Regional Haze SIP Revision – Second 10-Year Plan
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Chapter 11: Four-Factor Analysis

Introduction

The Regional Haze Rule (RHR) requires that 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). Sources for analysis were identified according to the Q/d screening methodology described below.

Although area and mobile sources may contribute to RH causing emissions they are not identified by the Q/d screening. These sources include, but are not limited to, international emissions, mobile sources (motor vehicles, airplanes, ships, trains, etc.), and residential wood smoke. We discuss these sources in Chapter 10: Long-term Strategy.

The Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring data shows that ammonium sulfate ($(NH_4)_2SO_4$) and ammonium nitrate (NH_4NO_3) are two of the most significant pollutants impairing visibility in Washington's CIAs. $(NH_4)_2SO_4$ is primarily from point sources and offshore sources (shipping traffic), and NH4NO3 is primarily from point and mobile sources, with slight contributions from non-point sources. After the intial screening for Q/d, the four factor analysis in this chapter addresses point sources of nigrogen oxides (NOx) and sulfur dioxides (SO2) emissions

The RHR provides no specific mechanisms to enforce emission reductions. Ecology relies on current Washington State laws and regulations to implement any reductions identified as reasonable in the FFA. We have identified four potential mechanisms for achieving identified emission reductions:

- Agreed order (AO) – a legally binding Order that requires agreement between the parties.
- Compliance action – legal action that the state can take if permit violations occur; the action must be appropriate to the violation.
- Permit modification – permittee initiated change to their facility

- Reasonable available control technology (RACT) – Revised Code of Washington (RCW) 70.94.154[1]

The first three options require agreement and actions from the sources. The RACT process may require rulemaking. Ecology prefers to use permit modifications and AOs to achieve emission reductions. Ecology will use the RACT process to initiate reasonable emission reductions when the sources and Ecology disagree.

The RACT process in state law requires a detailed evaluation of the characteristics of each individual source or source category when more than three individual sources exist in a source category. The RACT process also requires an evaluation of the efficacy of installation of various control equipment. The result of the process is (typically) a rule requiring all units in the defined source category to achieve the rule defined emission limitations. The rule allows for a specified timeframe to upgrade controls to meet the new or revised emission standards. The state RACT law includes an economic hardship provision. This allows a company that demonstrates it meets criteria for economic hardship either an extended timeframe to achieve compliance or a source specific emission limitation.

The timeframe to issue a new rule using the state's RACT process will extend past the submission date of this RH State Implementation Plan (SIP). The RACT rule implementation period would follow the conclusion of rulemaking. Therefore, the identified emission reductions might not take affect during this RH implementation period. They could occur in a future RH implementation period.

Source screening analysis (Q/d)

Q/d screening considers the ratio of tons of visibility-impacting emissions produced by a source (Q) to its distance from the nearest Class 1 area (d).

Ecology used Washington's 2014 emission inventory (EI) data to calculate Q values. The 2014 EI was the used as it was the year with the most recent certified EI data when RH screening started. The reported emissions of compounds that contribute to RH (NO_X, PM_{10}, SO_2, and SO_4) were summed (Q) for each source since these compounds contribute significantly to visibility in Washington's CIAs. We also calculated the shortest distance (d) from the source to the nearest CIA. The goal of this strategy is to target sources with larger Q/d values representing larger assumed visibility impacts.

[1] "Reasonably available control technology" (RACT) means the lowest emission limit that a particular source or source category is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT is determined on a case-by-case basis for an individual source or source category taking into account the impact of the source upon air quality, the availability of additional controls, the emission reduction to be achieved by additional controls, the impact of additional controls on air quality, and the capital and operating costs of the additional controls. RACT requirements for a source or source category shall be adopted only after notice and opportunity for comment are afforded. RCW 70A.15.1030(20)

Ecology screened the data by calculating the Q/d value for each source and ranking them from greatest Q/d to smallest Q/d. The resulting Q/d values were evaluated using two different EPA approved processes (EPA Draft RHR Guidance 2016).The first process looked at sources with a Q/d of 10 or greater, and the second process looked at the sources that were in the top 80 percent of the summed Q/d values. The sum of all Q/d scores is 855 and 80 percent of 855 is 685.

[APPENDIX XX] contains the full 2014 Washington emission inventory. Ecology maintains the inventory which contains all of the major sources in the state and a partial inventory of non-major sources. The inventory does not represent all non-major sources in the state, but only the sources the local air agencies report to Ecology.

The screening yielded a subset of 20 sources (17 major sources and 3 non-major sources) where the 80% Q/d score was equal to 6.7. The 6.7 value is lower than the Q/d threshold of 10. The 80 percent Q/d value yielded a larger number of sources and is more conservative, so we used the 80 percent Q/d value of 6.7 as the threshold for which we would evaluate sources using FFA.

Further evaluation of the data shows that one oil refinery is below the 80 percent Q/d threshold because of its small size and lower emissions. We included this facility in the FFA in order to evaluate all facilities in the same emission catagery concurrently. Table 1 shows the facilities that Ecology screened using the Q/d 80 percent threshold.

The sources in Table 1 contain three non-major sources. Two of these sources have emission values nearly an order of magnitude less than the facilities with similar Q/d values. The high Q/d value is because the facilities are close to a CIA, resulting in a small d value. Because we want to focus on the largest emitters of RH producing compounds, we removed those non-major sources from analysis and only looked at major sources.

We screened the major only sources using the same parameters as the initial screening with the results shown in Table 2.The sum of all major Q/d values was 756. The difference of 99 from the 855 Q/d value above is a direct result of the removing from consideration the non-major sources and represents a change of 11.5 percent. Eighty percent of the Q/d sum for major sources is 605. This does not include all of the Q/d values greater than 10, so we used a Q/d value of ten or greater for this threshold for a FFA as it is more conservative.

From the second evaluation of the 2014 inventory of all major sources, we removed 1,121 non-major sources facilities (~90% of sources) from consideration and only evaluated the 119 major sources. We focus on major sources because they represent 10 percent of all sources, but contribute 88 percent of the total Q/d value.

The screening of only major sources with a Q/d ≥ 10 yields a list of 16 sources. We included two sources with a Q/d ≤ 10 with the same facility categories as selected facilities (Boise Paper is a paperboard mill and US Oil is an oil refinery). These facilities were added to ensure all the facilities in a selected source category were selected for evaluation.

Ecology selected to perform a FFA on only the major facilities. This allows Ecology to focus on analyzing the 10 percent of sources that contribute 88 percent of the evaluated RH values.. This focus on RH contributions provides the greatest potential for RH reductions.

Table 1: Q/d analysis major and non-major sources

Facility Site Name	Type	Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4	d (km) to nearest CIA	Q/d	Nearest CIA	NO_X	PM_{10}	SO_2	H_2SO_4	Category 1	Agency
TransAlta Centralia Generation, LLC	major	10749.4	71.8	149.8	Mount Rainier NP	7525.0	149.5	3037.1		Coal powered electric	SWCAA
Nippon Paper Industries USA Co LTD	major	367.2	4.4	83.1	Olympic NP	172.5	37.6	153.5		Pulp and Paper Plant	ORCAA
Alcoa Primary Metals Wenatchee Works	major	3461.7	42.8	80.9	Alpine Lakes Wilderness	69.5	457.5	2934.8		Alumina Refining and Aluminum Production	Industrial
Alcoa Primary Metals Intalco Works	major	5658.5	78.9	71.7	North Cascades NP	227.4	636.8	4794.3		Alumina Refining and Aluminum Production	Industrial
BP Cherry Point Refinery	major	2945.0	80.8	36.4	North Cascades NP	1893.0	83.0	917.0	52.0	Petroleum Refineries	NWCAA

Facility Site Name	Type	Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4	d (km) to nearest CIA	Q/d	Nearest CIA	NO_X	PM_{10}	SO_2	H_2SO_4	Category 1	Agency
Tesoro Northwest Company	major	2312.3	75.4	30.7	Olympic NP	1918.0	128.0	191.1	46.2	Petroleum Refineries	NWCAA
RockTenn Tacoma Mill	major	1353.7	48.4	27.9	Mount Rainier NP	940.3	145.7	260.9		Pulp, Paper, and Paperboard Mills	Industrial
Weyerhaeuser NR Company	major	2656.0	104.8	25.3	Mount Adams Wilderness	2086.3	123.4	440.3		Paperboard Mills	Industrial
Puget Sound Refining Co. (Shell)	major	1793.1	73.0	24.5	Olympic NP	1229.7	180.8	348.9	31.6	Petroleum Refineries	NWCAA
Pt Townsend Paper	major	848.0	35.0	24.2	Olympic NP	494.0	210.0	79.0		Paper (except Newsprint) Mills	Industrial

Facility Site Name	**Type**	**Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4**	**d (km) to nearest CIA**	**Q/d**	**Nearest CIA**	**NO_X**	**PM_{10}**	**SO_2**	**H_2SO_4**	**Category 1**	**Agency**
Ash Grove Cement Co, E Marginal	major	1243.6	53.8	23.1	Alpine Lakes Wilderness	1144.0	33.5	57.0		Cement Manufacturing	PSCAA
Cosmo Specialty Fibers, Inc.	major	973.8	58.2	16.7	Olympic NP	465.2	262.0	236.9	0.1	Paperboard Mills	Industrial
Longview Fibre Paper and Packaging, Inc.	major	1574.2	100.7	15.6	Mount Adams Wilderness	1215.3	198.8	141.1		Paperboard Mills	Industrial
Georgia-Pacific Consumer Products (Camas) LLC	major	653.0	45.4	14.4	Mount Hood Wilderness	463.0	147.0	17.0		Paper (except Newsprint) Mills	Industrial
Interfor US Inc – Port Angeles Division	**non-major**	**77.0**	**6.1**	**12.6**	**Olympic NP**	**50.3**	**11.7**	**6.3**		**Lumber Mill - Logging**	**ORCAA**

Facility Site Name	**Type**	**Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4**	**d (km) to nearest CIA**	**Q/d**	**Nearest CIA**	**NO_X**	**PM_{10}**	**SO_2**	**H_2SO_4**	**Category 1**	**Agency**
Phillips 66	major	840.6	77.2	10.9	North Cascades NP	723.0	58.0	49.0	4.6	Petroleum Refineries	NWCAA
Cardinal FG Winlock	major	859.8	80.1	10.7	Mount Rainier NP	791.5	9.2	56.7		Flat Glass Manufacture	SWCAA
Boise Paper	major	1048.3	111.5	9.4	Eagle Cap Wilderness	742.1	114.2	186.4		Paperboard Mills	Industrial
Port Angeles Hardwood LLC	**non-major**	**33.6**	**3.8**	**8.9**	**Olympic NP**	**20.8**	**6.7**	**3.3**		**Wood Products**	**ORCAA**
Ardagh Glass Inc	major	358.4	53.5	6.7	Alpine Lakes Wilderness	172.1	70.3	105.9	7.1	Bottle Glass Manufacture	PSCAA

Facility Site Name	Type	Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4	d (km) to nearest CIA	Q/d	Nearest CIA	NO_X	PM_{10}	SO_2	H_2SO_4	Category 1	Agency
US Oil & Refining Co	major	149.2	46.4	3.2	Mount Rainier NP	132.9		4.2		Oil Refinery	PSCAA
Total		39956.5		686.8							

Table 2: Q/d majors only

Facility Site Name	Q (tons) of NO_X, PM_{10}, SO_2, and H_2SO_4	d (km) to nearest CIA	Q/d	Nearest CIA	Category 1	Agency
TransAlta Centralia Generation, LLC	10749.4	71.8	149.8	Mount Rainier NP	Coal powered electric	SWCAA
Nippon Paper Industries USA Co LTD	367.2	4.4	83.1	Olympic NP	Pulp and Paper Plant	ORCAA
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Cardinal FG Winlock	859.8	80.1	10.7	Mount Rainier NP	Flat Glass Manufacture	SWCAA
Boise Paper	1048.3	111.5	9.4	Eagle Cap Wilderness	Paperboard Mills	Industrial
US Oil & Refining Co	149.2	46.4	3.2	Mount Rainier NP	Oil Refinery	PSCAA
Total	39487.5		658.7			

Requests/contact with facilities

Ecology contacted the facilities selected for FFA in Spring of 2019, informing them that we had selected them for additional RH emission considerations (see Appendix XX). Some of these facilities had existing legal requirements or pending permit actions to reduce emissions, therefore Ecology did not request a FFA from them. We requested by letter that facilities in the pulp and paper and the refinery source categories perform an FFA and provide the results to Ecology.

Facility specific FFAs

The following sections contain the facility specific FFA information and Ecology's preliminary recommendation regarding additional emission controls.

Ash Grove Cement Company

Ash Grove Cement Company (Ash Grove) operates a dry process cement kiln in the Duwamish Industrial area of Seattle. The primary RH contributing emissions at the plant come from the cement kiln and its associated clinker cooler baghouses. Clinker is an intermediate product in cement production.

The existing particulate controls installed at the plant meet the regulatory requirements for dry material handling. The plant also complies with the Portland Cement Manufacturing National Emission Standard for Hazardous Air Pollutants (NESHAP). This standard regulates particulate matter (PM) as a surrogate for metals. The relevant NESHAP is 40 CFR Part 63, Subpart LLL. This NESHAP was last updated mid 2018 when the Environmental Protection Agency (EPA) determined that there were no developments in practices, processes, and control technologies that warrant revisions to the Maximum Achievable Control Technology (MACT) standards for this source category (83 FR 35122-35216 (July 25, 2018)).

SO_2 emissions from the plant come from burning sulfur containing fuels. The plant is capable of burning coal, natural gas, and tire-derived fuels. The plant has not been using coal for the last couple of years, but still has the ability to use coal. The alkaline cement clinker tends to remove SO_2 from the combustion gases. The facility has used this as a primary method of SO_2 control.

Oxides of nitrogen (NOx) emissions from the plant come from burning fuel.

Consent decree

The Ash Grove Cement Company entered into a consent decree with EPA, Ecology, the Puget Sound Clean Air Agency (PSCAA), and other state agencies in 2013 [SEE APPENDIX XX]. The consent decree required the Seattle facility to submit an optimization protocol for the Seattle Kiln. The purpose of the protocol was to optimize the operation of the Seattle Kiln to reduce NOx emissions to the maximum extent practicable from that kiln. The facility did not need to demonstrate compliance at the stack venting exhaust gases from the Seattle coal mill. EPA reviewed the optimization plan in consultation with the PSCAA.

The protocols for the optimization plan included optimization of key operating parameters resulting in the minimization of emissions of NOx. The consent decree required minimization of NOx to the greatest extent practicable without:

- incurring unreasonable cost.
- causing an exceedance of any other applicable emissions limit.
- impairing production quality or quantity.

The protocols also required the facility to identify all potential process and/or operational changes that they could implement to reduce emissions of NOx.

On June 30, 2016, the facility submitted the NOx demonstration period report and data related to optimization. On August 25, 2016, EPA, in consultation with Ecology and PSCAA, reviewed the data and approved the limit of 5.1 pounds of NOx per ton of clinker on a 30-day rolling average.

Four Factor Analysis

The following analysis recognizes that EPA approved the consent decree of 2013 and the optimization of the facility to limit NOx emissions in 2016. The basis of the plan was to reduce NOx emissions to the greatest practicable extent within reasonable costs. Ecology does not typically perform RACT analysis on single facilities that have had a reasonable analysis performed within the last five years. The following evaluates possible additional controls.

NOx emission controls

Selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) emission control systems are two potentially viable methods of reducing NO_X emissions. The exit stack temperature at the facility is typically around 350°F. This stack temperature is less than the typical SCR operation temperature and requires additional heating to 650°F. The temperature is significantly lower than optimal SNCR temperatures and requires heating, which generates more NOx.

Efficient operation of a SCR process requires consistent exhaust temperatures. Changes in the temperatures of the exhaust gas results in reduced NOx removal efficiency. When exhaust stream temperatures are too low, there is the potential that injected ammonia (the reducing agent) won't react (ammonia slip). Conversely, when the exhaust stream temperature is too high, ammonia (NH3) can oxidize to NO, potentially reducing efficiencies. The reducing process needs excess NH_3 to achieve removal efficiencies in excess of 80 percent and can result in ammonia slip.

Fouling of the catalyst bed is a risk when operating an SCR. Installing the catalyst bed downstream of the PM controls, (this facility uses baghouse dust collectors), can reduce fouling. The low exhaust gas temperature exiting the baghouse would require the installation of a heat exchanger system to reheat the exhaust stream to the desired reaction temperature range of between 480 °F to 800 °F. The use of a preheater would require additional fuel consumption, which would create even more NOx.

Installation of a SCR system would require storage and handling equipment for ammonia, and the required equipment for the SCR system would include a catalytic reactor, heat exchanger, and potentially additional NO_X control equipment for the emissions associated with the heat exchanger fuel combustion.

Installing the SCR in the high dust exhaust stream (e.g. before the baghouse) would put the SCR in the optimal temperature zone but there is a risk of fouling the catalyst. Faster fouling of the catalyst would result in increased operation cost and increased plant down time. A larger catalyst volume and mechanical mechanism to clean the catalyst could mitigate the fouling impacts but would require a larger physical footprint for installation.

SNCR systems operate at a substantially higher temperature (1600°F to 2100°F) than SCR systems. This would create an even higher preheater requirement. The SNCR system would have the same constraints with high dust environments as the SCR system.

The facility is located on a confined property with very little available area to install new equipment. The facility would need to move and relocate existing facilities in a vertical fashion to free up space. Another option would be to reduce the space allowed for stockpiles, but this would result in potential operational impacts and increased vessel traffic to deliver materials more frequently.

Based on these considerations we concludethat SCR and SNCR are not reasonably feasible for the Ash Grove Seattle facility at this time.

PM emission controls

The facility upgraded their emission controls in 2019 with the installation of a Dustex 10-module pulse jet baghouse with rated flow rate of 185,000 actual cubic feet per minute (ACFM). They performed this upgrade under a permit modification with PSCAA. The permit modification requires the facility to meet the requirements of the Best Available Control Technology (BACT) requirements. No additional control analyses are required as a PM BACT analysis was recently performed and the site is meeting relevant National Emission Standards.

SO_2 emission controls

The primary emission of SO_2 from the facility is from the burning of coal, tires, and various oils. The primary emission control for SO_2 is a wet scrubber. The installation of a wet scrubber and corresponding retention pond for the liquid coming out of the wet scrubber would take up significant space at the facility that is not available.. As discussed in the NO_X and SNCR emission devices above, space is limited at the site and installation would require extensive facility rearrangement in addition to the capital cost of the wet scrubber. Based on this, we do not consider the cost of a wet scrubber as reasonable at this time.

Cost of compliance

The cost to install NO_x and SO_2 emission controls would require significant facility reconstruction. The Ash Grove facility brochure in [APPENDIX XX] shows how congested the site is. To create room the emission devices would have to be elevated above the existing facility and would run into area height restrictions. The other option of raising existing plant equipment or positioning the emission control device above other equipment would require extensive structural work and would result in the facility shutting down operations during construction and reconfiguring the site. This would result in significant additional costs above capital expenditure and operational cost for the emission control equipment.

The lack of technically feasible control equipment, capital cost of the control equipment, and the increased structural cost to install or reconfigure the site make additional controls unreasonable.

Time necessary for compliance

Typical planning periods to design and then install NO_X or SO_2 controls run from two to three years. A tuning period after installation is required to understand the physical operation of the equipment. For the Ash Grove facility, the time required to plan and then install any equipment would increase by one to two years to allow for extensive facility modifications to accommodate any equipment.

Energy and non-air quality environmental impacts of compliance

SCR and SNCR equipment both require preheating the exhaust stream before entering the SCR or SNCR. Preheaters require burning of fuel to generate heat and this would consume additional energy and create additional emissions.

The installation of a wet scrubber for SO_2 controls would require obtaining a water quality permit for use with the liquid in the wet scrubber. Depending on the permit requirements, the facility could need additional energy to treat the liquid from the wet scrubber before discharge off-site.

Remaining useful life of any potentially affected sources

Proper maintenance of this facility should allow it to continue operations well into the future.

Summary and preliminary recommendations

Ecology recommends no additional installation of emission control equipment. This recommendation is a result of:

- The unreasonable cost to install equipment due to the confined space at the site
- The recent upgrade of PM controls at the site
- The recent consent decree that looked at SO_2, NO_X, and PM emissions.

Ecology may consider selecting this facility for evaluation during the next RH evaluation. The evaluation should look at SO_2 emissions reductions by removing the option to combust coal and waste oils at the facility. With the lack of coal use for the last couple of years, it shows that it is feasible to use non-coal sources of energy.

Cardinal Glass

Cardinal FG Company Winlock (Cardinal) operates a flat glass manufacturing plant in Winlock, near the intersection of Avery Road and Highway 603, in Lewis County, Washington. In 2019, Cardinal contacted Southwest Clean Air Agency (SWCAA) and proposed increasing production and adding SCR controls to reduce NO_X emissions.

Cardinal submitted a permit modification application to SWCAA to install a SCR emission control device and increase production of plate glass. The application also proposed removing the current emission controls of limiting excess oxygen. SWCAA is working with the facility to issue a permit to add SCR to the existing plant.

Ecology identified Cardinal in the Q/d analysis as a facility to review under the RH program. On January 17, 2020, Cardinal FG Company submitted a Four Factor analysis.

Four-factor analysis

Cardinal FG Company Winlock submitted an application to SWCAA to modify the facility's permit. The modification requested:

- Installation of a SCR system to control NO_X emissions from the glass furnace;
- Increase in rated furnace production from 650 tpd to 750 tpd;
- Removal of SCR from Emergency Generator #1;
- Installation of a new emergency generator; and
- Establishment of voluntary emission limits at levels below major source thresholds.

The use of the current emission control system (a proprietary 3R Process) will cease once the SCR system commences operation. The facility will also install a new supplemental heater between the Electrostatic Precipitator (ESP) and the SCR system. This heater will raise the exhaust stream temperatures to the range required for proper SCR operation.

Table 3 shows the emissions from, in tons and by pollutant, after the requested modification is complete. The table also shows the change in emissions from the current permit's values to the requested modified permit's values.

Table 3: Emissions summary

Pollutant	Facility-wide Potential to Emit after permit modification	Pollutant Emissions change between current limits and permit modification limits
NO_X	249.62 tpy	-583.05 tpy
CO	249.00 tpy	-522.48 tpy
VOC	57.79 tpy	1.92 tpy
SO_2	114.21 tpy	41.75 tpy
PM	141.96 tpy	16.84 tpy
PM_{10}	141.96 tpy	6.84 tpy
$PM_{2.5}$	141.96 tpy	16.84 tpy

Cost of compliance

a. Oxides of Nitrogen (NO_X) – cost and $/ton

Cardinal's permit modification application estimated a reduction of glass furnace annual NO_X emissions from 887.7 to 245.0 tons per year (tpy). This is an annual reduction of 642.7 tpy. The estimated cost of the new SCR control system is $10 million. Based on 3.5% interest and 20-year life, the annual cost is $944,000 per year. Using the annualized cost and emissions reduction, the estimated cost effectiveness is $1,469 per ton of NO_X. The actual cost will be higher since this does not include operating costs.

Ecology requested additional information to use the EPA Control Cost Manual. Ecology wanted to check the EPA Control Cost Manual results to actual data for quality purposes. Ecology received the following unit specific information from Cardinal on June 15, 2020:

- Exhaust rate of 181,157 acfm @ 600 F
- SCR inlet NO_X = 437.5 lbs/hr (above current emission limit)
- SCR outlet NO_X = 49.1 lbs/hr
- Capital cost updated to $11 million (annualized cost not updated)

b. SO_2, PM – Temperature change – higher scrubber temperature and reheat - cost and $/ton

The operating temperature of the new SCR system will require the existing spray dryer and electrostatic precipitator (ESP) to operate at higher temperatures, reducing their collection efficiency and requiring a reheat burner. This increased temperature results in a greater fuel consumption and SO_2 emissions. The SO_2 emissions limit will increase from 0.6 to 0.8 lbs of SO_2/ton of glass. The natural gas-fired reheat burner will have a capacity of 17 million British Thermal Units (mmbtu)/hr.

The permit modification application includes a production increase at the facility from 650 to 750 tons per day (TPD). This results in an increase of total annual PM emissions even though the total PM emission limits of 0.94 lbs/ton will not change.

Time necessary for compliance

Cardinal expects to have the proposed SCR installed and operational aapproximately one year after the permit is issued. The permit issued by SWCAA to the facility on [PUT DATE HERE] and it is anticipated to have the SCR operating by [PUT DATE HERE]

Energy and non-air quality environmental impacts of compliance

a. SCR - Ammonia and PM increases

The design of the SCR system at the facility assumes 19 percent ammonia reagent usage of 816 lbs/hr. Appendix D of the permit modification application calculates ammonia emissions. [APPENDIX XX] contains the permit modification application. Based on an ammonia slip limit of 10 ppm, estimated ammonia emissions based on continuous operation will be 9.5 tpy.

The total PM emission limits of 0.94 lbs PM/ton of glass will not change. Total PM emissions will increase, however, due to the facility increasing throughput capacity from 650 to 750 tpd of glass. Appendix C of the permit modification application calculates PM emissions. [APPENDIX XX] contains the permit modification application. The PM emissions from the glass furnace will increase from 111.0 to 128.7 tpy, for an increase of 17.7 tpy.

The SO_2 emissions limit will increase from 0.6 to 0.8 lbs/ton. Emission increases will occur due to the increase in capacity from 650 to 750 tpd of glass. Appendix C of the permit modification application calculates SO_2 emissions. [APENDIX XX] contains the permit modification application. The SO_2 emissions from the glass furnace will increase from 75.6 to 114.2 tpy, for an increase of 38.6 tpy.

b. SO_2/PM controls - additional fuel if needed – added emissions

The existing SO_2 and PM controls for the glass furnace use no fuels.

Remaining useful life of any potentially affected sources

The Cardinal facility has operated since 2006. The new SCR system's design life will last at least 30 years if the facility performs proper maintenance.

Ecology's review

The RH program does not prohibit or limit construction of new stationary sources of emissions or modification of existing stationary sources of emissions. Cardinal submitted a permit modification application that allows for increased glass production and a change in emission control devices. Based on the above information and SWCAA's technical support document for the permit action, Ecology concludes:

The new SCR emissions control device will control NO_X emissions. This will reduce permitted emissions from 882 to 245 tpy, a reduction of about 640 tpy. Ecology's independent review of the cost for installation of the SCR determined approximately $1,600/ton of NO_X reduced (640 tpy in actual reductions). The facility's estimate was slightly higher as the company included the additional equipment (temporary stack and larger crane) to install the new system while the facility stays in operation. This could explain the higher cost Ecology estimated from the EPA Control Cost Manual as the model uses a base reconstruction factor of 1.5 to simulate actual costs.

- This cost is reasonable for RH NO_X reductions. If the facility were not taking action on their own initiative to install a SCR system, Ecology would have pursued Cardinal Glass to install one. The permit modification with SWCAA is the only action needed for RH reductions.

Table 4: Cardinal cost vs Ecology using the EPA Control Cost Manual with June 15,2020,updated exhaust flow and capital cost

Company	Annualized Cost $	Actual cubic feet per minute	Capital $	Annualized $
Cardinal FG Winlock	5.2	181,157	11,000,000	944,000
EPA Model - R =1.5	6.21	181,157	10,899,998	1,125,337.57

Summary and preliminary recommendations

- The operating temperature of the new SCR system will require the existing spray dryer and ESP to operate at higher temperatures, reducing the collection efficiency and requiring a reheat burner. Ecology believes that the resulting minor increase in PM and SO_2 is justified by the larger decrease in NO_X.
- Installation of the SCR in 2021 follows a reasonable implementation schedule.
- The new permit limit for ammonia of 10 ppm and 9.5 tpy is reasonable. New SCR systems will typically have actual ammonia emissions less than 2 ppm after tuning.
- Based on past operation of the plant, Ecology would expect the facility to operate well below its permitted emission limits.

Coal-fired electrical generation unit

TransAlta Centralia Generation (TransAlta) is a coal-fired power plant located east of Centralia, WA. This is the largest source of NO_X in the state. TransAlta's large quantity of emissions and tall stacks create NO_X impacts to all of the CIAs within 300 km of the facility. TransAlta operates a two unit, pulverized coal-fired power plant. Each unit of the plant rates at 702.5-megawatt (MW) net output. Operation of a coal-fired power plant results in visibility impairing emissions of PM, SO_2, and NO_X.

The Coal-Fired Electric Generation Facility Bill was signed 2011, with an effective date of July 22, 2011. The state's greenhouse gas emission performance standard for power plants codified at Revised Code of Washington (RCW) 80.80.040 determined the main environmental impacts of the bill. The requirements in RCW 80.80.040 have compliance dates for one boiler to be compliant by December 31, 2020, and the other boiler to be compliant by December 31, 2025. TransAlta has acknowledged that they plan to meet the conditions by ceasing coal-fired power generation in the units on the dates specified.

Ecology identified TransAlta as a best available retrofit technology (BART) eligible facility in the first implementation period of RH. Ecology issued a BART Order to TransAlta on June 18, 2010. This BART Order required the installation of a SNCR emission control device. Ecology issued a revision to the BART Order on December 13, 2011. The revision incorporated an optimization study on urea volume injections for the SNCR. Ecology issued a second revision to the BART order on July 29, 2020. The second revision required the installation of automated controls on the combustion system, a lower NO_X emission limit, and removal of specific urea injection volumes.

In the summer of 2019, TransAlta experienced emission opacity readings that would have exceeded the opacity limits if TransAlta had not reduced plant capacity to compensate. During a maintenance shutdown, the facility examined their ESPs. The ESPs had a visual fouling of all interior components, which dramatically reduced their efficiency. The facility analyzed the material in the ESPs and identified it as ammonia sulfate. The source of ammonia in the system was from the reactions of urea in the SNCR system.

TransAlta installed a computerized emission control system called a Combustion Optimization System with Neural Network program (Neural Net) to decrease the ammonia slip in the SNCR in coordination with SWCAA and Ecology. SWCAA agreed to use enforcement discretion in 2019 on the urea injection rate mandated in the 2011 BART Order revision while TransAlta was tuning the Neural Net. TransAlta collected enough process data during tuning of the neural net to agree to a more stringent NO_X emission standard of 0.18 lb/MMBtu than the 0.21 lb/MMBtu required under the 2011 BART Order revision.

Because the Neural Net is able to maintain a more stringent emission standard, Ecology eliminated unnecessary requirements when issuing the second BART order revision. Specifically, the 2020 order:

- Removed the requirement of a specific urea injection rate to allow TransAlta to inject urea as required to meet the new emission standard.
- Removed the requirement to analyze and report nitrogen and sulfur coal content as the facility would have to meet NO_X, SO_2, and PM emission standards regardless of the coal used.
- Changed the requirement for ammonia emission monitoring to require monitoring only when using a urea injection rate of greater than 1.5 gallons per minute.

Four factor analysis

The FFA of TransAlta reflects that RCW 80.80 and the Memorandum of Agreement (MOA) between TransAlta and the Governor of Washington that TransAlta will completely cease coal-fired power generation by December 31, 2025. It also discusses the second BART Order revision that applies reduced NO_X emission standards on the facility.

Cost of compliance

The agreement to cease coal-fired power generation greatly influences the compliance cost for installin any emission controls at TransAlta. The first unit will cease operation on December 31, 2020. This will halve the plant emissions from coal-fired power generation. This emission reduction requires no capital cost. Operational costs to ensure that the unit will no longer be able to generate power from coal will occur, but all parties already considered this as part of the MOA.

The second BART Order revision includes the installation of the neural net to control combustion variables in one of the boilers. TransAlta proposed this installation and during optimization testing the data confirmed that the controls could reduce the NO_X emission limit. Ecology did not request the costs associated with installing, testing, and optimizing of the neural net as it was proposed by TransAlta and resulted in decreased NO_X emissions for the remaining coal-fired power generation life of the facility.

Time necessary for compliance

TransAlta will cease coal-fired power generation on one of their units by December 31, 2020. TransAlta will cease coal-fired power generation on their last unit by December 31, 2025. The neural net installation has already occurred and the more stringent emission limit applies to the facility until it ceases coal-fired power generation.

Energy and non-air quality environmental impacts of compliance

The energy required to meet compliance for ceasing coal-fired power operation is zero. We did not take non-air quality environmental impacts for the future of the facility into account for this analysis.

For the neural net, TransAlta is anticipating payback within a couple of years. This is because more efficient combustion controls reduce the amount of coal required to produce the same amount of heat.

Remaining useful life of any potentially affected sources

The facility useful life for coal-fired power generation is until December 31, 2020, for one unit and December 31, 2025, for the other unit.

Summary and preliminary recommendations

TransAlta already has an agreement to cease coal-fired power generation by December 31, 2025. This will result in coal related emissions from the facility going to zero. With the installation of the neural net, the facility will also have a reduced NO_X emission standard for the remaining life of the facility. For these reasons, Ecology does not anticipate further emission reductions or emission control devices for Regional Haze purposes.

Primary aluminum production

The state of Washington currently has two primary aluminum reduction facilities with active air permits:

- Alcoa Primary Metals Wenatchee Works located in Wenatchee, Washington.
- Alcoa Primary Metals Intalco Works located in Ferndale, Washington

Alcoa curtailed the Wenatchee facility in 2015 and the Ferndale facility in 2020, while keeping both air permits active.

In 2014, the emissions from the sites were as follows:

Table 5: Primary aluminum facility 2014 emissions

Facility	Tons PM_{25}	Tons SO_2	Tons NO_X
Alcoa Intalco	637	4,794	227
Alcoa Wenatchee	457	2,935	70

Alcoa Wenatchee Works

The Wenatchee Works facility, curtailed since 2014, has very low emissions. The facility is performing all requirements of their air permits and could restart “at any time”. Wenatchee

Works would need time to expand their work force from the current curtailment level and additional physical activities would need to occur prior to returning to production.

The four-factor analysis of Wenatchee Works is complicated by the curtailment status. Annual emissions are very low while in curtailment. In 2016-2018, annual emissions were less than 10 tpy for all pollutants. A facility in curtailment is also not generating revenue for its primary function (e.g., the facility is not selling any aluminum).

Four-factor analysis

The primary RH causing emission from the facility when it is operating is SO_2. A wet scrubber and associated liquid handling structures is a prevalent emission control for SO_2. The following FFA details how installation of a wet scrubber system is not reasonable when the facility is in curtailment.

Cost of compliance

The identification and analysis of emission reduction equipment based on actual emissions during curtailment will always result in a determination that the costs of compliance will be excessive for the facility. The facility reported 10 tons of total annual emissions in 2016. Assuming the facility could install control equipment for the entire 10 tons, the cost per ton of emissions reduced will exceed $10,000 per ton of pollutants removed with only a $100,000 expenditure. A cost of $10,000 per ton exceeds a reasonable cost for primary aluminum facilities at this time.

Facilities with large emissions of SO_2, in tons per year, typically utilize wet scrubbers for emission control. Direct capital equipment costs for wet scrubbers are typically in the millions of dollars range and installing a wet scrubber would result in a non-reasonable expenditure of at least $100,000 per ton of SO_2 removed based on current emissions.

Because the facility has the potential to restart “at any time”, emissions could potentially return to pre-curtailment levels. In this situation, an analysis of the facility could potentially result in reasonable emission control costs. Calculations of the cost of compliance would depend on numerous variables, from the number of pot lines brought back on line, amount of aluminum produced, regaining experienced operators for efficient operations, and other operational determinations.

Numerous variables associated with a restart of the facility need to be determined before performing a cost analysis. At the time of facility restart, we would need to do an analysis to determine the reasonableness of the cost of compliance.

Time necessary for compliance

With the facility in curtailment and no emission control equipment deemed reasonable, the facility is already complying with reasonable emission control. If the facility comes out of curtailment, we would need a new FFA to determine time for compliance if we identify control equipment.

Energy and non-air environmental impacts

With the facility in curtailment and no emission control equipment deemed reasonable, the facility would not have any new non-air environmental impacts. If the facility comes out of curtailment, we would need a new four-factor analysis to determine non-air environmental impacts if we identify control equipment.

Remaining useful life

The facility is currently in curtailment and not operating. The facility is performing maintenance on equipment to keep the facility in position to restart in the future. The facility has permanently closed a pot line within the last five years.

We assumed additional pot lines will permanently close in the future, but the facility currently has no pot lines scheduled to close.

Summary and preliminary recommendations

Wenatchee Works is currently in curtailment and it is not cost reasonable to have emission control devices added at this time. With the potential of the facility to restart "at any time", gaining an agreement with the facility to perform a FFA before the facility restarts is prudent. Ecology will be considering options for a legally enforceable agreement to require a FFA prior to facility restart. The AO will have the facility perform a FFA before restarting and provide the analysis to Ecology. Ecology will then act on the analysis appropriately.

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Alcoa Intalco

The Intalco facility near Ferndale is capable of making approximately 307,000 tons of aluminum metal each year. The facility is located in an area that had air monitor readings that were exceeding the one-hour sulfur dioxide (SO_2) National Ambient Air Quality Standards (NAAQS). Ecology and Intalco entered into Agreed Order 16449 on July 25, 2019. Intalco agreed in the AO to submit a complete Notice of Construction (NOC) application for the installation of a wet scrubber design and engineering report by October 31, 2020.

We anticipated using the AO as a basis of preparing the FFA. Ecology did not request the facility to perform a FFA as the AO obviated the need to perform one. On April 22, 2020, the Intalco facility announced that it was curtailing production. The AO contains a clause that "[n]otwithstanding anything else in this Order, in the event that Intalco announces the closure or curtailment of one of its three potlines (A, B, or C line, or any combination or equivalent measure thereof), then upon thirty days' prior written notice to Ecology, this Order and Intalco's obligations hereunder will become null and void."

With the curtailment and subsequent voiding of the AO Ecology cannot count potential emissions reductions from the previously agreed upon wet scrubber.

The Intalco facility and the separately described Wenatchee Works facility are now both curtailed primary aluminum facilities.

The Intalco facility will curtail in 2020 and will have very low emissions. The facility is planning to perform all requirement of their permits and could restart "at any time'. Intalco would need time to expand their work force from the current curtailment level and additional physical activities would need to occur prior to returning to production.

The FFA of Intalco during curtailment is more complicated than on an operating facility. Annual emissions are very low while in curtailment and should be comparable to the Wenatchee Work primary aluminum facility that is already in curtailment. The Wenatchee Works facility had annual emissions in 2016-2018 that were less than 10 tpy total for all pollutants. The Intalco facility entering curtailment will not generate any revenue for its primary function (that is, the facility is not selling any aluminum).

Four-factor analysis

The primary RH causing emission from the facility when it is operating is SO_2. A wet scrubber and associated liquid handling structures is a prevalent emission control for SO_2. The following FFA details how installation of a wet scrubber system is not reasonable when the facility is in curtailment.

Cost of compliance

The identification and analysis of emission reduction equipment based on actual emissions during curtailment will always result in a determination that the costs of compliance will be excessive for the facility. If Intalco curtailed emissions are similar to the Wenatchee Works facilities' reported 10 tons of total annual emissions in the 2016 EI, then Intalco will also have around 10 tons of annual emissions. Assuming the facility could install control equipment for the entire 10 tons, the cost per ton of emissions reduced will exceed $10,000 per ton of pollutants removed with only a $100,000 expenditure. A cost of $10,000 per ton exceeds a reasonable cost for primary aluminum facilities at this time.

Facilities with large emissions of SO_2, in tons per year, typically use wet scrubbers as emission controls. Direct capital equipment costs for wet scrubbers are typically in the millions of dollars range and then installing a wet scrubber would result in anunreasonable expenditure of at least $100,000 per ton of SO_2 removed based on current emissions.

Because the facility has the potential to restart “at any time”, emissions could potentially return to 2014 EI levels. In this situation, an analysis of the facility could potentially result in reasonable emission control costs. Calculations of the cost of compliance would depend on numerous variables from the number of pot lines brought back on line, amount of aluminum produced, regaining experienced operators for efficient operations, and other operational determinations.

Numerous variables associated with a restart of the facility need to be determined before performing a cost analysis. At the time of facility restart, we would need to do an analysis to determine the reasonableness of the cost of compliance.

Time necessary for compliance

With the facility in curtailment and no emission control equipment deemed as reasonable, the facility is already complying with reasonable emission control. If the facility comes out of curtailment, we would need a new FFA to determine time for compliance if we identify control equipment.

Energy and non-air environmental impacts

With the facility in curtailment and no emission control equipment deemed as reasonable, the facility would not have any new non-air environmental impacts. If the facility comes out of curtailment, a new FFA would be needed to determine non-air environmental impacts if control equipment is identified.

Remaining useful life

The facility is currently in curtailment and not operating. The facility is performing maintenance on equipment to keep the facility in position to restart in the future. The facility has permanently closed a pot line within the last 5 years. We assume the facility will permanently close additional pot lines in the future, but the facility has not currently scheduled any pot lines to close. Because of the uncertainties above, we cannot determine the remaining useful life of the facility at this time.

Summary and preliminary recommendations

Intalco is currently in curtailment and it is not cost reasonable to have emission control devices added at this time. With the potential of the facility to restart “at any time”, gaining an agreement with the facility to perform a four factor analysis before the facility restarts is prudent. Ecology plans to negotiate a legally enforceable AO with the facility. The AO will have the facility perform a FFA before restarting and provide the analysis to Ecology. Ecology will then act on the analysis appropriately.

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Chemical Pulp & Paper Mill FFA recommendations

This section considers and evaluates six options with only four[2] of the options considered by Ecology for addressing RH in the chemical pulp & paper mill industrial sector. They include both sulfate (kraft) and sulfite chemical processing facilities. Cosmo Specialty Fiber is currently the only sulfite mill in Washington. All other facilities listed are kraft mills.

Initial review

On September 10, 2019, Ecology requested an FFA from the seven chemical pulp mills in Washington State. Ecology received a combined FFA report from the six kraft mills and a separate FFA from the sulfite mill (Cosmo) on December 5, 2019. After review, on January 13 2020, Ecology requested that six of the seven mills provide follow-up information to Ecology by February 28, 2020.

- Ecology did not request additional information from GP Camas because they are no longer operating as a chemical pulp mill. In addition, steps were underway to provide enforceable conditions that would prevent GP Camas from operating as a chemical pulp mill under their current permit. If GP Camas pursues operation as a chemical pulp mill in the future, they will need to go through new source review.
- On February 20, 2020, Cosmo requested a time extension due to impacts of the coronavirus in China. Ecology agreed to a time extension to April 30, 2020.

Ecology received follow-up information from each of the mills within the timeframes agreed to above. All the submittals from the pulp mills are in Appendix A. A snapshot summary of the mill submittal values for NO_X, SO_2, and PM control costs after evaluation and adjustment by Ecology is in Appendix B.

RACT and BACT concepts

In 2016, Ecology published a Reasonably Available Control Technology (2016 RACT Analysis) analysis for the chemical pulp mills in Washington State. Using the recent FFA information from the mills, Ecology considered updating portions of the 2016 RACT Analysis for the current timeframe (2019/2020). As explained in the 2016 RACT Analysis, RACT is different from Best

[2] Two options were removed because they included outdated interest rates or equipment useful life values inconsistent with EPA's current cost manual approach based on conversations between Ecology, other EPA Region 10 states RH staff, and EPA. May 7, 2020; August 11, 2020.

Available Control Technology (BACT). However, as a starting point for initial review, Ecology considered the principles of BACT in order to inform a potential RACT update for the mills.

Principles of cost considerations from a BACT-level approach and other incurred costs

The following cost information is based on a BACT-level approach of cost per ton of pollutant removed, according to the BACT cost guidelines as described in the October 1990 EPA Draft New Source Review Workshop Manual (or Puzzlebook). As explained in section IV.D.2.c. of the Puzzlebook titled: "Determining an Adverse Economic Impact," when determining what values are cost effective, the engineer should consider the: *"cost previously borne by other sources of the same type."* And, "*the range normally incurred by other sources in that category*."

Therefore, the regulatory agency's experience with permitting and costs[3] incurred by other similar sources informs the BACT cost-effective decision. The costs that one source category or industry has incurred (for an SCR for example), may be different from the costs another source category or industry has incurred.

Ecology compared the cost per ton values of current combustion units with BACT and other cost values of recently purchased controls at the pulp mills.

Where BACT costs are not available, Ecology used other costs incurred such as for MACT[4] compliance.

Ecology learned from the pulp mills of the following recent costs incurred[5]:

- A 2018 low-NOx burner installed at WestRock Tacoma boiler #6 at **$6,302/ton**,
- A 2012 SNCR NO_X control installed at WestRock Longview hogged fuel boiler #20 to meet MACT requirements at **$6,245/ton**.
- A 2015 wet electrostatic precipitator (WESP) installed at Port Townsend Paper Corporation (PTPC) power boiler #10 to meet MACT requirements at **$15,634/ton**.

We could potentially use these recent actual cost per ton values incurred by the mills for similar units for BACT determination considerations (or cost thresholds). However, BACT is determined on a case-by-case basis taking into account other considerations also, such as energy and environmental concerns. Whereas cost thresholds are not necessarily the starting point for BACT determinations, we can use this information to inform a RACT-level consideration.

[3] From the puzzlebook: "Cost effectiveness is the dollars per ton of pollutant emissions reduced." Ecology focuses on the average cost effectiveness (total annualized cost per ton of pollutant removed) more than the incremental costs between two control alternatives.

[4] Maximum Achievable Control Technology.

[5] Estimates based on the first option assumptions using 3.25% interest rate and 20 years remaining useful life for low-NOx burners, SNCRs, wet scrubbers, and ESPs (wet and dry), and 25 year remaining useful life for SCRs.

Using a BACT-level cost approach and other costs incurred to arrive at RACT thresholds

Although similar to BACT in that Ecology has full discretion when making RACT determinations, there are some different RACT guidance principles based on experience and collaboration with other agencies such as EPA, Northwest Clean Air Association (NWCAA), and PSCAA. Some of these principles are:

As explained in the 2016 RACT Analysis, "*the RACT process includes an economic component that is generally less stringent than BACT*[6]," except possibly when addressing non-attainment areas, or other specific circumstances such as meeting MACT compliance.

- During the development of Ecology's Petroleum Refinery Greenhouse Gas Emission Requirements,[7] with NWCAA and PSCAA, RACT was generally described as a less stringent[8] analysis method to determine emission controls. Lowest Achievable Emission Rate (LAER) is more stringent and in most cases, is followed by BACT[9] in level of stringency. RACT generally indicates an "average-level" control upgrade, as opposed to BACT, which regulators generally consider above average in most cases.
- Ecology considered a RACT cost threshold at approximately 50 percent of a BACT cost threshold in the past and this approach is reasonable[10]. Depending on the circumstances, we could use a 50 percent factor for MACT costs. We could also use a 50 percent or lower factor for LAER costs.
- The previously used $5,000/ton value cost threshold for RACT is outdated[11]. Updating it with either a cost index, such as the Chemical Engineering Plant Cost Index (CEPCI), or actual recent costs incurred is a reasonable approach.

Using recent actual costs incurred is a reasonable approach to update the $5,000/ton threshold to a value of $6,245 for SNCR (or SCR) to the current timeframe (2020). Similarly, using the recent costs incurred of $6,302/ton for low-$NO_X$ burners would also be reasonable. These nearly identical costs could justifiably form the lower range of RACT cost thresholds for pulp and paper mills.

Based on Ecology's experience with BACT however, forming an upper range RACT cost threshold based on costs incurred of $15,634/ton for PM10 control (WESP) would appear too

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[6] Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills November 2016, Publication no. 16-02-023 p. 6.

[7] Chapter 173-485 WAC (Last Update: 5/28/14).

[8] Sometimes referred to as a "C-grade, " RACT is less stringent that BACT and LEAR except possibly when addressing non-attainment areas, or other specific circumstances such as meeting MACT compliance

[9] In some cases, BACT can be at a LEAR level of control such as when addressing non-attainment areas.

[10] Conversation between Ecology and EPA. December 5, 2019.

[11] This threshold was mentioned in conversations between Ecology, other EPA Region 10 states RH staff, and EPA. May 7, 2020. EPA noted during that conversation, that it is outdated.

costly.[12] This is based on the fact that RACT is generally less stringent than BACT or other costs incurred to address specific circumstances (such as non-attainment or MACT compliance) that might not apply to all facilities of the same type. Using the 50 percent principle applied to this cost would place the RACT pulp mill upper cost threshold value at a more reasonable $7,817/ton. Using rounded values, these thresholds would be: $6,250/ton to $7,800/ton; where $6,250/ton could be a threshold for NO_X control using either SNCR or SCR; $6,300/ton for low-NOx burners; and $7,800/ton for PM_{10} control.

Potential RACT thresholds applied to current chemical pulp mill units

We applied a potential RACT cost threshold range ($6,250/ton to $7,800/ton) to the pulp mill units described in the FFA. This provided the following lists of units for RACT consideration. In other words, the following units have estimated cost/ton values that are less than the threshold costs already incurred by the mills for similar pollutants. For NO_X control, the thresholds considered are $6,250/ton and $6,300/ton. For PM_{10} control, the threshold is $7,800/ton.

For NO_X control using a low-NOx burner, the following units have estimated cost/ton value less than the potential RACT threshold of $6,300/ton. Adding these controls could potentially reduce NO_X emissions by approximately 150 tpy.

- Nippon Boiler #9 ($2,754/ton);
- PCA boiler #1 ($5,893/ton);
- PCA boiler #2 ($4,834/ton).

For NO_X control using an SCR or SNCR, the following units have a cost/ton value less than the potential RACT threshold of $6,250/ton. Adding one of these controls could potentially reduce NO_X emissions by approximately 500 tpy to 1025 tpy.

- Nippon hog fuel (HF) boiler #11 ($5,413 for SNCR); ($5,466/ton for SCR);
- Nippon Boiler #9 ($6,041 for SCR).

For PM_{10} control, the following units have a cost/ton value less than the potential RACT threshold of $7,800/ton. Adding these controls could potentially reduce PM10 emissions by approximately 30 to 225 tpy depending whether Cosmo (currently in curtailment) is included (see footnotes for Cosmo).

- WestRock Tacoma Lime Kiln #1 ($6,964/ton).

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[12] Similar to RACT costs in non-attainment areas, RACT costs for MACT compliance are not necessarily the type of RACT costs applicable to RH. In non-attainment areas, RACT costs could rise to the level of LEAR, where cost is less of a factor. In MACT compliance, RACT costs could also be elevated and be applicable to a specific facility rather than all similar facilities if those other facilities are already meeting that specific MACT requirement.

- Cosmo Specialty Fiber Recovery Furnaces 1-3 ($6,403/ton - $12,740/ton)[13] [14].

For SO_2 control, Ecology did not receive recent cost incurred information from the pulp mills (the scrubber at WR Tacoma was for HCl control). The SO_2 control cost estimates that the pulp mills submitted to Ecology are greater than the potential cost threshold range of the other RH pollutant costs of $6,250 - $7,800.

Intermediate review

Ecology performed further analysis, taking into account the initial review, additional information, and including potential ramifications on RH during the current 2014-2028 implementation period.

Specifically, Ecology considered the following information as part of this intermediate analysis:

- Two of the mills are currently not operating as chemical pulp and paper mills (GP Camas no longer operates as chemical pulp mill and Cosmo went into curtailment in 2020).
- If the facility implemented the controls listed above, the amount of RH pollutants removed from the chemical pulp mill emissions would be approximately 500 tpy to 1,300 tpy.
- The amount of reductions considered in Ecology's 2016 RACT Analysis was approximately 1,345 tpy. The visibility benefits based on comprehensive photochemical grid modeling was no more than 0.127 deciview (dv) in CIAs.
- From page 38 of EPA's August 2019 Guidance on Regional Haze State Implementation Plans for the Second Implementation Period (EPA Guidance): "a measure may be necessary for reasonable progress even if that measure in isolation does not result in perceptible visibility improvement."

[13] This estimate assumes that adding a WESP can achieve 80% reduction. A 2020 vendor quote for Cosmo by B&W (Babcock & Wilcox; March 27, 2020) was based on approximately 56% reduction. The vendor assumed 56% reduction based on facility specific conditions at Cosmo. This includes a particle size range of 0.1 to 0.5 micrometers where removal efficiencies decrease due to lack of charge saturation (more effective above 0.7 microns), and lack of diffusion (more effective below 0.3 microns). References: "Applied Electrostatic Precipitation" (Parker, K.R. Nov 1996); "Control of reclamation (sinter) Plant Emissions using Electrostatic Precipitators" and Scarfing Machine Wet Electrostatic Precipitator Design Characteristics" (Varga, J. Jr. Jan and Mar 1976).

[14] Cosmo is currently in curtailment for the 2nd time in the last 15 years. Estimated costs ($8,918/ton) assuming 80% reduction and emissions equal to the last 15 year facility average; or estimated costs ($12,740/ton) using vendor quoted reductions at 56% and a 15 year average, are both above the upper RACT cost threshold ($7,800).

- The Federal Land Managers (FLMs) have not issued an Adverse Impact Determination for any of the chemical pulp mills in Washington State, as they have for other industries included in Ecology's current Q/d[15] analysis[16] [17].
- The amount of RH pollutants from the chemical pulp mills has decreased by 2,362 tpy from the estimated emission averages used in the 2016 RACT Analysis to 2019 EIs[18] (See Figure 1). Other RH pollutants (such as ammonia or NH3) have negligible emissions compared to those shown in Figure 1.

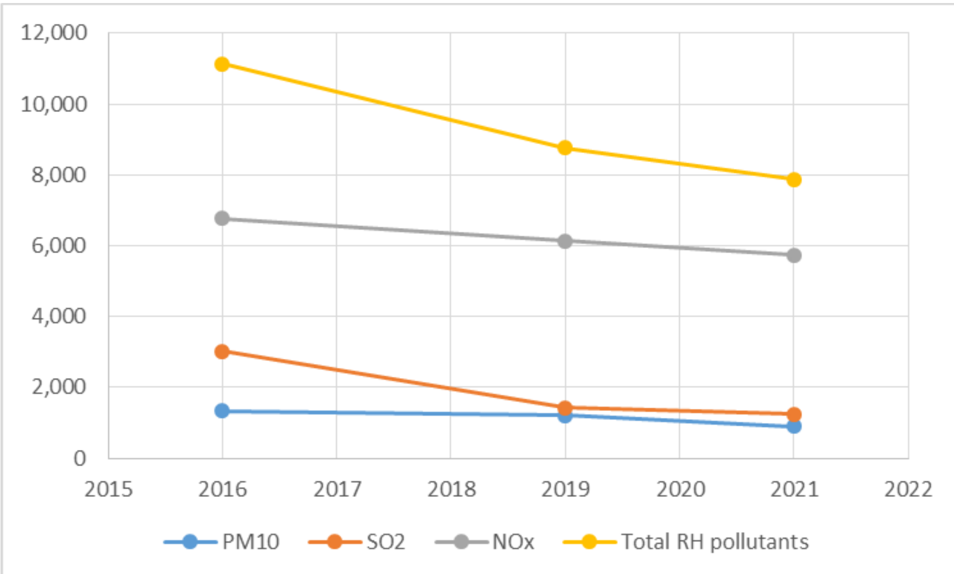

Figure 1: Emission reductions of WA chemical pulp mills

Based on an intermediate review of information, Ecology concludes that:

- Currently, no one has demonstrated using SCRs for recovery furnaces (boilers) in practice, but they could potentially progress to a level of technically feasibility during a future implementation period.

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[15] Ecology used a Q (quantity of RH emissions) divided by d (distance to Class I areas) analysis from the FLMs 2010 FLAG manual to determine which facilities to focus on for this implementation period. While the manual requires that Q/D include only maximum hourly increases from specific projects when applied to New Source Review, it can be used for entire facility emissions as a starting point for RHR applications (outside of NSR).
[16] The National Park Service (NPS) issued an Adverse Impact Determination for the BP refinery during the comment period of the 2016 BP Coker Heater Replacement Project PSD permit. NPS also noted contributions of RH from the Tesoro refinery during the comment period of the 2017 Tesoro Clean Products Upgrade Project (CPUP) PSD permit.
[17] Based on Ecology's Q/d analysis, Ecology is reviewing approximately 20 facilities from 8 different industries for RH reductions during this current implementation period.
[18] Emissions listed in figure 1 for the year 2019 include Cosmo, which operated the full year. Estimates for the year 2021 consider possible extended curtailment at Cosmo (the previous curtailment at Cosmo lasted multiple years). The figure includes emissions from GP Camas which was operating as a chemical pulp mill in 2016, but not in 2019.

- The pulp mills had greater actual reductions (2,363 tpy) in RH pollutants after the 2016 RACT Analysis was prepared than were proposed in the 2016 RACT Analysis itself (1,345 tpy).
- The pulp mills had greater reductions (2,363 tpy) in RH pollutants since the 2016 RACT analysis than would be accomplished if the controls in the Initial Review section of this document were to be implemented (500 tpy to 1,300 tpy)[19].

Based on this information, Ecology focused on the section from the 2019 EPA 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.”

Ecology has demonstrated that the controls discussed in this section would most likely not result in perceptible visibility improvement in CIAs in Washington State if applied only by the pulp mills. We based this assessment on the 2016 RACT analysis and a comparison between the amount of proposed emission reductions in the 2016 RACT analysis to the reductions in our initial analysis for the RH SIP.

It is true that although a very small contribution in isolation might not provide a noticeable improvement in visibility, if combined with many other small contributions they could potentially add up to a visibility benefit for Class I areas.

Therefore, when considering the EPA Guidance of what “may be necessary,” Ecology considered the facilities both individually and all together to determine if it could satisfy “reasonable progress” without implementing the potential controls for pulp mills listed in this document. However, based on a review of the facilities in Ecology’s Q/d analysis, there are only six chemical pulp mill facilities currently permitted in Washington State, with one of them in curtailment at the time of this report, so that the sum of the individual effects is small.

Therefore, Ecology concludes 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 but could be both necessary and beneficial during future implementation periods starting in 2028. Ecology will reevaluate these sources during the next implementation period.

[19] Note: the majority of the 1,345 tpy reductions considered in the 2016 RACT analysis are not added to the 500-1,300 tpy reductions considered in this analysis because controls for these pollutants are not cost effective.

Discussion

We determined the reasonableness of potential emission control options as described below.

First option

The cost values in this first option are based on a 3.25 percent interest rate and 20 years remaining useful life for low-NO_X burners, SNCRs, wet scrubbers, and ESPs (wet and dry), and 25 year remaining useful life for SCRs.

- The mills provided a recent cost/ton value for a low-NO_X burner installed in Dec 2018. We determined it is reasonable to use this information as a reference for the other low-NOx burner units for the reduction of NO_X. We assume cost/ton values below this amount are reasonable because they are less than "costs already incurred by similar sources." This is from natural gas boiler#6: WestRock Tacoma.
- The mills provided a recent cost/ton value for an SNCR installed in 2012, which we can assume is reasonable to use as a reference for the other SNCR, as well as SCR, units for the reduction of NO_X. We assume cost/ton values below this amount are reasonable because they are less than "costs already incurred by similar sources." This is from power boiler#20: WestRock Longview.
- The mills provided a recent cost/ton value for WESP, which (after applying the RACT adjustment factor explained above) we assume is reasonable to use as a reference for the other similar units for reduction of PM. We assume cost/ton values below this amount are reasonable because they are less than "costs already incurred by similar sources." This is from boiler #10: Port Townsend Paper Corporation (PTPC).
- The low-NO_X burner cost reference of $6,300/ton, the SNCR cost reference of $6,250/ton, and the RACT adjusted WESP cost reference of $7,800/ton are all within the range of other WRAP states (at least in preliminary discussions during early 2020; final values may vary). They also satisfy EPA's comment that $5,000/ton is probably too low[20], by providing updated actual cost incurred values.
- The 2016 RACT modeling indicated that the controls considered in this analysis will not result in perceptible visibility improvement towards the reasonable progress goals.

Second option

This approach is based on previous generic Ecology cost calculations (but without input from the mills) and provides a general snapshot of controls to consider. It shows cost effectiveness for multiple pulp mill combustion units.

[20] Conversation between Ecology, other EPA Region 10 states RH staff, and EPA. May 7, 2020.

- This approach does not take into account the site-specific information we requested from the mills, and is therefore less accurate and harder to reconcile. According to page 32 of EPA's August 2019 RH guidance document: "We recommend that states exercise caution before accepting or rejecting controls based on generic cost estimates if adequately documented source-specific estimates are available or can be prepared."
- This approach assumes SCRs can be applied to recovery furnaces, but SCRs have not been demonstrated for recovery furnaces in the United States or elsewhere. At best, it is only a "theoretical study[21]" to consider SCR for recovery furnaces (boilers).

Third option

This approach takes the cost values from the first option (a 3.25% interest rate and 20 years remaining useful life for low-NO_X burners, SNCRs, wet scrubbers, and ESPs (wet and dry), and 25 year remaining useful life for SCRs.), and applies them to specific control units via statewide rules. The goal would be to get "more bang for the buck." We could use rules, for example a statewide low-NO_x burner rule,to focus on visibility effects.

- Factors considered for this approach would include units outside of the pulp & paper industry and provide increased pollutant reduction statewide..
- This approach focuses on RH pollutants like NO_X and less on PM_{10}[22].
- This approach would be more time-consuming than just focusing on controls for pulp mills via the RACT process or voluntary AOs. It would involve many more stakeholders.
- This approach might not be feasible based on Ecology staff resources at this time, and is beyond the scope of Q/d industries identified for this RH period.

Fourth option (no action)

- Factors considered for this approach are based on the 2016 Ecology RACT analysis that showed minimal deciview or inverse megameters, Mm-1, (visibility) benefit even if the facility implements substantial controls.
- The RHR requires that states complete an FFA. The FFA does not point to meaningful RH improvement or noticeable benefit toward the reasonable progress goals during this second implementation period, so we determined that no additional controls were reasonable.

[21] https://www.valmet.com/globalassets/media/downloads/white-papers/power-and-recovery/recovery_boiler_scr_whitepaper.pdf July 2017

[22] According to EPA, "Coarse particles, or the subset of PM10 that is larger than 2.5 µm, do not remain airborne as long and their spatial impact is typically limited because they tend to deposit on the ground downwind of emissions sources." Source: EPA: Report on the Environment https://www.epa.gov/roe/ Particulate Matter Emissions

Summary and preliminary recommendations

After initial review and further analysis, no action at this time is the recommended option.

Refineries

Five petroleum refineries are located in the state of Washington. The refineries are Cherry Point refinery (B P Cherry Point), Shell Anacortes refinery (Shell), Marathon Anacortes refinery (Phillips 66), Ferndale refinery (Tesoro), and U.S. Oil refinery (U.S. Oil).

The refineries in Washington are over 40 years old and the facilities have maintained the majority of the equipment in a manner that has not required emission controls updates to current standards. EPA national enforcement actions and the installation of new equipment have yielded the updating of some equipment. All the refineries have made changes to accommodate the new fuel standards, lower sulfur, and benzene content.

Washington's refineries existed before the federal Clean Air Act (CAA). The majority of the equipment has not been modified since the CAA was promulgated, thus no additional control equipment or requirements have been triggered. As described below, three Washington refineries emit more oxides of nitrogen per barrel of production capacity than any other refineries in the U.S.

Each refinery is uniquely configured. The major difference is how they handle the heavy crude bottom fraction:

- BP Cherry Point uses hydrocracker and coker units to handle the heavy fractions.
- Phillips 66 uses a Fluidized Catalytic Cracking Unit (FCCU) to handle the heavy fractions.
- Shell uses a FCCU and coker to handle the heavy fractions.
- Tesoro uses a FCCU to handle the heavy fraction.
- U.S. Oil produces asphalt or exports it to other refineries for further processing.

All the refineries have flexibility to send intermediate products to other refineries for final processing.

Table 6, below, shows how Washington refineries compare nationally based on NO_X emissions per barrel of production capacity. The table shows the top refineries and all Washington refineries ranked by NO_X emissions in ton pers year. The table is then sorted from highest to lowest NO_X emissions deivided by production capacity. The data is from the 2014 EPA emission data of 88 refineries located in nine states: AK, CA CO, IL, LA, MT, TX, WA, and WY. Washington refineries represent 4 of the top 5 facilities in the nine states in NO_X emissions per 1,000 barrels produced per day.

Table 6: Washington refineries annual emissions and production capacity

State	Company	NO_X tpy 2014	Ranking NO_X tpy	1,000 BPD	NO_X tpy/1,000 BPD
WA	**Tesoro Northwest Company**	**1,918**	**3**	**119**	**16.12**
WA	**Shell Puget Sound Refinery**	**1,230**	**16**	**145**	**8.48**
WA	**BP Cherry Point Refinery**	**1,882**	**4**	**242**	**7.78**
LA	Equilon Enterprises LLC - Shell Oil Products US Norco Refinery	1,626	11	225	7.23
WA	**Phillips 66 Ferndale Refinery**	**723**	**31**	**105**	**6.89**
IL	Exxon Mobil Oil Corp	1,386	13	238	5.83
LA	Phillips 66 Co - Alliance Refinery	1,432	12	253	5.66
IL	ConocoPhillips Co	1,863	6	334	5.58
LA	Citgo Petroleum Corp - Lake Charles Manufacturing Complex	2,197	1	418	5.25
TX	Beaumont Refinery	1,868	5	365	5.12
LA	ExxonMobil Refinery & Supply Co - Baton Rouge Refinery	1,944	2	540	3.60
TX	Deer Park Plant	1,702	9	500	3.40
TX	Baytown Refinery	1,828	8	560	3.26
WA	**US Oil & Refining Co**	**133**	**68**	**41**	**3.24**
TX	Port Arthur Refinery	1,858	7	603	3.08
TX	Galveston Bay Refinery	1,692	10	571	2.96
LA	Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery	1,379	14	564	2.45

Initial emission analysis plan

Ecology offered to enter into an AO with each refinery to achieve enforceable NO_X emission reductions. We proposed to calculate the total amount of NO_X reductions for each refinery achieved upon implementation of Subpart Ja of the National Emissions Standards for Hazardous Air Pollutants (NESHAP). The Ja NO_X total emission values would be used to calculate NO_X emissions reductions that would need to occur over the remaining implementation periods. The refinery could meet the calculated NO_X emission reductions through any NO_X reduction work and not specifically tied to Ja requirements.

Ecology met on September 17, 2019, with the refineries and the Western States Petroleum Association (WSPA) to discuss this approach. Ecology also discussed at the meeting the option of using a FFA at each facility and not using the Subpart Ja option. Ultimately, the refineries rejected the proffered AO approach, preferring the FFA option.

On November 27, 2019, Ecology requested that the refineries perform a FFA review of equipment at the refineries. Ecology limited the scope of the FFA to equipment with large emissions of NO_X. Ecology also limited the scope to facilitate timely returns of the FFA to fit the timeline for RH SIP submittal. We requested FFA for NO_x emission reductions on specific on-site pieces of equipment.

The refineries requested time extensions to the FFA request date and Ecology extended the final deadline to May 1, 2020. All of the refineries delivered their FFA's to Ecology prior to May 1, 2020.

Two refineries did not submit any information on FCCU controls, which are the largest emission source on their sites. The refineries' FFA indicated selective catalytic reduction (SCR) controls were not a cost-effective emissions control. The refineries also indicated that low-NOx burners were either not a cost-effective emissions control or that more extensive and in-depth engineering evaluation would be required to establish costs.

Ecology's initial review of the refineries' FFA on SCR emissions indicated the results deviated from the EPA SCR Control Cost Manual (EPA Control Cost Manual) and Excel file. Ecology used the EPA Control Cost Manual to evaluate the controls. Ecology's review indicated that SCR controls were cost-effective for the FCC units and various heaters/boilers. Ecology plans to use the submitted FFA's and the EPA Control Cost manual as the basis of a RACT determination. This determination allows for the start of rule development for the installation of SCR controls that is separate from this RH SIP revision. Ecology has identified 19 pieces of equipment to consider during the RACT rule development. The expected NO_X emission reductions would be over 3,800 tpy.

The table below lists:

1. The identified 19 pieces of equipment
2. The refinery where the equipment is located
3. Ecology's $/ton estimate from the EPA Control Cost manual (25 year equipment life, 3.25% interest, actual exhaust flow or design heat duty)
4. The refineries FFA supplied cost
5. The estimated ton per year of NO_X reduction calculated from actual emissions and emission reductions (90 percent).

Table 7: Refinery equipment identified for RACT rule development

Company	Equipment	EPA Control Cost Manual $/Ton	Refinery $/Ton	TPY Reduced	Comment
BP	#1 reformer heaters	3,601	24,378	304	
BP	Crude heater	2,579	24,378	393	
BP	Reforming furnace #1 (N H2 plant)	5,060	78,065	262	Combined N & S
BP	Reforming furnace #2 (S H2 plant)	---	---	---	
Phillips 66	Crude heater 1F-1	2,651	12,225	166	
Phillips 66	FCCU/CO Boiler/Wet Gas Scrubber 4F-100, 4F-101	4,394	---	222	NSCR is installed
Shell	Boiler #1 Erie City--31G-F1	2,452	12,511	179	8 yrs life
Shell	Cogen turbine 1 MW	---	---	---	Current SCR controls – Study
Shell	Cogen turbine 2 MW	---	---	---	Current SCR controls – Study
Shell	Cogen turbine 3 MW	---	---	---	Current SCR controls – Study
Shell	FCCU regenerator unit	2,262	---	521	
Shell	CRU #2 HTR, INTERHTR--10H-101,102,103	6,375	10,813	69	
Tesoro	CCU CO boilers (F-302 & F-304)	1,346	14,381	843	
Tesoro	F 102 crude heater	2,975	16,086	148	
Tesoro	F 201 vacuum flasher heater	7,623	35,279	58	Route to one SCR
Tesoro	F 6650 CAT reformer heater	3,753	21,196	117	

Company	Equipment	EPA Control Cost Manual $/Ton	Refinery $/Ton	TPY Reduced	Comment
Tesoro	F 6651 CAT reformer heater	3,535	21,196	124	
Tesoro	F 751 main boiler	2,168	10,060	203	
Tesoro	F 752 main boiler	2,581	10,513	170	
Sum				3,779	

Reasonably Available Control Technology

The RH rule does not provide a direct enforcement mechanism; states use their existing laws, regulations, or processes to enforce emission reductions. Washington State law includes provisions for requiring use of Reasonably Available Control Technology. RCW 70.94.154

RACT is determined on a case-by-case basis for an individual source or source category taking into account the source's impact on air quality, the availability of additional controls, the emission reduction achieved by additional controls, the impact of additional controls on air quality, and the capital and operating costs of the additional controls. The Federal Clean Air Act uses RACT for existing facilities under the National Ambient Air Quality Standards (NAAQS) in non-attainment areas. Washington's RACT statue is not limited to determination for attainment purposes..

1. Impact on air quality
    a. The National Park Service (NPS) declared during Prevention of Significant Deterioration (PSD) permit comment periods for BP (December 2016) and Tesoro (April 2017) that the refineries are impacting CIAs.
    b. Ecology estimates the NO_X refinery emission reductions on the Olympic National Park from 5,900 to 2,100 tpy.
    c. A PSD permit issued to BP increased the Q/d screening calculation by four. BP's modeled impact was a 2.77 percent change in visibility. We consider a change of 5 percent or more as perceivable. The total Q/d for all the refineries is about 120, which is 30 times the above modelled impacts.
    d. The Washington Environmental Health Disparities Map has identified the Anacortes community as a high impact area for Environmental Justice concerns. The Tesoro's

site emissions (Anacortes) are about 2,000 tpy NO_X and the Shell site emissions are about 1,500 tpy NO_X[23].

e. NO_X emissions mainly impact respiratory conditions causing inflammation of the airways at high levels. Long-term exposure can decrease lung function, increase the risk of respiratory conditions and increases the response to allergens.

2. Availability of additional controls
   a. Various industry groups have installed more than 1,000 SCR controls during the last 20 years. The cost of SCR has decreased because of the increased demand.
   b. Most major US refineries have already installed SCR or Low-NOx Burners to control emissions from heaters, boilers, and FCCU.
3. Emission reductions
   a. SCR suppliers are quoting 95% NO_X emission reductions, less than 5 ppm NO_X emissions concentrations, and less than 2 ppm ammonia slip.
   b. Ecology has conservatively used a 90% reduction value in our analysis.
   c. The 90% NO_X emissions reduction estimate results in a cumulative reduction of over 3,800 tpy.
   d. These reductions will reduce NO_X health impacts by half near the facilities and improve perceived visibility.
4. Capital and operating cost of controls
   a. Ecology has estimated the cost of 15 units to range between $1,300/ton and $7,600/ton of NO_X removed. Three units currently have SCRs installed, but have older lower emission limits in their permits. Ecology will determine if these units should reduce NO_X emission limits as part of the RACT process. Newer units with SCR controls installed are at emission limits below 2 ppm NO_X. The majority of the equipment we are considering for this RACT rulemaking have emissions over 100 tpy of NO_X.

Low-NOx Burners

Ecology also requested information on installation of low-NOx burners on heaters/boilers. Two of the refineries indicated that it was not cost-effective to install controls. Three refineries indicated that it was potentially cost-effective to install controls, but they would need additional computer design to confirm that it was technically feasible. Ecology agrees with the refineries that installation of low-NOx burners requires more extensive analysis to determine

23 https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/InformationbyLocation/WashingtonEnvironmentalHealthDisparitiesMap

feasibility. Ecology will focus on the installation of SCR system for NO_X emission reductions because of the difficulty and uncertainty for specific low-NOx burner installation.

Facility specifics

BP/Cherry Point Refinery

The BP/Cherry Point Refinery has a total crude oil capacity of 250,000 barrels per calendar day (bpcd). The refinery processes Canadian crude, domestic crude from North Dakota and Alaska North Slope and international crudes to manufacture gasoline, distillates, heavy fuel oil and propane. The refinery distributes products through pipeline-connected terminals, marine terminal via ships and barges. The refinery is the only refinery in the Pacific Northwest capable of manufacturing diesel made from biomass-based feed stocks. The refinery processes bio-mass feed stocks alongside conventional feed stocks in an existing ultra-low-sulfur diesel unit. Over the past decade, BP invested more than $1.5 billion in capital improvements at the refinery.[24]

PSD permit

Ecology issued a PSD permit to BP Cherry Point (BP) on May 23, 2017. During the PSD permit's public comment period, the National Park Service submitted comments regarding impacts to the Olympic National Park (NP).

Below is a summary of the FLMs' comments that directly pertain with RH and visibility:

- According to modeling performed by the NPS, the NPS believes that "emissions from the refinery are currently causing visibility impairment at Olympic NP and North Cascades NP and significantly contributing to excess nitrogen deposition at both parks." In addition, the NPS also believes that the Coker Replacement project itself "will significantly increase the impacts of visibility-impairing pollutants at Olympic NP and significantly increase nitrogen deposition at North Cascades NP."
- On October 14, 2016, the NPS provided helpful clarifications of their concerns in a document submitted to Ecology. The letter from NPS documented no dispute that the facility followed PSD regulations, or that the BP application was complete, but rather emphasized the different approaches used to address PSD regulatory applicability from approaches used to address project impacts on the CIAs Air Quality Related Values (AQRV).
- On December 25, 2016 the NPS sent a letter to Ecology stating that emissions from the Cherry Point refinery were adversely impacting air quality related values at North Cascades and Olympic National Parks.

[24] https://www.bp.com/en_us/united-states/home/where-we-operate/washington/cherry-point-refinery.html

Regional Haze, Four Factor Analysis 2020

BP submitted a FFA to Ecology in April 2020. Ramboll US Corporation (Ramboll) prepared the submittal. Ecology performed an analysis and concluded that the technical data used in the review was based on the 2010 BART analysis. The cost of installing SCR's has decreased substantially over the last decade. BP included loss of profit during the maintenance period, which inflated the cost substantially. They also included the cost of safety control systems be installed by 2020 per safety regulations[25].

Ecology evaluated two new Coker heaters for SCR at a cost of about $12,000/ton of NO_X reduced after the installation of low-NOx burners. The current equipment Ecology is evaluating has NO_X emissions four to six times the current low-NOx burners, therefore the cost would be $2,000/ton to $3,000/ton of NO_X emission reduction.

BPs cost was approximately 10 times that of the Control Cost Manual. Therefore, Ecology could not reconcile BP's cost data. In 2020, Ecology worked with two companies that are in the process of installing SCR equipment on existing equipment. One was a relatively simple installation and a second one was much more complex with the addition of a temporary stack to facilitate maintaining continuous operation of the equipment. When compared to the Cost Control Manual, both facilities' costs were within a factor of two.. Therefore, Ecology will use EPA's Cost Control Manual to estimate costs.

The following is Ecology's review of the FFA supplied by BP Cherry Point on selected equipment compared to the Cost Reports and Guidance for Air Pollution Regulations- Section 4 - NOx Controls spreadsheet (EPA Control Cost Manual)[26]:

Table 8: BP Cherry Point equipment identified for RACT rule development

Company	Equipment	EPA Control Cost Manual $/Ton	Refinery $/Ton	TPY Reduced	Comment
BP	#1 Reformer Heaters	3,101	24,378	304	
BP	Crude Heater	2,051	24,378	393	
BP	Reforming Furnace #1 (N H2 Plant)	6,161	78,065	262	Combined N & S
BP	Reforming Furnace #2 (S H2 Plant)	---	---	---	

25 The safety regulation is Process Safety Management (PSM) https://www.osha.gov/Publications/OSHA3918.pdf

26 Cost Reports and Guidance for Air Pollution Regulations- Section 4 - NOx Controls spreadsheet: https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution

Ecology reviewed the following equipment using the EPA Control Cost Manual

Reformer Heaters

Ramboll supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 9: Reformer heaters cost comparison

	Ramboll	Ecology – EPA Control Cost Manual
Capital cost $	94,809,582	9,929,730
Maintenance $/yr	420,048	49,649
Reagent $/yr	284,001	57,895
Catalyst $/yr	180,467	33,548
Annualized cost $/yr	7,827,719	943,315
NO_X tpy reduced	321	304
$/ton NO_X reduced	24,378	3,101

Ecology used the EPA Control Cost Manual cost with 90% controls. Ramboll did not supply the cost data they used to scale their cost data.

Crude Heater

Ramboll supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 10: Crude heater cost comparison

	Ramboll	Ecology – EPA Control Cost Manual
Capital cost $	94,809,582	9,325,358
Maintenance $/yr	420,048	46,627
Reagent $/yr	284,001	51,515
Catalyst $/yr	180,467	29,852
Annualized cost $/yr	7,827,719	871,136
NO_X tpy reduced	321	425
$/ton NO_X reduced	24,378	2,051

The EPA Control Cost Manual uses current cost with 90% controls. Ramboll did not supply the cost data they used to scale their cost data.

Two Reforming Furnace #1 (H2 PLANT)

Ramboll supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 11: Two reforming furnace #1 (H2 Plant) cost comparison

	Ramboll	Ecology – EPA Control Cost Manual
Capital cost $	143,325,183	9,325,358
Maintenance $/yr	479,126	46,627
Reagent $/yr	125,031	51,515
Catalyst $/yr	65,513	29,852
Annualized cost $/yr	11,038,382	871,136
NOx tpy reduced	141	141
$/ton NOx reduced	78,065	6,161

The EPA Control Cost Manual uses current cost with 90% controls. Ramboll did not supply the cost data they used to scale their cost data.

Summary and preliminary recommendations

Ecology's review indicates that additional controls are cost-effective and therefore recommends RACT rule development. Ramboll's cost estimates are inflated and Ecology cannot reconcile the values presented by BP Cherry Point.

Ecology's Four Factor review has determined the following:

Factor #1 – The costs of compliance

> $2,100/ton to $6,200/ton

Factor #2 – The time necessary for compliance.

> Ecology will accommodate the time necessary for design, and installation of the equipment during a planned shutdown to occur in a reasonable amount of time.

Factor #3 – The energy and non-air quality environmental impacts of compliance

> The power needed to drive the exhaust fans is included in the analysis.

Factor #4 – The remaining useful life on existing source subject to such requirement

> BP Cherry Point did not indicate that any of the equipment had a limited lifetime

Future rule development will follow the RACT process.

Phillips 66

The Phillips 66 refinery has an average annual processing rate of approximately 108,000 barrels of crude oil per day. Located outside of Ferndale in Whatcom County, this petroleum refinery uses crude oil as a feedstock that is processed into a variety of petroleum products including gasoline, diesel, fuel oil, liquefied petroleum gas (LPG), and butane. The refinery receives crude oil via marine vessels, railcars, and by pipeline.[27]

Regional Haze, State Implementation Plan, Final December 2010

BART for Phillips 66 did not require review of the eight identified sources because the modeled impact was less than the 0.5 dv value.

Regional Haze, Four Factor Analysis 2020

Phillips 66 submitted a FFA to Ecology in April 2020. Trinity Consultants prepared it. Ecology performed an analysis and concluded that Trinity Consultants based the technical data used in the review on the 2008 SCR cost data. The cost of installing SCR's has decreased substantially over the last decade. Phillips 66's has a FCCU for which they did not supply cost data.

Phillips 66's cost was approximately 5 times that of the EPA SCR cost manual. Therefore Ecology could not reconcile Phillips 66 cost data. As stated in the above BP section, Ecology used EPA's Control Cost Manual and Tools to estimate costs.

As part of our analysis, Ecology compared cost data provided by Phillips 66 with corresponding costs from the EPA Control Cost Manual's SCR tools with the results shown in Table 12 below.

Table 12: Phillips 66 Equipment identified for RACT rule development

Company	Equipment	EPA Control Cost Manual $/Ton	Refinery $/Ton	TPY Reduced	Comment
Phillips 66	Crude heater 1F-1	2,640	12,225	166	
Phillips 66	FCCU/CO Boiler/Wet Gas Scrubber 4F-100, 4F-101	3,954	---	247	NSCR is installed.

Ecology reviewed the following equipment using the EPA SCR Cost Model:

Crude heater 1F-1

Trinity Consultants supplied a table with the limited support information. Ecology found the following discrepancies that inflated the cost for the retrofit.

[27] https://www.phillips66.com/refining/ferndale-refinery

Table 13: Crude heater 1F-1 cost comparison

	Trinity Consultants	Ecology – EPA Control Cost Manual
Capital cost $	16,615,487	5,084,927
Maintenance $/yr	83,077	25,425
Reagent $/yr	17,691	20,677
Catalyst $/yr	18,680	11,982
Annualized cost $/yr	1,944,651	437,150
NO_X tpy reduced	159	166
$/ton NO_X reduced	12,225	2,640

Ecology used the EPA Control Cost Manual cost with 90% controls. Trinity Consultants did not supply the cost data they used to scale their cost data.

FCCU/CO Boiler

Trinity Consultants did not supply cost data for this equipment.

Table 14: FCCU/CO boiler cost comparison

	Trinity Consultants	Ecology – EPA Control Cost Manual
Capital cost $	NA	8,983,013
Maintenance $/yr	NA	44,915
Reagent $/yr	NA	49,624
Catalyst $/yr	NA	27,183
Annualized cost $/yr	NA	976,820
NO_X tpy reduced	NA	247
$/ton NO_X reduced	NA	3,954

Ecology used the EPA Control Cost Manual cost with 90% controls.

Summary & Recommendations

Ecology's review indicates that additional controls are cost-effective and therefore recommends RACT rule development. Trinity Consultants' data is inflated and Ecology cannot reconcile the values presented by Phillips 66.

Ecology's Four Factor review has determined the following:

Factor #1 – The costs of compliance

$2,600/ton to $4,000/ton

Factor #2 – The time necessary for compliance

During rule development, ecology will accommodate the time necessary for design, and installation of the equipment during planned shutdowns to occur within a reasonable amount of time.

Factor #3 – The energy and non-air quality environmental impacts of compliance

The power needed to drive the exhaust fans is included in the analysis.

Factor #4 – The remaining useful life on existing source subject to such requirements.

Phillips 66 did not indicate that any of the equipment had a limited lifetime.

Future rule development will follow the RACT process.

Shell

The Shell refinery has an average annual processing rate of approximately 145,000 barrels (5.7 million gallons) of crude oil per day. When the refinery first began operating, most of its crude oil came from Canada via pipeline. Although it continues to receive crude from central and western Canada, feedstock also arrives by tanker from oilfields on Alaska's North Slope.

On an annual basis, the refinery produces multiple types of gasoline in addition to fuel oil, diesel fuel, propane, jet fuel, butane, and petroleum coke. It also produces two chemicals---nonene and tetramer---that industry uses in a variety of plastic products. Shell also owns and operates a cogeneration facility on the refinery site.[28]

The cogeneration facility was originally the March Point Cogeneration Company (MPCC), which Puget Sound Refinery (PSR) took possession of in February 2010. Air Liquide and Linde operate hydrogen plants on property owned by PSR and adjacent to the refinery. However, both Air Liquide and Linde are independent companies and permitted separately from PSR. This report does not address emission sources from Air Liquide and Linde in this report.

Regional Haze, Four Factor Analysis 2020

Shell submitted a FFA to Ecology in April 2020. Trinity Consultants prepared it. Ecology performed an analysis and concluded that Trinity Consultants based the technical data used in the review on the EPA SCR cost manual and site-specific cost data. The cost of installing SCR’s has decreased substantially over the last decade. Shell has a FCCU for which they did not supply cost data. The FFA assumed that the Erie City boiler to only have an eight-year life expectancy.

[28] https://www.shell.us/about-us/projects-and-locations/puget-sound-refinery/about-shell-puget-sound-refinery.html

Shell has three power turbines with SCR installed. The current turbines have specifications indicating emissions can be 2 to 3 times lower than current permit values. Ecology is recommending an engineering study of the turbines to establish an optimized system to limit emissions to the maximum practical extent.

Shell's cost was approximately two to five times that of the EPA SCR cost manual. Therefore, Ecology could not reconcile BP's cost data.-As stated in the above BP section, Ecology will be using EPA's SCR cost manual to estimate costs

Table 15: Shell equipment identified for RACT rule development

Company	Equipment	EPA Model $/Ton	Refinery $/Ton	TPY Reduced	Comment
Shell	Boiler #1 Erie City--31G-F1	2,441	12,511	179	8-yr life
Shell	Cogen turbine 1 MW	---	---	---	Current SCR controls – Study
Shell	Cogen turbine 2 MW	---	---	---	Current SCR controls – Study
Shell	Cogen turbine 3 MW	---	---	---	Current SCR controls – Study
Shell	FCCU Regenerator Unit	1,948	---	521	
Shell	CRU #2 HTR, INTERHTR--10H-101,102,103	6,346	10,813	69	

Ecology reviewed the following equipment using the EPA Cost Control Manual:

BOILER #1 ERIE CITY--31G-F1

Trinity Consultants supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 16: Boiler #1 Erie City--31G-F1 cost comparison

	Trinity Consultants	Ecology – EPA Control Cost Manual
Capital cost $	11,420,745	5,084,927
Maintenance $/yr	57,104	25,425
Reagent $/yr	17,221	20,677
Catalyst $/yr	39,340	11,982
Annualized cost $/yr	2,053,888	437,150
NO_X tpy reduced	164	179

	Trinity Consultants	Ecology – EPA Control Cost Manual
$/ton NO_X reduced	12,511.00	2,441

Ecology used the EPA Control Cost Manual cost with 90% controls. Trinity Consultants did not supply the cost data they used to scale their cost data and had only an 8-yr life of the boiler.

FCCU/CO Boiler

Trinity Consultants did not supply cost data for this equipment.

Table 17: FCCU/CO boiler cost comparison

	Trinity Consultants	Ecology – EPA Control Cost Manual
Capital cost $	NA	10,680,913
Maintenance $/yr	NA	53,405
Reagent $/yr	NA	62,274
Catalyst $/yr	NA	36,086
Annualized cost $/yr	NA	1,014,677
NO_X tpy reduced	NA	521
$/ton NO_X reduced	NA	1,948

Ecology used the EPA Control Cost Manual cost with 90% controls.

CRU #2

Trinity Consultants supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 18: CRU #2 cost comparison

	Trinity Consultants	Ecology – EPA Control Cost Manual
Capital cost $	5,939,772	5,084,927
Maintenance $/yr	29,699	25,425
Reagent $/yr	6,165	20,677
Catalyst $/yr	13,454	11,982
Annualized cost $/yr	635,480	437,150
NO_X tpy reduced	59	77
$/ton NO_X reduced	10,813	6,346

Ecology used the EPA Control Cost Manual cost with 90% controls. Trinity Consultants cost was similar but they used a lower emission reduction.

Three turbines have SCR installed on the units. The current emission limits is 74 tpy at 9 ppm NO_X. Actual emissions vary from 46-64 tpy (5.6-7.8 ppm) with less than 2 tpy (less than 0.5 ppm) ammonia. Ecology determines that an engineering study performed by the facility to establish new lower limits based on RACT. Similar new units are permit below 2 ppm NO_X.

Summary & Recommendations

Ecology's review indicates that additional controls are cost-effective. Trinity Consultants' data is inflated and Ecology cannot reconcile the values presented by Shell.

Ecology's Four Factor review has determined the following:

Factor #1 – The costs of compliance

> $1,900/ton to $ 6,300/ton

Factor #2 – The time necessary for compliance

> During rule development, ecology will accommodate the time necessary for design and installation of the equipment.

Factor #3 – The energy and non-air quality environmental impacts of compliance

> The power needed to drive the exhaust fans is included in the analysis.

Factor #4 – The remaining useful life on existing source subject to such requirements

> Shell indicates that the BOILER #1 ERIE CITY--31G-F1 had a limited lifetime of 8 years. Ecology will work with NWCAA to have a regulatory order on the boiler to shut the unit down by January of 2028.

Future rule development will follow the RACT process.

Tesoro

Marathon Petroleum Company owns the Tesoro Anacortes facility. Located in Anacortes, the refinery has a total crude oil capacity of 119,000 barrels per calendar day (bpcd).

The refinery processes Canadian crude, domestic crude from North Dakota and Alaska North Slope, and international crudes to manufacture gasoline, distillates, heavy fuel oil, and propane. The refinery distributes products through pipeline-connected terminals and Marathon Petroleum Company (MPC)'s marine terminal via ships and barges.[29]

[29] https://www.marathonpetroleum.com/Operations/Refining/Anacortes-Refinery/

Table 19: Tesoro emission rates pre - and post - Best Available Retrofit Technology

	Pre-BART, tpy	Post-BART, tpy	Basis of comparison	Sources included in comparison
NO_X	1360	1303	2005 vs. post-BART projects (F-103 ULNB)	BART sources only
SO_2	5540	474	2005 vs. 2008 (FGS; RFG treatment*)	All refinery sources
$PM/PM1_0$	588	140	2005 vs. post BART projects (FGS); no oil burning at F-103)	BART sources plus F-302

* Refinery Fuel Gas (RFG) treatment improvements affected all combustion sources

2010 regional haze BART

Tesoro had a BART determiniation for the first implementation period of RH. The BART analysis conluded installation of SCR systems was reasonable if the installation occurred during a regularly scheduled facility outage. The cost was unreasonable if the facility needed to have a special outage just for the SCR installation. These outages usually occur every 5 to 6 years.

Tesoro did not have an outage scheduled during the remaining time of the first implementation period. The lack of a scheduled outage made Ecology's determination as unreasonable and no action recommended.

PSD permit

On July 18, 2017, Ecology issued a PSD permit to Tesoro. During the public comment period, the Federal Land Managers made comments regarding the impacts to the Olympic Class 1 area. These comments are contained in the PSD technical support document, https://fortress.wa.gov/ecy/ezshare/AQ/PSD/PSD_PDFS/Tesoro_Anacortes_TSD.pdf

Federal Land Managers comments 4-6, pages 45-51

The major issues presented include:

- Tesoro should be reviewed in the next RH period
- Noted: Installation of SCR on the new boiler and control of vapors from loading marine vessels
- Modeling impacts
    - Visibility
    - Deposition

Regional Haze, Four Factor Analysis 2020

In 2010, BART and Federal Implementation Plan Tesoro found that four of the BART-eligible sources contribute approximately 93 percent of the NO_X emissions from the 14 combustion sources: F-103, F-304, F-6650, and F-6651. Tesoro identified that it was cost effective to add NO_X controls on these four units. It was determined that there was not enough time to install this equipment during the 2010 planning cycle thus EPA allowed an alternative to adding NO_X controls.

Tesoro submitted a FFA to Ecology in April 2020. BARR Consultants prepared it. Ecology performed an analysis and concluded that the technical data used in the review was based on the EPA Control Cost Manual with an inflated factor for Ft3/min-MMBtu/hr. Tesoro's cost was approximately five to ten times that of the EPA SCR cost manual with the correct factor, therefore ecology could not reconcile Tesoro's 2020 cost data. The BART cost data was similar to Ecology's 2020 cost. As stated in the above BP section, Ecology will be using EPA's Control Cost Manual to estimate costs.

The following is Ecology's review of the Four Factor Analysis supplied by Tesoro on selected equipment compared to BART and the EPA SCR cost model:

Table 20: Tesoro equipment identified for RACT rule development

Company	Equipment	EPA Model 2020 $/Ton	Tesoro 2020 $/Ton	BART 2008 $/Ton	TPY Reduced
Tesoro	FCCU	1,159	14,381	4,592	843.3
Tesoro	F 102 Crude Heater	2,962	16,086	---	147.6
Tesoro	F 201 Vacuum Flasher Heater	7,589	35,279	---	57.6
Tesoro	F 6650 CAT Reformer Heater	3,736	21,196	3,349	117
Tesoro	F 6651 CAT Reformer Heater	3,520	21,196	3,349	124.2
Tesoro	F 751 Main Boiler	2,159	10,060	---	202.5
Tesoro	F 752 Main Boiler	2,570	10,513	---	170.1

Ecology reviewed the following equipment using the EPA SCR Cost Model:

FCCU

BARR engineering supplied a table with the limited backup information. Ecology found the following discrepancies that inflated the cost for the retrofit.

Table 21: FCCU cost comparison

	BARR	Ecology EPA Control Cost Manual
Capital cost $	114,030,975	10,286,436
Maintenance $/yr	570,155	51,432
Reagent $/yr	1,340,590	59,974
Catalyst $/yr	116,845	34,754
Annualized cost $/yr	10,747,992	977,202
$/ton NO_X reduced	14,381	1,159

Ecology used the EPA Control Cost Manual cost with 90% controls. BARR did not supply the cost data they used to scale their cost data. The BART data is based on SNCR controls at about 60% controls, which account for the higher $/ton cost.

F 102 CRUDE HEATER

Both BARR and Ecology use the EPA Control Cost Manual with highly different results:

Table 22: Crude heater cost comparison

	BARR EPA Control Cost Manual	Ecology EPA Control Cost Manual
Ft3/min-MMBtu/hr	55,577	484
Ammonia $/gal	3.513	0.293
acfm	6,381,721	115,784
Vspace	19,760.72	112
Catalyst Ft2	6,648	121
Capital cost $	20,876,000	5,084,927
Maintenance $/yr	104,380	25,425
Reagent $/yr	315,021	20,677
Catalyst $/yr	3,548	11,982
Annualized cost $/yr	2,021,692	437,150
$/ton NO_X reduced	16,086	2,962

BARR incorrectly changed the default value for the Ft3/min-MMBtu/hr input to the model. Ecology determined the minimum cost for the model of $439,065/yr.

Other equipment

We used the default cost of $437,150/yr for the other equipment. BARR incorrectly changed the default value for the Ft3/min-MMBtu/hr input to the EPA Control Cost Manual for all their determination other than the FCCU.

Summary & Recommendations

The 2008 BART review supports Ecology's review that additional controls are cost-effective and therefore RACT rule development is recommended. BARR's data is inflated and Ecology cannot reconcile the values presented by Tesoro.

Factor #1 – The costs of compliance

> $1,200/ton to $7,600/ton

Factor #2 – The time necessary for compliance

> During rule development, ecology will accommodate the time necessary for design and installation of the equipment.

Factor #3 – The energy and non-air quality environmental impacts of compliance

> The power needed to drive the exhaust fans is included in the analysis.

Factor #4 – The remaining useful life on existing source subject to such requirements

> Tesoro did not indicate that any of the equipment had a limited lifetime.

Future rule development will follow the RACT process.

US Oil

The US Oil Refinery has an average daily processing rate of approximately 41,000 barrels of crude oil per day. It uses crude oil as a feedstock processed into a variety of petroleum products including gasoline, diesel, fuel oil, and asphalt.[30]

Regional Haze, State Implementation Plan, Final December 2010

BART for US Oil was not triggered based on their emissions.

Regional Haze, Four Factor Analysis 2020

US Oil submitted a FFA to Ecology in April 2020. Trinity Consultants prepared it. Ecology performed an analysis and concluded that Trinity Consultants based the technical data used in the review on the EPA Control Cost Manual. The data was similar to Ecology's review. The

[30] http://usor.com/about/about

emissions were only 28 tpy for the largest unit and the cost effectiveness was over $15,000/ton of NO_X reductions.

The following is Ecology's review of the Four Factor Analysis supplied by US Oil on selected equipment compared to the EPA Control Cost Manual:

HEATER H11

Trinity Consultants supplied a table with the limited backup information.

Table 23: Heater H11 cost comparison

	Trinity Consultants	**Ecology EPA Control Cost ManualControl Cost Manual**
Capital cost $	4,894,235	5,084,927
Maintenance $/yr	24,471	25,425
Reagent $/yr	2,979	20,677
Catalyst $/yr	9,862	11,982
Annualized cost $/yr	522,175	437,150
NO_X tpy reduced	28	28
$/ton NO_X reduced	18,649	15,612

Ecology and Trinity Consultants used the EPA Control Cost Manual with minor differences.

Summary and preliminary recommendations

Ecology's review indicates that additional controls are above level that were cost-effective in the BACT for the Coker Heater PSD permit. Ecology may not consider US Oil for SCR rule development. Other RACT requirement may effect US Oil operations.

Factor #1 – The costs of compliance

Over $15,000/ton for SCR controls

Factor #2 – The time necessary for compliance

During rule development, ecology will accommodate the time necessary for design and installation of the equipment.

Factor #3 – The energy and non-air quality environmental impacts of compliance

The power needed to drive the exhaust fans is included in the analysis.

Factor #4 – The remaining useful life on existing source subject to such requirements

US Oil did not indicate that any of the equipment had a limited lifetime

Future rule development will follow the RACT process.