls at certain facilities are cost effective, but then has proposed to find that no controls were justified based on modeling that was done for its 2016 NOx RACT analysis.[227] Ecology points to a statement in the 2019 EPA Regional Haze Guidance which states that "a measure may be necessary for reasonable progress even if that measure in isolation does not result in perceptible visibility improvement."[228] While Ecology acknowledges that the combination of many small improvements in visibility can add up to a visibility benefit for Class I areas, it found that "control measures for the pulp mills do not appear necessary to meet the reasonable progress goals during this implementation period and would not provide meaningful visibility improvement…."[229]There are both legal and technical problems with Ecology's reasoning. As discussed above in Section II.C., Ecology's consideration of modeling results as a fifth-factor is inconsistent with the Act's four-factor reasonable progress analysis requirement.

With respect to the technical arguments, Ecology relies on its 2016 RACT analysis for the pulp and paper industry for which Washington State University (WSU) did a modeling analysis of potential RACT controls.[230] The 2016 RACT analysis only evaluated controls for recovery furnaces/boilers and lime kilns, and the modeling only focused on PM and SO2 emission reductions.[231] No reductions in NOx emissions were modeled. Further, the modeling was based on emission reductions from a 2007 baseline,[232] which is out of date and not necessarily reflective of emissions from these plants in 2028. Ecology is not justified in relying

---

226 *Id.* at 43.
227 *Id.* at 39.
228 *Id.* a 37.
229 *Id.*
230 *Id.* at 37.
231 *See* November 2016 Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills, Appendix C at 150.
232 *Id.,* Appendix C at 147.

on such out-of-date modeling that did not even model NOx reductions or even consider emission reductions at power boilers in making any claims about the visibility benefits of further emissions controls at the pulp and paper industry. Further, the scale of emission reductions that could be achieved with SCR or SNCR at the power boilers, which Ecology claims would be cost effective for several units, is much greater than the scale of emission reductions modeled in the 2016 study.

One of the facilities that Ecology stated could cost-effectively install SCR or SNCR at two boilers was the Nippon Dynawave facility, for which Ecology estimated would reduce NOx emissions by 500 to 1,025 tons of NOx per year with the high end of emission reductions presumably reflecting installation of SCR.[233] Relying on the 2016 modeling which, according to Ecology, modeled reductions in SO2 and PM of 1,345 tons per year,[234] Ecology assumed that reducing NOx by approximately 1,125 tons per year at the Nippon Dynawave facility along with reductions of about 200 tons per year in NOx and PM10 at a few other facilities would only achieve similar visibility benefits that were shown in the 2016 modeling analysis, which purportedly predicted at maximum a visibility benefit of 0.127 deciviews. Not only are the 2016 modeling results out of date, the results of the 2016 analyses are not comparable because no NOx emission reductions were modeled and because no emission reductions from the Nippon Dynawave facility (formerly part of the Weyerhaeuser NR facility) were modeled.[235]

Thus, if it was appropriate to rely solely on modeled visibility benefits to justify not considering cost-effective controls for emission units at pulp and paper facilities in the state's regional haze plan for the second implementation period, which we contend is not appropriate, the modeling that Ecology is planning to rely on fails to provide any analysis of Ecology's finding of cost-effective emission reductions, particularly in emissions of NOx. The 2016 modeling cannot be considered as a technically sound basis for finding that no additional NOx controls are justified for the emission units at any of Washington's pulp and paper facilities.

IX. Comments on Four-Factor Analyses for Ash Grove Cement Company

The Ash Grove Cement Company operates a cement kiln in the Seattle area. According to Ecology, its 2014 NOx emissions were 1,144 tons per year based on 2014 emissions.[236] In 2017, its NOx emissions were much higher at 1,367.9 tons per year.[237] Thus, the facility is a large source of NOx. Based on 2017 emissions and considering Class I areas in which the facility had a Q/d equal to or greater than 5, we calculate a cumulative Q/d of the Ash Grove Cement Company as 135.8.

[233] Draft Chapter 11 at 34.
[234] *Id.* at 35.
[235] Appendix C at 150 (Table C.3.).
[236] Washington Department of Ecology (WDOE), Draft Regional Haze SIP Revision – Second 10-Year Plan, Chapter 11 ("WDOE Draft SIP Revision, Chapter 11"), at 11.
[237] Data from EPA's National Emissions Inventory for 2017.

Ecology has proposed no additional NOx controls for this cement plant, claiming technical infeasibility for SCR and SNCR in large part based on space constraints.[238] However, space constraints should not be an issue for SNCR. The EPA describes the SNCR process as "injecting an ammonia type reactant into the furnace at a properly determined location" and EPA lists cement kilns as among the "multitude of combustion sources" at which SNCR has been utilized.[239] EPA states that the "mechanical equipment associated with an SNCR system is simple compared to an SCR" and that "[i]nstallation of SNCR equipment requires minimal downtime."[240] EPA also states that it does not expect substantial differences in costs to retrofitting SNCR to an existing source compared to the cost to install it with the construction of a new source, based on evaluation of costs of SNCR installations in the 1990's.[241] Thus, for all of these reasons, retrofit difficulty and/or space constraints should not be an issue for SNCR installation.

Ecology also implies that SNCR systems cannot be installed in the high temperature zone before the particulate controls. [242] However, that is not correct. Because there is no catalyst with an SNCR system, the reagent is injected in the combustion zone and high dust concentrations in the exhaust are not an issue for effective operation. Thus, Ecology's claims of retrofit difficulty due to space and of the need to reheat the exhaust stream for effective SNCR operation are without merit.

Ecology states that, in August 2016, the PSCAA approved a NOx limit of 5.1 lb NOx per ton of clinker.[243] This NOx limit was apparently developed a 2013 Consent Decree with the Ash Grove Cement Company, but that Consent Decree only required the optimization of the operation of the cement kiln at the Seattle plant to reduce NOx emissions.[244] Ecology left out that the 2013 Consent Decree with Ash Grove Cement Company required SNCR installation at several Ash Grove Cement Company plants.[245] It is not clear why the Seattle facility was not required to install SNCR, but it is clear that SNCR has been installed to control NOx at several of the company's cement kilns. The lowest NOx limit required for cement kilns with SNCR in the Consent Decree was 1.5 lb NOx per ton of clinker. This same emission limit has also been imposed to meet BACT, based on installation of SNCR and combustion controls.[246] Such a limit would reflect a reduction in emissions of 70.6% on a lb NOx per ton of clinker basis. The Seattle Ash Grove Cement facility had NOx emissions of 1,144 tons per year in 2014,[247] thus a 70.6% reduction would equate to 807.7 tons per year of NOx reduced from 2014 levels.

---

238 WDOE Draft SIP Revision, Chapter 11 at 18.
239 EPA, Control Cost Manual, Selective Noncatalytic Reduction, at 1-1.
240 *Id.* at 1-6.
241 *Id.*
242 WDOE Draft SIP Revision, Chapter 11 at 18.
243 *Id.* at 17.
244 2013 Consent Decree, *United States et al. v. Ash Grove Cement Company*, (No. 2:13-cv-02299-JTM-DJW) at 25 (¶21), available at https://www.epa.gov/sites/production/files/documents/ashgrove-cd.pdf. ("Exhibit 4," attached)
245 *Id*. at ¶¶ 13, 15, 17, 19, 24, 25, 27, and 30.
246 *See* Georgia Environmental Protection Division Permit No. 3241-153-0075-P-01-0 for US Cement, LLC, issued 6/29/2020, at 1 and at 15, available at https://permitsearch.gaepd.org/.
247 WDOE Draft SIP Revision, Chapter 11, at 11.

Given that several similar sources have installed SNCR to meet Clean Air Act requirements, the costs of SNCR at the Seattle Ash Grove Cement facility would very likely be cost effective. Ecology should not have dismissed SNCR as technically infeasible. SNCR could readily work with whatever combustion optimization procedures the company put into place to comply with the Consent Decree. Ecology thus should not have excluded SNCR from review in a four-factor analysis for the Ash Grove Cement Plant.

X. Comments on Ecology's Draft Chapter 10 Long-Term Strategy for Visibility Impairment

Ecology's draft long-term strategy states that it "relied on the Western Regional Air Partnership (WRAP) for air quality modeling and other analytical tools to identify pollutants, the sources of those pollutants, and to predict future levels of visibility impairment."[248] Ecology also states "[t]hrough WRAP technical collaborations, the western states agreed upon the [reasonable progress goals (RPGs)] set for 2028 and a regionally consistent approach to addressing visibility impairment in the West."[249] First, the RPGs are not to be developed before the four-factor analyses but as a result of the four-factor analyses.[250]

Second, while the western states may have agreed on the modeling (and presumably the emission inventory development) compiled or completed by the WRAP, the general public has not had the opportunity to review and comment on the assumptions that went into the emission inventories or the modeling. The regional haze regulations require the long term strategy to "document the technical basis, including modeling, monitoring and emissions information, on which the State is relying to determine its apportionment of emission reduction obligations necessary for achieving reasonable progress in each mandatory Class I Federal area it affects."[251] While the regional haze rule allow states to meet this requirement "by relying on technical analyses developed by the regional planning organization and approved by all State participants."[252] As part of its proposed SIP revisions, Ecology must not only follow the requirements in the RHR, but also the requirements for preparation, adoption and submittal of SIPs (i.e., 40 C.F.R. §§ 51.100, 51.102, 51.103, 51.104, 51.105 and Appendix V to Part 51. Ecology has an obligation to make transparent and cite to (and provide weblinks to) the technical support documentation it proposes to rely on and use as part of its SIP revision (e.g., such regional planning organization technical analyses) and provide the public with the opportunity to comment on such analyses. Thus, Ecology must cite to and provide weblinks to the WRAP's documentation and analysis for the emissions information, monitoring and modeling.[253]

---

[248] WDOE Draft Chapter 10, at 3.
[249] *Id.*
[250] *See*, e.g., 82 Fed. Reg. 3090-91 (Jan. 10, 2017).
[251] 40 C.F.R. 51.308(d)(3)(iii).
[252] *Id*
[253] 40 C.F.R. Part 51, Appendix V ¶ 2.2 Technical Support. "(a) Identification of all regulated pollutants affected by the plan. (b) Identification of the locations of affected sources including the EPA attainment/nonattainment

The regional haze rule requires that "[t]he State must identify the baseline emissions inventory on which its strategies are based."[254] Except for the facilities for which it conducted four-factor analyses, Ecology has not provided its baseline emission inventory of all visibility-impairing pollution from the various sources within its state. Ecology must provide that information with the long-term strategy for public review and comment. Given that the state is relying on federal, state, and local rules regarding mobile onroad engines, nonroad engines, marine engines, fuel sulfur limitations, petroleum refinery maximum achievable control technology (MACT), boiler MACT, revised utility boiler MACT, various area source MACT, industrial/commercial boiler burning designated solid wastes NSPS, sewage sludge incinerator NSPS, ozone and PM10 SIPs, state oil and gas emission control programs, the 2010 SO2 and NO2 NAAQS, the 2013 PM2.5 NAAQS, and the 2015 ozone NAAQS,[255] it is important that Ecology provide a baseline emissions inventory for these various source categories so that the public can evaluate the emission reductions that are being proposed as part of Washington's long-term strategy.

In its discussion of state, federal and local rules and controls that limit visibility-impairing pollutants, Ecology states "[o]f special importance are federal fuel and engine rules for on-road and nonroad engines. These result in large projected percent decreases in visibility-impairing emissions in Washington by 2028."[256] Ecology's draft long-term strategy chapter states that information will be added regarding the percentage reduction due to these rules. We request that Ecology document the technical basis for the assumed emission reductions in nonroad engines, as required by 40 C.F.R. 51.308(d)(3)(iii). The nonroad engine requirements in 40 C.F.R. Parts 89 and 1039 require manufacturers to only make engines meeting certain specified emission standards with the most stringent Tier 4 emission standards applying in approximately 2014 and beyond. However, the federal rules do not require companies to use these cleaner burning engines. It is not clear whether Washington State or local rules require companies to replace existing engines with these cleaner burning engines. Similarly, while ultra-low sulfur diesel fuel has been available since about 2006 and has been required by diesel

---

designation of the locations and the status of the attainment plan for the affected areas(s). (c) Quantification of the changes in plan allowable emissions from the affected sources; estimates of changes in current actual emissions from affected sources or, where appropriate, quantification of changes in actual emissions from affected sources through calculations of the differences between certain baseline levels and allowable emissions anticipated as a result of the revision. (d) The State's demonstration that the national ambient air quality standards, prevention of significant deterioration increments, reasonable further progress demonstration, and visibility, as applicable, are protected if the plan is approved and implemented. …. (e) Modeling information required to support the proposed revision, including input data, output data, models used, justification of model selections, ambient monitoring data used, meteorological data used, justification for use of offsite data (where used), modes of models used, assumptions, and other information relevant to the determination of adequacy of the modeling analysis. (f) Evidence, where necessary, that emission limitations are based on continuous emission reduction technology. (g) Evidence that the plan contains emission limitations, work practice standards and recordkeeping/reporting requirements, where necessary, to ensure emission levels. (h) Compliance/enforcement strategies, including how compliance will be determined in practice. (i) Special economic and technological justifications required by any applicable EPA policies, or an explanation of why such justifications are not necessary."

[254] *Id.*

[255] WDOE Draft Chapter 10 at 5-7

[256] *Id.* at 6.

manufacturers since 2014, there are exemptions for older locomotive and marine engines.[257] Thus, Ecology should provide the technical basis for assumed emission reductions from nonroad engines in Washington state, both due to use of lower-emitting engines and use of lower sulfur fuel. To the extent the assumptions regarding emission reductions from nonroad engines were developed by the WRAP, Ecology should document the WRAP's assumptions and provide links to the underlying documentation so that the public can have the opportunity to review and comment on it. Finally, if Ecology is relying on federal rules for future emission projections, Ecology must also document its assumptions, provide citations to the federal rules it relies on, and if enforceable measures are necessary, include them in the proposed SIP revision.

Ecology identifies several control strategies that were not in the previous Regional Haze SIP that apply at the Federal and/or State level. Ecology states that the most current emission inventory reflects several of these rules, including the following:[258]

- MARPOL V
- The North American Emission Control Area (ECA) for marine vessels
- The marine vessel fuel sulfur standard
- NAAQS revisions since 2007

Ecology should document the extent to which emission reductions have actually occurred as a result of these regulations and requirements. For example, for the sulfur standard for marine vessels, Ecology acknowledges that EPA and the U.S. Coast Guard have allowed some shipping companies delayed compliance dates with these requirements.[259] Ecology should document the extent to which shipping companies doing business in Washington state are complying with these standards or whether such companies have been granted a delay in compliance and, if so, how long compliance has been delayed. It appears that the MARPOL V requirements are applicable to marine engine manufacturers pursuant to 40 C.F.R. Part 90, but the requirements do not require that shipping companies use those engines. Further, the EPA recently proposed regulations on marine engines that would weaken emission standards and sulfur in fuel standard.[260] Thus, we request that Ecology identify the extent to which the lower-emitting engines are being utilized by shipping companies doing business in Washington state. Ecology states that "[t]he effects of the marine vessel fuel sulfur requirements are reflected in the IMPROVE data, though the effect of the [North American Emissions Control Area (ECA)] are not fully reflected in the data due to the long lead time for the MARPOL requirements and the relatively recent date (2013) for vessels to meet the first stage requirements."[261] We request that Ecology also document the extent to which emission reductions associated with these programs have been reflected in the emissions inventories modeled by the WRAP and the extent to which any such modeled emission reductions were ground-truthed. Finally, if Ecology is relying on federal rules for future emission projections, Ecology must also document its assumptions,

---

[257] *See* https://www.epa.gov/diesel-fuel-standards/diesel-fuel-standards-and-rulemakings.
[258] WDOE Draft Chapter 10, at 7.
[259] *Id.*
[260] 84 Fed. Reg. 46909, Sept. 6, 2019.
[261]WDOE Draft Chapter 10, at 7.

provide citations to the federal rules it relies on, and if enforceable measures are necessary, include them in the proposed SIP revision.

With respect to mobile sources, Ecology states that Washington's vehicle emissions testing program was phased out by the legislature "based on Ecology's prediction that more fuel efficient and electric vehicles would replace the need for it by 2020…."[262] Ecology also discusses the Washington legislature's adoption of California vehicle emission standards for passenger cars, light duty trucks and medium duty passenger vehicles. Ecology should provide more documentation as to when these provisions took effect (or when the provisions will take effect) in the state. Ecology should also discuss whether and how the Trump administration's decision to revoke California's waiver under the Clean Air Act to impose more stringent emission standards may have impacted this emission reduction strategy in Washington state.

For the emission reductions due to NAAQS revisions since 2007, the state identified the 2010 NOx NAAQS, the 2010 SO2 NAAS, the 2013 PM2.5 NAAQS, and the 2015 ozone NAAQS. Ecology should identify rules/emission standards and requirements that it has adopted to require emission reductions to comply with these NAAQS and when compliance was or will be required. Ecology should also make clear whether any area in Washington state has been or will be designated as nonattainment for any of these NAAQS and whether additional NAAQS control requirements will be forthcoming in the state. The long-term strategy is supposed detail the enforceable emission limitations and compliance timeframes.[263] Thus, Ecology's plan must include more details on the NAAQS requirements that it relies on for future emissions controls.

XI. Ecology Should Analyze the Environmental Justice Impacts of its Regional Haze SIP, and Ensure the SIP Will Minimize Harms to Disproportionately Impacted Communities

In Seattle, 13 of the 14 heaviest industrial polluters are located within a half-mile of the places where marginalized communities live, work, play, and worship in Seattle. Of the 20 biggest regional haze producing facilities in Washington, two of them are located in the Duwamish Valley – Ash Grove Cement and Ardagh Glass.

Ardagh's facility has had a long history of violations in addition to inadequate or lack of required emissions reporting. Ardagh's glass melting furnaces emit quantities of SO2 and NOx that place it in the "major source" Air Operating Permit program, and also significant qualities of total particulate matter (PM). For the last decade or more, the annual levels of fine particulate matter at the E. Marginal Way S (Duwamish) monitor in the industrial area, that includes Ardagh, have been higher than any monitor in the Puget Sound Clean Air Agency (PSCAA) four-county area.

The Duwamish Valley's riverfront neighborhoods Georgetown and South Park are situated within two miles of the Ardagh Glass facility and have long been disproportionately

[262] *Id.* at 9.
[263] 40 C.F.R. 51.308(d)(3).

exposed to contamination, cumulative environmental injustices, and subsequent adverse health-related outcomes. Residents who Georgetown and South Park have some of the highest health discrepancies in the City of Seattle. Childhood asthma hospitalization rates are the highest in the City. Heart disease death rates are 1.5 times higher than the rest of Seattle and King County. Life expectancy is 13 years shorter when compared to Laurelhurst in North Seattle; one of Seattle's wealthiest neighborhoods. Ardagh Glass has existed in the Duwamish Valley for over 100 years where old practices and technologies have led to a legacy of frequent air pollution violations.

By evaluating Ardagh Glass and other glass facilities as its own sector, we believe Washington state will identify emission-reducing options that if required will improve air quality and help achieve reasonable progress in this round of regional haze rulemaking. Historically, conservation and environmental work has concerned itself with protecting nature from people and has thus "siloed" its work (e.g., mainstream conservation vs. environmental justice.) While this siloed approach has led to the protection of many vulnerable habitats, it ignores the reality that people live in concert with and are a part of nature; to protect one and not the other is a job half done. By considering viewshed protection and environmental justice at the same time, we can collectively begin to dismantle the silos that exist in conservation and environmental work and chart a new path forward.

Ecology recognizes these environmental justice concerns, and that "pollution and environmental contamination can affect everyone living in Washington, but some people are significantly more burdened than others."[264] Furthermore, DOE explains that "[r]esearch shows that people of color, low-income people, and indigenous people are disproportionately harmed by environmental hazards … have real impacts on the lives of many in Washington, such as: …[h]igher rates of illness and disease … [m]ore frequent hospitalization [and] [l]ower life expectancy. We support the Department's commitment "to making decisions that do not place disproportionate burdens on disadvantaged communities," while "seeking to lift the weight of pollution and contamination borne by those communities." Additionally, we applaud DOE's "focus ... [of its] time and resources toward strategic actions to address these long-standing inequities" so that its actions "will lead to improvements in health and the environment, and more resilient communities in Washington."

In addition to Ecology's commitments, the Governor's Interagency Council on Health Disparities (Governor's Council) was established by the Legislature in 2006 when it passed, and the Governor signed a bill to create it.[265] Under the law, the Governor's Council:

- Creates an action plan for eliminating health disparities by race, ethnicity, and gender in Washington.
- Convenes advisory committees to assist in the planning and development of specific issues in collaboration with several state agencies and non-government stakeholders.[266]

[264] Department of Ecology, "Environmental Justice at Ecology," available at https://ecology.wa.gov/About-us/Accountability-transparency/Environmental-Justice. ("Exhibit 6," attached.)
[265] Governor's Interagency Council on Health Disparities, "The Council's Work," available at https://healthequity.wa.gov/TheCouncilsWork. ("Exhibit 7," attached.)
[266] *Id.*

Additionally, Section 221, subsection 48 of the 2019-2021 biennial operating budget (Engrossed Substitute Senate Bill 1109) directed the Governor's Council to convene and staff an Environmental Justice Task Force,[267, 268] which includes a representative from Ecology. "The Task Force is responsible for recommending strategies to incorporate environmental justice principles into future state agency actions."[269] The EJ Task Force was required to "submit a final report by October 31, 2020 to include:

> 1. Guidance for using the Washington Environmental Health Disparities Map, hosted on the Department of Health's website to identify communities that are highly impacted by environmental justice issues with current demographic data.
>
> 2. Best practices for increasing meaningful and inclusive community engagement that takes into account barriers to participation.
>
> 3. Measurable goals for reducing environmental health disparities for each community in Washington state and ways in which state agencies may focus their work towards meeting those goals.
>
> 4. Model policies that prioritize highly impacted communities and vulnerable populations for the purpose of reducing environmental health disparities and advancing a healthy environment for all residents. The Governor's Council includes several task force groups, including the Environmental Justice Task Force.[270]

The EJ Task Force's posted materials for 2019 and 2020[271] demonstrate considerable activity and include: Task Force meeting agendas, minutes and materials; Mapping Subcommittee meeting agendas and minutes; Community Engagement Subcommittee agendas and minutes; Task Force Feedback Listening Session agenda minutes, materials and minutes; and Task Force Work Group agenda and minutes.[272] However, there is no information available on the final report that was due October 31, 2020. The January 2020, Report of the Governor's Council's recognizes EPA's definition of environmental justice: "[t]he Environmental Protection Agency defines environmental justice as, '…the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.'"[273]

---

[267] "The Governor's Interagency Council on Health Disparities: State Policy Action Plan to Eliminate Health Disparities," (Jan. 2020) (2020 Council Report), available at https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/HDC-ActionPlan-Jan2020.pdf. ("Exhibit 8," attached.)

[268] Governor's Interagency Council on Health Disparities, 2019 and 2020 Environmental Justice Task Force Materials, available at https://healthequity.wa.gov/TaskForceMeetings/EnvironmentalJusticeTaskForce. ("Exhibits 9 and 10," attached.)

[269] 2020 Council Report at 6.

[270] *Id.*

[271] Environmental Justice Task Force Meeting Materials, available at https://healthequity.wa.gov/TaskForceMeetings/EnvironmentalJusticeTaskForce. ("Exhibits 9 and 10," attached.)

[272] *Id.*

[273] 2020 Council Report at 6, citing EPA's Environmental Justice website, https://www.epa.gov/environmentaljustice/learn-about-environmental-justice. ("Exhibit 11," attached)

Under the Clean Air Act, states are permitted to include in a SIP measures that are authorized by state law but go beyond the minimum requirements of federal law.[274] Therefore, consistent with the Governor's Council and the Environmental Task Force's efforts, Ecology should analyze the environmental justice impacts of its second planning period haze SIP. For those RP sources located near a low-income or minority community that suffers disproportionate environmental harms, Ecology's four-factor analysis for that source should take into consideration how each considered measure would either increase or reduce the environmental justice impacts to the community. Such considerations will not only lead to sound policy decisions but are also pragmatic as pointed out above, most of the same sectors and sources implicated under the regional haze program are of concern to disproportionately impacted communities in Washington. Thus, considering the intersection of these issues and advancing regulations accordingly will help deliver necessary environmental improvements across issue areas, reduce uncertainty for the regulated community, increase the state's regulatory efficiency, result in more rational decision making and be consistent with the Washington State Legislature's and Governor's directives, priorities and funding to focus on policies that "prioritize highly impacted communities and vulnerable populations for the purpose of reducing environmental health disparities and advancing a healthy environment for all residents."[275]

There are additional legal grounds for considering environmental justice when determining reasonable progress controls. Under the Clean Air Act, states are permitted to include in a SIP measures that are authorized by state law but go beyond the minimum requirements of federal law.[276] Moreover, the State can also consider environmental justice when developing its haze plan, regardless of whether the Clean Air Act's haze provisions require such consideration. Ultimately, EPA will review the haze plan that Washington submits, and EPA will be required to ensure that its action on Washington's haze plan addresses any disproportionate environmental impacts of the pollution that contributes to haze. In addition to existing Executive Orders that requires federal executive agencies such as EPA to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs,

---

[274] *See Union Elec. Co v. EPA*, 427 U.S. 246, 265 (1976) ("States may submit implementation plans more stringent than federal law requires and . . . the Administrator must approve such plans if they meet the minimum requirements of s 110(a)(2)."); *Ariz. Pub. Serv. Co. v. EPA*, 562 F.3d 1116, 1126 (10th Cir. 2009) (quoting *Union Elec. Co.*, 427 U.S. at 265) ("In sum, the key criterion in determining the adequacy of any plan is attainment and maintenance of the national air standards . . . 'States may submit implementation plans more stringent than federal law requires and [ ] the [EPA] must approve such plans if they meet the minimum [Clean Air Act] requirements of § 110(a)(2).'"); *BCCA Appeal Group v. EPA*, 355 F.3d 817, 826 n. 6 (5th Cir. 2003) ("Because the states can adopt more stringent air pollution control measures than federal law requires, the EPA is empowered to disapprove state plans only when they fall below the level of stringency required by federal law.").

[275] 2020 Council Report at 6.

[276] *See Union Elec. Co v. EPA*, 427 U.S. 246, 265 (1976) ("States may submit implementation plans more stringent than federal law requires and . . . the Administrator must approve such plans if they meet the minimum requirements of s 110(a)(2)."); *Ariz. Pub. Serv. Co. v. EPA*, 562 F.3d 1116, 1126 (10th Cir. 2009) (quoting *Union Elec. Co.*, 427 U.S. at 265) ("In sum, the key criterion in determining the adequacy of any plan is attainment and maintenance of the national air standards . . . 'States may submit implementation plans more stringent than federal law requires and [ ] the [EPA] must approve such plans if they meet the minimum [Clean Air Act] requirements of § 110(a)(2).'"); *BCCA Appeal Group v. EPA*, 355 F.3d 817, 826 n. 6 (5th Cir. 2003) ("Because the states can adopt more stringent air pollution control measures than federal law requires, the EPA is empowered to disapprove state plans only when they fall below the level of stringency required by federal law.").

policies, and activities on minority populations and low-income populations,"[277] on January 27, 2021, the current Administration signed "Executive Order on Tackling the Climate Crisis at Home and Abroad."[278] The new Executive Order on climate change and environmental justice provides that:

It is the policy of [this] Administration to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; … protects public health … delivers environmental justice …[and that] … [s]uccessfully meeting these challenges will require the Federal Government to pursue such a coordinated approach from planning to implementation, coupled with substantive engagement by stakeholders, including State, local, and Tribal governments."[279]

Washington can facilitate EPA's compliance with these Executive Orders by considering environmental justice in its SIP submission.

Consistent with legal requirements and government efficiency, we urge Washington to take impacts to EJ communities, like the ones we have expressed for the Ash Grove Cement and Ardagh Glass facilities, into consideration as it evaluates all sources that impact regional haze.

Conclusion

We appreciate Ecology's consideration of these comments. Additionally, we look forward to reviewing and providing comments on the draft plan in the spring of 2021 during the official public comment period. Please do not hesitate to contact me with any questions.

Sincerely,

Joshua Jenkins, MPA
NW Senior Program Coordinator
National Parks Conservation Association
1200 5th Ave Suite 1118
Seattle, WA 98101
jjenkins@npca.org

Stephanie Kodish
Senior Director and Counsel
Clean Air and Climate Programs

[277] Exec. Order No. 12898, § 1-101, 59 Fed. Reg. 7629 (Feb. 16, 1994), as amended by Exec. Order No. 12948, 60 Fed. Reg. 6381 (Feb. 1, 1995).
[278] "Executive Order on Tackling the Climate Crisis at Home and Abroad," (Jan. 27, 2021) (Climate Change and EJ EO), available at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/; *see also,* White House Fact Sheet, "President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government," (Jan. 27, 2021), available at https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/.
[279] Climate Change and EJ EO, § 201.

National Parks Conservation Association
777 6th Street NW, Suite 700
Washington, DC 20001
skodish@npca.org

Sara L. Laumann
Principal
Laumann Legal, LLC.
3800 Buchtel Blvd. S. #100236
Denver, CO 80210
sara@laumannlegal.com
Counsel for National Parks Conservation Association

Katelyn Kinn
Staff Attorney
Puget Soundkeeper Alliance
130 Nickerson Street, Suite 107
Seattle, WA 98109
katelyn@pugetsoundkeeper.org

Adrienne Hampton
Climate Policy and Engagement Manager
Duwamish River Cleanup Coalition/TAG
7400 3rd Ave S Seattle, WA 98108
adrienne@duwamishcleanup.org

Greg Wingard
Executive Director
Waste Action Project
gwingard@earthlink.net

Joshua Smith
Senior Attorney
Sierra Club Environmental Law Program
2101 Webster Street, Suite 1300
Oakland, California 94612
joshua.smith@sierraclub.org

cc: Collen Stinson, Department of Ecology
Philip Gent, Department of Ecology
Jacob Berkey, Department of Ecology
Chris Hanlon-Myer, Department of Ecology
Gary Huitsing, Department of Ecology
Scott Inloes, Department of Ecology
Kathy Taylor, Department of Ecology
Krishna Viswanathan, EPA

Enclosures

List of Exhibits

1. Klafka, Steven, P.E. BCEE, Environmental Engineer, Wingra Engineering, S.C., "The Four-Factor Reasonable Progress Analysis for Ardagh Glass," (Jan. 27, 2021).
2. National Parks Conservation Association comments submitted on the Draft Air Quality Agreed Orders for Alcoa Wenatchee Agreed Order 18100 (Chelan County), Intalco Agreed Order 18216 (Whatcom County), which included proposed source-specific amendments for Ecology's Regional Haze SIP Revision, (Dec. 3, 2020).
3. "Petition for Petition for Reconsideration of Guidance on Regional Haze State Implementation Plans for the Second Implementation Period," submitted by National Parks Conservation Association, Sierra Club, Natural Resources Defense Council, Coalition to Protect America's National Parks, Appalachian Mountain Club, Western Environmental Law Center and Earthjustice, to former EPA Administrator Andrew Wheeler (May 8, 2020).
4. 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.
5. 2013 Consent Decree, *United States et al. v. Ash Grove Cement Company*, (No. 2:13-cv-02299-JTM-DJW), available at https://www.epa.gov/sites/production/files/documents/ashgrove-cd.pdf.
6. Department of Ecology, "Environmental Justice at Ecology," available at https://ecology.wa.gov/About-us/Accountability-transparency/Environmental-Justice.
7. Governor's Interagency Council on Health Disparities, "The Council's Work," available at https://healthequity.wa.gov/TheCouncilsWork.
8. "The Governor's Interagency Council on Health Disparities: State Policy Action Plan to Eliminate Health Disparities," (Jan. 2020) (2020 Council Report), available at https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/HDC-ActionPlan-Jan2020.pdf.
9. Governor's Interagency Council on Health Disparities, Environmental Justice Task Force Materials, available at https://healthequity.wa.gov/TaskForceMeetings/EnvironmentalJusticeTaskForce.
10. Environmental Justice Task Force Meeting Materials, available at https://healthequity.wa.gov/TaskForceMeetings/EnvironmentalJusticeTaskForce.
11. EPA's Environmental Justice website, https://www.epa.gov/environmentaljustice/learn-about-environmental-justice.

Wingra Engineering, S.C.
Environmental Engineering Consultants

January 27, 2021

National Parks Conservation Association
Clean Air and Climate Program
Attn: Stephanie Kodish, Senior Director & Counsel
777 6th Street NW, Suite 700
Washington, DC 20001-3723

Subject: Four-Factor Reasonable Progress Analysis
Ardagh Glass, Inc.
Seattle, Washington

Dear Ms. Kodish:

The National Parks Conservation Association requested the preparation of a Four-Factor Reasonable Progress Analysis for Ardagh Glass, Inc. in Seattle, Washington. This analysis evaluates the feasibility of installing emission control equipment for air pollutants which are precursors to regional haze. The enclosed report describes the procedures and results of this analysis.

Should you have further questions, please contact me at (608) 255-5030.

Sincerely,

Wingra Engineering, S.C.

Steven Klafka

Steven Klafka, P.E., BCEE
Environmental Engineer

Enclosure

303 South Paterson Street, Madison, WI 53703, (608) 255-5030, (fax) 255-5042, www.wingraengineering.com

Ardagh Glass, Inc.

Seattle, Washington

Four-Factor Reasonable Progress Analysis

January 27, 2021

Prepared by:

Steven Klafka, P.E., BCEE

Wingra Engineering, S.C.

Madison, Wisconsin

1.0 INTRODUCTION

In 2010, Washington Department of Ecology (DOE/WDOE) updated its regional haze state implement plan to improve visibility in certain national parks and wilderness areas in the state.[1] These are referred to as Class I areas for implementation of air pollution protection regulations and include the following:

- Alpine Lakes Wilderness
- Glacier Peak Wilderness
- Goat Rocks Wilderness
- Mt. Adams Wilderness
- Mt. Rainier National Park
- North Cascades National Park
- Olympic National Park
- Pasayten Wilderness

Figure 1 is a WDOE map showing the location of these areas.[2]

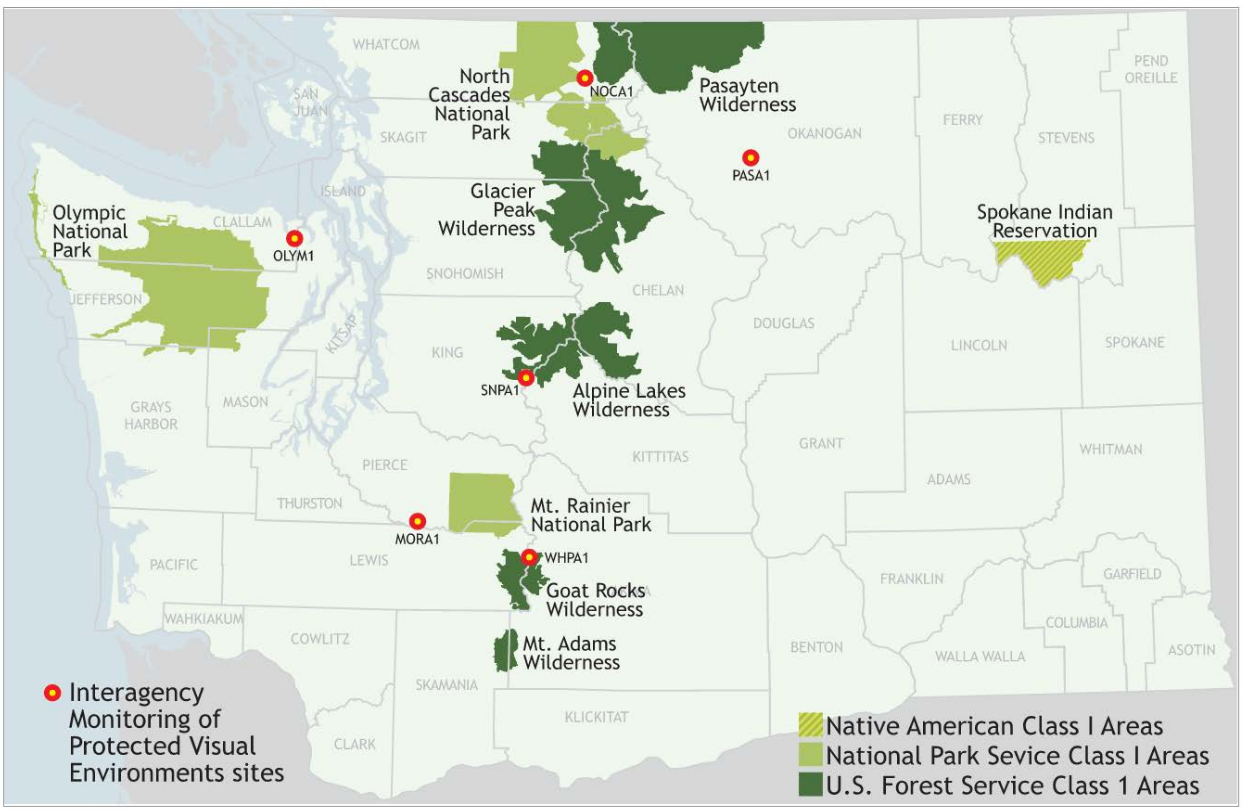

Figure 1 - Washington State Class I Areas

---

[1] Department of Ecology, State of Washington, Regional Haze, State Implementation Plan, Final December 2010
[2] https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Regional-haze

The DOE regional haze state implementation plan is evaluating the retrofit of emission control technology at large industrial sources to make reasonable progress toward natural conditions in Class 1 areas. To determine the effectiveness of retrofitting emissions control technology, USEPA requires states to use a Four-Factor Reasonable Progress Analysis (FFA). In its background document for this analysis, WDOE states:

Consider the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources, and include a demonstration showing how these factors were taken into consideration in selecting the goal (40 CFR 51.308(d)(1)(i)(A)). This four factor analysis is used to identify controls necessary to meet the reasonable progress goals for each mandatory Class 1 area (CIA).

Therefore, the four statutory factors are:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality impacts of compliance
- Remaining useful life of any potentially affected sources

This report presents an FFA for Ardagh Glass, Inc. located in Seattle, Washington. DOE has identified this industrial facility has potentially having impacts on regional haze at surrounding Class I areas.

2.0 FACILITY DESCRIPTION

Ardagh Glass, Inc. is located at 5801 East Marginal Way S. in Seattle, King County, Washington. It manufactures glass containers. It was issued Air Operating Permit No. 11656 on June 6, 2007. Specifications for the air pollution sources at the plant are taken from this operating permit and the Statement of Basis for Administrative Amendment 5-31-17 (SOB) which provides a description of activities and a compliance history for the plant. Both documents were obtained from the Puget Sound Clean Air Agency.[3]

The closest Class I areas to Ardagh include the following:

- Olympic National Park
- Alpine Lakes Wilderness
- Mount Rainier National Park
- Glacier Peak Wilderness
- Goat Rocks Wilderness

[3] https://www.pscleanair.gov/182/List-of-Approved-Permits

In its regional haze plan, DOE modeled facilities that were within 300 km of Class I areas to determine if they had a significant impact these areas. The closest Class I area to Ardagh is the Alpine Lakes Wilderness at 53.5 km. All of the Class I areas are within the 300 km distance from Ardagh.

While there are numerous air pollution sources at glass manufacturing plants, the largest sources 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.

For the No. 1 glass furnace, DOE states that the company does not have any reported emissions from this electric furnace and it vents through the roof and normally has no visible emissions, but is capable of emitting visible emissions from the furnace during upset conditions. It will be assumed for this analysis that there are no significant emissions from this furnace and its emissions will not be considered.

Specifications for the remaining furnaces are provided in Table 1. The actual daily production melt rates are taken from the Puget Sound Clean Air Agency SOB and come from 1994 source tests. Current emission inventory reports only provide annual production rates. If 1994 are the last source tests, it is recommended that DOE require new stack tests to verify current actual emission rates.

The full production capacity of each furnace provided by the SOB is also summarized in Table 1.

Table 1 - Ardagh Glass Furnace Specifications

Glass Melting Furnace	Tested Melt Rate	Capacity Melt Rate
	(tons per day)	(tons per day)
No. 2	144.6	195
No. 3	166.8	160
No. 4	131.3	430
No. 5	130.7	205
Total	573.4	990

Table 2 provides the annual actual emissions from the Ardagh plant as reported in its emissions inventory submitted to DOE.[4] The air pollutants evaluated include nitrogen oxides (NO_x), sulfur dioxide (SO_2) and particulate matter (PM). The actual emissions can be used to estimate the cost effectiveness of emission control equipment in an FFA.

---

[4] Department of Ecology, State of Washington, Air emissions inventory summaries, https://ecology.wa.gov/Air-limate/Air-quality/Air-quality-targets/Air-emissions-inventory

Furnaces Nos. 2, 3 and 5 are oxy-fuel fired. This combustion technique would reduce the formation of NO_x. It is assumed that any NO_x emission reductions due to this technique are already incorporated into the reported actual emissions summarized in Table 2. The DOE SOB indicates Furnace No. 5 was equipped with a Tri-Mer Cloud Mist Scrubber in approximately 2009. This scrubber would capture the SO_2 and PM emissions. It is assumed that the reported actual emissions incorporate any emission reductions due to the use of the mist scrubber.

Table 2 - Ardagh Actual Emissions

Reporting	NO_x	SO_2	PM_{10}	Total
2012	227.1	61.4	75.2	363.7
2013	166.5	73.3	92.8	332.6
2014	172.1	105.9	73.2	351.2
2016	153.7	98.7	95.3	347.6
2017	153.3	98.7	88.2	340.2
2018	167.6	89.9	82.2	339.7
Maximum	-	-	-	351.2

Table 3 provides the annual potential, legally enforceable emissions from the Ardagh plant. It is a common practice in air pollution control, especially for a Best Available Control Technology analysis following the federal Prevention of Significant Deterioration regulations, to estimate the cost effectiveness of air pollution control equipment based on 100% capacity and the potential emissions. As shown in Table 2, actual annual emissions vary with annual production. Looking at historical emission inventory reports, total emissions have been as high as 700.7 tpy in 2008. Based on the Ardagh air quality operating permit, there is no limitation on annual production. Actual emissions are approved as long as they remain below the potential emissions approved by the operating permit. Potential emissions, in addition to actual emissions, can be used to estimate the cost effectiveness of emission control equipment in an FFA.

Table 3 - Ardagh Potential Emissions

Glass Melting Furnace	Capacity (tons per day)	Air Pollutant	Limitation (lbs/ton)	Limitation (tpy)
No. 2	195	NO_x	3.8	135
		SO_2	1.6	57
		PM	1.0	36
No. 3	160	NO_x	3.8	111
		SO_2	1.6	47
		PM	1.0	29
No. 4	430	NO_x	3.8	298
		SO_2	1.6	126
		PM	1.0	78
No. 5	205	NO_x	3.8	142
		SO_2	1.6	60
		PM	1.0	37
Total	990	NO_x	-	687
		SO_2	-	289
		PM	-	181
		All	-	1,156

3.0 FOUR-FACTOR ANALYSIS

The four factors included in this analysis are:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality impacts of compliance
- Remaining useful life of any potentially affected sources

Each of these factors are evaluated for the Ardagh plant.

3.1 Costs of Compliance

The emissions from the Ardagh furnaces which need to be controlled are NO_x, SO_2 and PM. Historically, these pollutants were controlled using separate air pollution control systems due to their physical and chemical properties. NO_x emission control requires changes in the combustion conditions that form NO_x from N_2 at high temperatures, or use ammonia or urea injection to react with the NO_x to form N_2 as the reaction product. SO_2 emissions require wet or dry injection of a chemical to react with and neutralize this pollutant. PM emissions are solids which requires capture by filtering or agglomeration into larger particles using water sprays.

Furnace No. 1 at the Ardagh plant is electrically heated. Puget Sound concluded there were no emissions from this furnace except during upsets. If this is true, then changing the other four furnaces from fossil fuel-fired to electrically heated is an emission control option that DOE should evaluate. Glass furnaces are rebuilt every 10 to 20 years. The next rebuilt would be an appropriate time to change the heating method.

A common resource to determine the latest control methods for an industry is the *BACT Clearinghouse* operating by the United States Environmental Protection Agency (USEPA).[5] This website lists the most recent results of Best Available Control Technology analyses for air pollution permits issued to major source under the Prevention of Significant Determination. For glass manufacturing, the website provides only two entries during the past 10 years. These include the 700 ton per day flat glass plant approved for Cardinal FG Company in Winlock, Washington. As BACT, the glass furnace was equipped with a spray drier scrubber for SO_2 control, ESP to capture PM, and use of the *3R Process* combustion modifications to reduce NO_x emissions. The second project was 18 furnaces for the production of high purity glass at the Corning Incorporated plant in Canton, New York. BACT for NO_x emissions was determined to be the use of oxygen-fired combustion to minimize the formation of NO_x.

There have been additional emission control projects in the U.S. which have not been subject to the PSD regulations so are not documented in the BACT Clearinghouse. These also provide insight into demonstrated emission control methods.

In 2010, USEPA reached a settlement with Saint Gobain Containers Inc. over violations of the Clean Air Act at their container glass plants.[6] The settlement required the installation of new emission control systems for NO_x including the use of an Oxyfuel Furnace, Oxygen Enriched Air Staging (OEAS) and Selective Catalytic Reduction (SCR); new emission control systems for SO_2 including semi-dry scrubbers, dry scrubbers, cloud chamber scrubber systems and process controls; and, new emission control systems for PM including cloud chamber scrubber systems, electrostatic precipitators, or process controls. Ardagh Glass Inc. later purchased some of the Saint Gobain plants included in the USEPA settlement. These plants included the Seattle facility. In the settlement, this plant was required to use oxyfuel to reduce NO_x emissions from Furnaces No. 3 and 5 and install a cloud chamber scrubber system to reduce SO_2 and PM emissions from Furnace No. 5.

In 2015, USEPA reached a settlement with Guardian Industries Corporation over violations of the Clean Air Act at their flat glass plants.[7] Guardian was required to install new emission controls for NO_x, SO_2 and PM including selective catalytic reduction, dry scrubbing and dust capture

[5] https://www.epa.gov/catc/ractbactlaer-clearinghouse-rblc-basic-information
[6] https://www.epa.gov/enforcement/saint-gobain-containers-inc-clean-air-act-settlement
[7] https://www.epa.gov/enforcement/guardian-industries-corp-clean-air-act-settlement

equipment. For some plants, Guardian chose to use a new emission control technology which has been demonstrated to simultaneously control NO_x, SO_2 and PM emissions from glass plants. This technology uses catalytic ceramic filters in combination with ammonia injection for NO_x control and reagent injection for SO_2 control. PM is captured on the surface of the ceramic filters.

In 2015, Cardinal FG Company began a voluntarily program to install additional control equipment to reduce it flat glass plant emissions. At three existing flat glass plants already equipped with spray drier – ESP control systems for SO_2 and PM control, an additional Selective Catalytic Reduction or SCR system for NO_x control would be installed. At two existing flat glass plants using the *3R Process* for NO_x control, the new catalytic ceramic filter control system has been installed. Compliance testing of catalytic ceramic filter systems show they are achieving the lowest emission levels for NO_x, SO_2 and PM combined at existing glass plants. Based on the system quotation used for this analysis, the guaranteed control efficiencies for these air pollutants are 90%, 75% and 95.8%, respectively.

The two catalytic ceramic filter installations at Cardinal FG were manufactured by the Tri-Mer Corporation. Table 4 summarizes glass plant installations of the catalytic ceramic control system by Tri-Mer. It is noteworthy that one of the installations is the Ardagh Glass container plant in Dolton, Illinois. This makes this type of system an excellent option to consider for controlling the emission of these pollutants from the Ardagh plant in Seattle. Based on the success of the catalytic ceramic filter systems at existing glass plants, it will be used for the FFA for the Ardagh plant in Seattle.

Table 4 - Tri-Mer Filter Projects in U.S.

Company	Location	Glass Type
Durand	Millville, NJ	Tableware
Anchor	Monaca, PA	Mixed
AGC	Church Hill, TN	Flat
Gallo	Modesto, CA	Container
AGC	Hill, KS	Flat
Adagh	Dolton, IL	Container
Kohler	Kohler, WI	Specialty
Guardian	Carleton, MI	Flat
PG Corporation	L.A. Basin	Specialty
Cardinal FG	Mooresville, NC	Flat
Cardinal FG	Durant, OK	Flat

For typical BACT analyses, order-of-magnitude cost estimates are typically generated.[8] The cost estimate is improved if it incorporates actual vendor quotations for the required equipment. A prior quotation for a catalytic ceramic filter system was available for one of the Cardinal FG plants. Like the Ardagh plant, the cost estimate reflects the retrofit of a new control system at an existing

[8] USEPA, Air Pollution Control Manual, Sixth Edition, EPA/452/B-02-001 January 2002.

industrial facility. These capital, installation and operating costs were adjusted to reflect the differences between the Cardinal and Ardagh plants. The development of this cost estimate is provided in the supporting calculations of Appendix A.

As previously noted, BACT analyses are typically based on full capacity and potential emissions. For Ardagh, cost estimates were developed for both actual and potential production and emissions. The actual cost estimate is based on reported emissions and incorporates any existing air pollution control measures on the four glass furnaces at Ardagh. The potential cost estimate reflects the production capacity and emissions approved for the four glass furnaces.

Table 5 presents a summary of the cost estimate for the Ardagh plant. Because the catalytic ceramic filter system is a multi-pollutant control technology, cost effectiveness was calculated based on the total expected emission reductions in NO_x, SO_2, and PM emissions. The cost effectiveness for actual conditions is $4,766 per ton of total air pollutants removed and for potential conditions is $2,238 per ton of total air pollutants removed. Both of these values are well within the cost effectiveness level considered reasonable in prior BACT and control equipment analyses by regulatory agencies. It is not unusual for $10,000 per ton of pollutant removed to be considered acceptable. In correspondence with DOE staff on this topic, they provided reasonable cost example values for actual and potential emissions of $5,250 and 4,000 per ton, respectively.[9] The estimates for Ardagh are within these values. It is concluded that the installation of a catalytic ceramic filter system at the Ardagh plant in Seattle would be considered a reasonable expense.

This analysis is more accurate than one based on order-of-magnitude cost estimates. However, it would be improved if a budget quotation were obtained for the plant.

3.2 Time necessary for compliance

Based on prior projects, the time frame to obtain a quotation for a catalytic ceramic filter, issue a purchase order, complete engineering, construct and install the equipment is 12 months. Furnace No. 5 at the Seattle plant is equipped with a Cloud Mist Scrubber manufactured by Tri-Mer. Additionally, the plant in Dolton, Illinois is equipped with a catalytic ceramic filter system manufactured by Tri-Mer. The familiarity of Ardagh staff with Tri-Mer products would improve the ability to obtain a quotation and installation of a new control system at the Seattle plant.

[9] Email, P. Gent – WDOE to S. Klafka – Wingra Engineering, Regional haze four-factor analysis for Ardagh Glass, Inc., January 19, 2021.

Table 5 - Cost Estimate for Catalytic Ceramic Filter System to Control Actual and Potential Emissions from Ardagh Glass, Inc.

Basis	Actual	Potential
Capacity (tpd)	573.4	990
Capital Costs	$11,866,967	$16,468,204
Annual Capital Costs	$816,210	$1,132,683
Annual Operating Costs	$330,980	$700,622
Annual Capital and Operating Costs	$1,147,190	$1,833,305
Inlet NO_x (tpy)	172	687
Inlet SO_2 (tpy)	106	289
Inlet PM (tpy)	73	181
Inlet Total NO_x, SO_2 and PM (tpy)	351	1,156
Outlet NO_x (tpy)	17	69
Outlet SO_2 (tpy)	26	72
Outlet PM (tpy)	3	8
Outlet Total NO_x, SO_2 and PM (tpy)	47	148
Removed NO_x (tpy)	155	618
Removed SO_2 (tpy)	79	217
Removed PM (tpy)	70	173
Removed Total NO_x, SO_2 and PM (tpy)	304	1,008
Cost Effectiveness ($ per Total Ton removed)	$3,768	$1,819

3.3 Energy and non-air quality impacts of compliance

Significant operating costs in order of magnitude include electricity, ammonia reagent, hydrated lime reagent and labor. These costs are taken into account in the enclosed cost estimates. The cost estimates provided in this report incorporate electricity usage for control system fans.

The cost estimates adjust ammonia reagent consumption rates based on the anticipated actual and potential emissions. The ammonia selected for the control of NO_x emissions is 19% aqueous ammonia. This is a less concentrated and safer alternative to anhydrous ammonia. This type of ammonia has no federal requirement to evaluate the potential impacts of an accidental release.

The cost estimates adjust hydrated lime consumption rates based on the anticipated actual and potential emissions. The calcium sulfate formed by the reaction of hydrated lime with SO_2 will be captured as dust by the ceramic filters. Calcium sulfate is a raw material in glass making and it is common practice to recycle the captured dust to the glass furnace. The cost estimates provided with this report includes the cost of a recycling system for 100% of the dust. This system avoids waste disposal impacts and costs.

3.4 Remaining useful life of any potentially affected sources

It is common practice in the glass industry to rebuild glass furnaces after their refractory has completed its useful life. This may last 10 to 20 years. It is not clear from the available DOE background documents how long a glass factory has been in the location of Ardagh. A history of glass container manufacturing suggests there has been a Ardagh connected plant in Seattle since 1931.[10] This would suggest there have been numerous new and rebuilt furnaces, and a new control system at the Ardagh plant would continue to operate for its entire useful life. As previously discussed with available emission control options, the time when a glass furnace is rebuilt would be an appropriate time to consider changing from a fossil fuel-fired furnace to one that is electrically heated and eliminating the emissions associated with regional haze.

4.0 CONCLUSIONS

It is technically feasible to add additional emission controls to the Ardagh Glass Inc. plant in Seattle and further reduce its air pollution emissions of NO_x, SO_2 and PM which contribute to regional haze. The catalytic ceramic control system evaluated in the enclosed FFA has been installed on other glass plants, including Ardagh's own plant in Illinois.

The existing Seattle plant does have some control measures in place. Furnace Nos. 2, 3 and 5 are oxy-fuel fired to reduce their NO_x emissions and Furnace Nos. 3 and 5 are equipped with a cloud mist control system to reduce SO_2 and PM emissions. Nevertheless, the residual emissions can be controlled further by the use of the catalytic ceramic control system.

Based on actual and potential emissions, the enclosed cost estimates show that the new control system would have a cost effectiveness of $3,768 and $1,819 per ton of total air pollutants removed, respectively. Both of these values represent a reasonable expenditure for the reduction of NO_x, SO_2 and PM emissions.

---

[10] https://glassbottlemarks.com/ball-bros-glass-company/

Appendix A

Supporting Cost Calculations

	Reference	Original	Reference	Original	Reference	Ardagh	Reference	Ardagh
Basis		Potential		Potential		Actual		Potential
Capacity (tpd)	Quotation	700		700	2017 DOE SOB	573.4	2017 DOE SOB	990
Inlet NOx (lbs/ton)	Quotation	18.0		18.0			2017 DOE SOB	3.8
Inlet SO2 (lbs/ton)	Quotation	4.0		4.0			2017 DOE SOB	1.6
Inlet PM (lbs/ton)	Quotation	1.2		1.2			2017 DOE SOB	1
Inlet NOx (tpy)	Calculated	2,299.5		2,299.5	2014 Inventory	172.1	Calculated	686.6
Inlet SO2 (tpy)	Calculated	511.0		511.0	2014 Inventory	105.9	Calculated	289.1
Inlet PM (tpy)	Calculated	153.3		153.3	2014 Inventory	73.2	Calculated	180.7
NOx Removal (%)	IN vs OUT	90.0%		90.0%	Same as Original	90.0%	Same as Original	90.0%
SO2 Removal (%)	IN vs OUT	75.0%		75.0%	Same as Original	75.0%	Same as Original	75.0%
PM Removal (%)	IN vs OUT	95.8%		95.8%	Same as Original	95.8%	Same as Original	95.8%
Outlet NOx (lbs/ton)	Quotation	1.8		1.8			Calculated	0.38
Outlet SO2 (lbs/ton)	Quotation	1.0		1.0			Calculated	0.40
Outlet PM (lbs/ton)	Quotation	0.1		0.1			Calculated	0.04
Outlet NOx (tpy)	Calculated	230.0		230.0	Calculated	17.2	Calculated	68.7
Outlet SO2 (tpy)	Calculated	127.8		127.8	Calculated	26.5	Calculated	72.3
Outlet PM (tpy)	Calculated	6.4		6.4	Calculated	3.1	Calculated	7.5
Removed NOx (tpy)	Calculated	2,069.6		2,069.6	Calculated	154.9	Calculated	617.9
Removed SO2 (tpy)	Calculated	383.3		383.3	Calculated	79.4	Calculated	216.8
Removed PM (tpy)	Calculated	146.9		146.9	Calculated	70.2	Calculated	173.1
Removed NOx, SO2 and PM (tpy)	Calculated	2,599.7		2,599.7	Calculated	304.5	Calculated	1,007.9
Capital Costs		Original (2015)	Inflation	Original (2020)	Adjustment Method	Actual Basis	Adjustment Method	Potential Basis
Complete System Equipment and Installation		$12,159,935	1.10	$13,375,929	Six-Tenths by Capacity	$11,866,967	Six-Tenths by Capacity	$16,468,204
Capital Recovery Factor (CRF)	CRF (20 yrs, 3.25%)	0.06878	CRF (20 yrs, 3.25%)		CRF (20 yrs, 3.25%)	0.06878	CRF (20 yrs, 3.25%)	0.06878
		$836,360				$816,210		$1,132,683
Operating Costs								
Electricity		188953	1.10	$207,848	Ratio by Capacity	$170,257	Ratio by Capacity	$293,957
19% Aqueous Ammonia		665665	1.10	$732,232	Ratio by Inlet NOx	$54,802	Ratio by Inlet NOx	$218,623
Hydrated Lime		361,810	1.10	$397,991	Ratio by Inlet SO2	$29,787	Ratio by Inlet SO2	$118,829
Labor for Operation and Maintenance		69,213	1.10	$76,134	No Change	76,134	No Change	69,213
Annual Operating Costs		1,285,641				330,980		700,622
Capital Costs		$12,159,935				$11,866,967		$16,468,204
Annual Capital Costs		$836,360				$816,210		$1,132,683
Annual Operating Costs		$1,285,641				$330,980		$700,622
Annual Capital and Operating Costs		$2,122,001				$1,147,190		$1,833,305
Inlet NOx (tpy)		2,300				172		687
Inlet SO2 (tpy)		511				106		289
Inlet PM (tpy)		153				73		181
Inlet NOx, SO2 and PM (tpy)		2,964				351		1,156
Outlet NOx (tpy)		230				17		69
Outlet SO2 (tpy)		128				26		72
Outlet PM (tpy)		6				3		8
Outlet NOx, SO2 and PM (tpy)		364				47		148
Removed NOx (tpy)		2,070				155		618
Removed SO2 (tpy)		383				79		217
Removed PM (tpy)		147				70		173
Removed NOx, SO2 and PM (tpy)		2,600				304		1,008
Cost Effectiveness ($ per ton removed)		$816				$3,768		$1,819

Notes:

Complete System Equipment and Installation includes: emission control system, controls, infrastructure, engineering design and project management, installation, services, batch recycle system, ammonia tank shelter.

Inflation multiplier from November 2015 to December 2020 = 1.10 - https://www.bls.gov/data/inflation_calculator.htm

Capital Recover Factor based on lifetime of operation and % interest from DOE, Four-Factor Analysis, https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Regional-haze

Last Page