DEPARTMENT OF
ECOLOGY
State of Washington

Final Cost-Benefit and Least-Burdensome Alternative Analyses

Chapter 173-485 WAC
Petroleum Refinery Greenhouse Gas Emission Requirements

May 2014
Publication no. 14-02-005

Publication and Contact Information

This report is available on the Department of Ecology's website at https://fortress.wa.gov/ecy/publications/SummaryPages/1402005.html.

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Final Cost-Benefit and Least-Burdensome Alternative Analyses

Chapter 173-485
Petroleum Refinery Greenhouse Gas Emission Requirements

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Executive Summary

This report reviews two of the economic analyses performed by the Washington State Department of Ecology to estimate the costs and benefits of the adopted Petroleum Refinery Greenhouse Gas Emission Requirements rule (chapter 173-485 WAC). These analyses – the Cost-Benefit Analysis (CBA) and Least-Burdensome Alternative Analysis (LBA) – are based on the best available information at the time of publication. Ecology received public comments on the preliminary version of this document, and has incorporated their input where appropriate in this document.

The adopted rule requires:

- Demonstrated emissions reduction, by a petroleum refinery either:
  1. Meeting an Energy Intensity Index ® (EII®) greater than or equal to the 50th percentile EII® for petroleum refineries its size, using any EII® report issued between 2006 and the first annual report in 2014, **OR**
  2. By 2025 reporting (2024 data), implementing sufficient projects that result in a 10-percent reduction from 2010 (or 2011 if 2010 data is not representative) emissions, or meet the energy efficiency standard described in option 1, above.
- Annual reporting:
  - Submitting annual reports on October 1st until compliance with either standard above is demonstrated.
- Recordkeeping:
  - Keeping records supporting reports and compliance for five years after last report.

Ecology estimated the following ranges of costs and benefits of the adopted rule.[1]

Compliance Year (report following year)	FIRST-YEAR BENEFITS (In year reductions occur)	TOTAL BENEFITS (All Years)	TOTAL COSTS LOW	TOTAL COSTS HIGH
2013	$0	$0	$9,107	$9,107
2014	$12,075,987	$301,246,910	$3,253,258	$4,935,638
2015	$12,402,365	$289,170,923	$3,162,418	$4,795,797
2016	$12,728,743	$276,768,558	$3,074,225	$4,660,029
2017	$13,055,121	$264,039,816	$2,988,600	$4,528,216
2018	$13,381,499	$250,984,695	$2,904,469	$4,399,241
2019	$13,707,877	$237,603,196	$2,824,759	$4,275,995
2020	$14,034,255	$223,895,320	$2,746,400	$4,155,367
2021	$14,360,633	$209,861,065	$2,670,324	$4,038,253
2022	$14,687,011	$195,500,432	$2,596,463	$3,924,549
2023	$15,013,389	$180,813,421	$2,524,754	$3,814,158
2024	$15,339,767	$165,800,033	$2,455,133	$3,706,981

[1] Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

After evaluating the likely costs and benefits of the adopted rule, Ecology believes that the likely qualitative and quantitative benefits of the rule exceed their likely costs. The compliance costs likely to be accrued by petroleum refineries are, over 20 years, likely less than the benefits of reduced emissions and improved efficiency and information.

Ecology also determined that the content of the rule is the least burdensome set of requirements necessary to meet the goals and objectives of the authorizing statutes.

Chapter 1: Introduction and Background

1.1 Introduction

This report reviews two of the economic analyses performed by the Washington State Department of Ecology (Ecology) to estimate the costs and benefits of the adopted Petroleum Refinery Greenhouse Gas Emission Requirements rule (chapter 173-485 WAC). These analyses – the Cost-Benefit Analysis (CBA) and Least-Burdensome Alternative Analysis (LBA) – are based on the best available information at the time of publication. Ecology received public comments on the preliminary version of this document, and has incorporated their input where appropriate in this document.

The Washington Administrative Procedure Act (APA; RCW 34.05.328) requires Ecology to evaluate significant legislative rules to "determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the law being implemented." Chapters 1 through 5 of this document describe that determination.

The APA also requires Ecology to "determine, after considering alternative versions of the rule…that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives" of the governing and authorizing statutes. Chapter 6 of this document describes that determination.

1.2 Description of the adopted rule

The adopted rule requires:

- Demonstrated emissions reduction, by a petroleum refinery either:
    1. Meeting an Energy Intensity Index ® (EII®)[2] greater than or equal to the 50th percentile EII® for petroleum refineries its size, using any EII® report issued between 2006 and the first annual report in 2014, **OR**
    2. By 2025 reporting (2024 data), implementing sufficient projects that result in a 10-percent reduction from 2010 (or 2011 if 2010 data is not representative) emissions, or meet the energy efficiency standard described in option 1, above.
- Annual reporting:
    - Submitting annual reports on October 1st until compliance with either standard above is demonstrated.
- Recordkeeping:

[2] The Solomon Associates proprietary petroleum refinery energy efficiency metric that compares actual energy consumption for a petroleum refinery with the standard energy consumption for a petroleum refinery of similar size. The standard energy consumption is based on an analysis of refining capacity as contained in the database maintained by Solomon Associates. The ratio of a facility's actual energy consumption to the standard energy consumption is multiplied by 100 to arrive at the Solomon EII® for a refinery.

- Keeping records supporting reports and compliance for five years after last report.

These requirements are described in greater detail in Chapter 2 of this document.

1.3 Reasons for the adopted rule

Ecology initially undertook this rule making in response to a March 27, 2012 Order on Remedies entered in the United States District Court – Western District of Washington at Seattle (Case No. C11-417 MJP, Washington Environmental Council, et al. vs. Sturdevant, et al.). In that order, Ecology, Puget Sound Clean Air Agency (PSCAA), and Northwest Clean Air Agency (NWCAA) were ordered to complete a reasonably available control technology (RACT) determination process pursuant to Revised Code of Washington (RCW) 70.94.154 within 26 months, addressing greenhouse gases (GHGs) for each of five Washington State petroleum refineries owned and operated by:

- BP PLC (BP)
- Phillips 66 Company (Phillips 66)
- Shell Oil Company (Shell)
- Tesoro Refining and Marketing Company (Tesoro)
- US Oil & Refining Company (US Oil)

Because the RACT analysis and determination affects three or more refineries, state law requires Ecology to establish the new standards in rule. The Order on Remedies established a schedule to implement the judge's decision, and required the rule to be effective by May 27, 2014.

On July 10, 2013, a three judge panel of the 9th Circuit Court of Appeals heard an appeal of the District Court decision. On October 17, 2013, the court ruled the plaintiffs do not have standing to bring a citizen suit under the Clean Air Act to force state and local air agencies to regulate greenhouse gas. On February 12, 2014, the District Court's order was vacated with the mandate issued dismissing the case for lack of standing. Ecology has chosen to finish the rule under existing agency regulatory authority.

1.4 Petroleum refineries in Washington State

The adopted rule applies specifically to five petroleum refineries in Washington State, as listed above in section 1.3. Ecology estimated relevant[3] 2010 emissions for the five petroleum refineries as follows.

[3] The adopted rule applies only to certain greenhouse gas emissions; carbon dioxide, nitrous oxide and methane. Carbon dioxide from combustion of fuels accounts for 90+% of the CO2-equivalent emissions.

Table 1: Petroleum Refinery Emissions

Facility	Metric Tons per Year of CO2-Equivalent Emissions[4]
BP	2,536,740
Phillips 66	880,730
Shell*	1,578,330
Tesoro**	1,164,670
US Oil**	147,120
TOTAL	6,307,590
*The Shell calculation excludes the emissions from electricity production at the cogeneration unit. ** 2011 emissions (due to plant shutdown affecting 2010 data).	

All confidential business information (CBI) data used in making the determination was provided only to Northwest Clean Air Agency or Puget Sound Clean Air Agency, depending on which refineries they regulate. Ecology has not received any of the data covered under CBI requirements. Because of this, we do not have comprehensive data on specific facility attributes, emissions and energy efficiency, completed or planned projects, reports made to Solomon Associates, or evaluations and results provided by Solomon Associates. We feel that, despite lack of this data and information, this analysis addresses the assessments required under the APA.

Additional information about petroleum refineries that was used in this analysis is discussed in the cost or benefit section to which it is relevant.

1.5 Document Organization

The remainder of this document is organized in the following chapters:

- Baseline and the adopted rule (Chapter 2): Description and comparison of the baseline (what would occur in the absence of the adopted rule) and the adopted rule requirements.
- Likely costs of the adopted rule (Chapter 3): Analysis of the types and size of costs we expect impacted entities to incur as a result of the adopted rule.
- Likely benefits of the adopted rule (Chapter 4): Analysis of the types and size of benefits we expect to result from the adopted rule.
- Cost-benefit comparison and conclusions (Chapter 5): Discussion of the complete implications of the CBA, and comments on the results.
- Least-burdensome alternative analysis (Chapter 6): Analysis of considered alternatives to the contents of the adopted rule.

[4] Ecology (2013), Washington Oil Refinery RACT Technical Support Document, September 9, 2013 draft.

Chapter 2: Baseline and the Adopted Rule

2.1 Introduction

In this chapter, we describe the baseline to which the adopted rule is compared. The baseline is the regulatory context in the absence of the rule being adopted, and its results.

We also describe, in this chapter, the adopted rule and identify which requirements will likely result in costs or benefits (or both), and which requirements require analysis under the APA. Here, we address complexities in the scope of analysis, and indicate how costs and benefits are analyzed and discussed in chapters 3 and 4 of this document.

2.2 Baseline

In most cases, the regulatory baseline for CBAs is the existing rule. Where there is no existing rule (as in this case), federal and local regulations are the regulatory baseline. In the case of the adopted rule, the baseline consists of the authorizing statute, as well as the court directive to make a RACT determination for petroleum refineries.

2.2.1 State regulation

The authorizing statute for the adopted rule is RCW 70.94.154 (RACT Requirements). It generally sets out requirements for those source categories that must have RACT determinations made by rule (those containing three or more sources). Though it cross-references to multiple statutes, neither the authorizing statute, nor its references, give specific direction on the content of the adopted rule that would not entail Ecology using its discretion. Therefore, while the authorizing statute and other existing law are part of the baseline, they do not include any specific elements in which Ecology had no discretion that may be excluded from this analysis.

At the state and local levels, some additional existing regulations also apply to petroleum refineries:

- General regulations:
    - General regulations are developed and adopted by Washington State air quality agencies to address regional needs. The general regulations support the maintenance of Ambient Air Quality Standards, and many of these regulations have been submitted to and approved by the Environmental Protection Agency (EPA) for incorporation into the State Implementation Plan (SIP).
    - The general regulations for the NWCAA and PSCAA jurisdictions (where the five petroleum refineries are located) include emission limits for PM, visible emissions, and SO2.
    - The various emission limits and other regulations that help limit emissions are included in each refinery's air operating permit as applicable and enforceable requirements.

- Minor New Source Review Requirements:
    - RCW 70.94.152 of the Washington State Clean Air Act (WCAA) goes beyond the US Clean Air Act Prevention of Significant Deterioration (USCAA PSD) program requirements by requiring permits for all new sources and modifications, including those that are minor. Moreover, the minor new source review program also includes approximately 40 toxic air pollutants (TAPs). Even the smallest of the local petroleum refineries (US Oil) has nearly five dozen such permits covering an even greater number of emission units. Similar to the PSD program, Best Available Control Technology is a requirement for permit approval.

2.2.2 Federal regulation

A number of federal regulations apply to petroleum refineries. These include:

- National Ambient Air Quality Standards:
    - The 1970 USCAA established the EPA and directed it to develop and enforce regulations for all air pollutants that might reasonably be anticipated to endanger public health or welfare. Section 109 of the USCAA required EPA to set primary National Ambient Air Quality Standards (NAAQS) to protect human health with an adequate margin of safety and secondary NAAQS to protect against other effects, such as damage to vegetation, structures, ecosystems, and visibility.
    - EPA has set primary NAAQS for PM10, PM 2.5, CO, NO2, SO2, ozone precursors, and lead.
    - EPA has not set any NAAQS for GHGs.
    - For Washington State petroleum refineries, the NAAQS are implemented and enforced through the NWCAA, PSCAA, Ecology, and the EPA.
- Federal New Source Performance Standards (NSPS):
    - Section 111 of the USCAA requires EPA to promulgate standards of performance for new stationary sources "which reflect the degree of emissions limitation achievable through the application of the best system of emissions reduction which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated."
    - GHG emissions reductions may be achieved in cases where more-efficient combustion devices are installed to achieve compliance with criteria pollutant emission limits under this regulation. Such reductions are difficult to quantify and would vary by installation.
- Federal Hazardous Air Pollutant Requirements (NESHAPs):
    - Section 112 of the USCAA requires EPA to promulgate national emission standards for HAPs. For major sources of HAPs (including refineries), these standards require that "The maximum degree of reduction in emissions that is deemed achievable for new sources in a category or subcategory shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator."

    - The above was further refined to require promulgation of technology-based standards for 188 HAPs, reflecting "the average emission limitation achieved by the best performing 12 percent of the existing sources." Nearly 130 such NESHAPs contained in 40 CFR Part 63 have been promulgated.
    - NESHAPs are also referred to as "maximum achievable control technology" (MACT) standards.
- New Source Review Requirements:
    - Part C of the USCAA requires EPA to establish a permitting program for new major sources and major modifications of existing sources. The Prevention of Significant Deterioration (PSD) permitting program is designed to allow growth while protecting air quality, reducing the potential for future violations of NAAQS, and limiting impacts to national parks and wilderness areas.
    - Sources are required to employ the best available control technology (BACT).
    - BACT means that an "emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this chapter emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques for control of each such pollutant."
    - BP and Phillips 66 have obtained PSD permits for modifications to their oil refineries.
- Regional Haze Program:
    - The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in 156 national parks and wilderness areas. In Washington State, initial best available retrofit technology (BART) determinations have been issued by Ecology and submitted to EPA for review and approval. Ecology has issued BART orders that establish reductions pursuant to the Regional Haze Rule to BP and Tesoro for NOX, SO2, and PM.

2.2.3 Court directive

The March 27, 2012 Order on Remedies entered in the United States District Court – Western District of Washington at Seattle (Case No. C11-417 MJP, Washington Environmental Council, et al. vs. Sturdevant, et al.). In that order, Ecology, PSCAA, and NWCAA were ordered to complete a RACT determination process pursuant to RCW 70.94.154 within 26 months, addressing GHGs for each of five Washington State petroleum refineries owned and operated by BP, Phillips 66, Shell, Tesoro, and US Oil.

This directive was the initial motivation for undertaking this rule making and under the directed timeline. On July 10, 2013, a three judge panel of the 9th Circuit Court of Appeals heard an appeal of the District Court decision. On October 17, 2013, the court ruled the plaintiffs do not have standing to bring a citizen suit under the Clean Air Act to force state and local air agencies to regulate greenhouse gas. On February 12, 2014, the District Court's order was vacated with the mandate issued dismissing the case for lack of standing. Ecology has chosen to finish the rule under existing agency regulatory authority.

The Order on Remedies was originally part of the baseline, but was not separable from the adopted rule in analysis. Similarly, the authorizing statute governing RACT is the legal direction governing the rule making, but is not separable from the adopted rule in analysis. This concept is discussed further in section 2.3, below.

2.3 Analytic scope

This analysis is not required to consider the costs or benefits of those elements of the adopted rule that are part of the baseline.

It is often the case that there is a legal requirement prompting a rule making (in that the law or courts require rule language to implement a legal requirement or court decision). The need for a rule typically happens due to broad authorization from the WA State Legislature, leaving specifics up to Ecology's discretion, but establishes a baseline legal requirement – in this case, develop RACT requirements for petroleum refineries – that is not separable from the specific rule language implementing it.

Where possible, we evaluate the costs and benefits of the adopted rule separate from the requirements set under the baseline, but that was not possible for this adopted rule. And where this separation is not possible, we interpret the requirement conservatively including all content of the adopted rule in this analysis.

2.4 Analyzed requirements

In this analysis, we evaluated the following, describing the requirements individually and in detail.

2.4.1 Option 1: Improve efficiency to 50th+ percentile

The adopted rule requires petroleum refineries to comply with either of two options. The first of these options is to demonstrate that the refinery has an EII® equal to or more efficient than the EII® value representing the 50th percentile of similarly sized US petroleum refineries, based on 2006 data, and using EnergyStar® methodology. Refineries must use any EII® report issued to the refinery by Solomon Associates between 2006 and 2014 to demonstrate this compliance. The EII® is a proprietary metric generated by Solomon Associates, based on data reported to them by petroleum refinery owners and operators. The index compares actual energy consumption at a petroleum refinery to energy consumption at similarly sized refineries in the US.

We do not expect compliance with this option to generate costs in and of itself for any refinery able to comply with it at the outset.[5] These refineries have already chosen to subscribe to Solomon to produce an EII® report.[6] The costs to subscribe with Solomon are part of their baseline costs. As compliance with this option indicates that efficiency improvements have already been made (and are not a result of the adopted rule), we do not expect compliance with this option to generate benefits.

2.4.2 Option 2: Reduce emissions by 10 percent

If a petroleum refinery cannot demonstrate compliance with option 1, above, then it must, by October 1, 2025 demonstrate compliance with a second option: an emissions-reduction standard. To comply with this emissions reduction standard, a petroleum refinery must demonstrate that it has reduced its GHG emissions by 10 percent from 2010 (or 2011, if 2010 data is not representative) levels, or has met the option 1 standard, above. A refinery must demonstrate emissions reduction by reporting emissions-reduction projects and emissions annually, and may use existing projects implemented beginning in 2010.

We expect compliance with this option, via emissions reduction, to generate technology or program-revision costs. We also expect compliance with this option to generate social (economic, environmental, health) benefits associated with reducing GHG emissions.

2.4.3 Annual reporting

The adopted rule requires annual reporting beginning on October 1, 2014, and occurring every year until compliance with one of the above options is demonstrated.

Compliance with the energy efficiency standard must be demonstrated in report form, including a letter from Solomon Associates certifying a compliant EII®, identification of the year of refinery data used, and confirmation that all data supplied to Solomon were reviewed by a licensed professional engineer licensed in Washington State.

Compliance with the emissions reduction standard (Option 2) must be demonstrated in report form, including requests for emissions reduction credit for projects, consisting of an engineering description, a quantitative analysis of emissions reduction, and information supporting that analysis.

We expect this requirement to generate reporting compliance costs.

[5] There will be costs associated with meeting the standard if refineries do not already meet it at the outset. These costs are included in the discussion of costs associated with implementing projects as needed to meet the 10-percent emissions reduction standard. Refineries are likely to meet the efficiency standard when including existing projects, but we chose to estimate conservatively high costs by estimating the complete compliance costs required to reduce emissions by 10 percent.

[6] Confirmed via phone calls with Northwest Clean Air Agency employees, May 14-15, 2014 (NWCAA, 2014).

2.4.4 Recordkeeping

The adopted rule requires recordkeeping for five years after the last report has been submitted by a petroleum refinery. We expect this requirement to generate recordkeeping costs associated with retaining and maintaining records and reports.

We expect this requirement to generate some cost, but less than would be generated by a requirement to generate new records, which this rule does not require.

Chapter 3: Likely Costs of the Adopted Rule

3.1 Introduction

Ecology estimated the expected costs associated with the adopted rule, as compared to the baseline described in section 2.2 of this document, and with impacts discussed in section 2.4 of this document. The baseline is what would happen in the absence of the adopted rule being adopted. The costs analyzed here are associated with specific requirements and impacts falling into the following categories.

- Emissions reduction
- Reporting
- Recordkeeping

3.2 Affected Entities

The adopted rule explicitly applies to five petroleum refineries in Washington State:

- BP Cherry Point Refinery in Blaine, WA
- Phillips 66 Company Refinery in Ferndale, WA
- Shell Oil Company Refinery in Anacortes, WA
- Tesoro Refining & Marketing Company, LLC Anacortes Refinery in Anacortes, WA
- U.S. Oil & Refining Co. Tacoma Refinery in Tacoma, WA

The adopted rule applies to greenhouse gas emissions from combustion. The specific greenhouse gases are carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and hexafluoride. Other greenhouse gas emissions are not included.

Ecology has determined that two of the refineries have already asserted efficiency that would meet the energy-efficiency standard.[7] These two refineries – Phillips 66 Company Refinery in Ferndale, WA, and BP Cherry Point Refinery in Blaine, WA – would not need to take additional action to comply with efficiency/emissions standards. They would, however, still incur recordkeeping and reporting costs. We, therefore, estimated costs and benefits for the remaining three refineries with unknown efficiency/emissions status incurring efficiency/emissions costs, and for all five refineries incurring recordkeeping and reporting costs.

[7] "ENERGY STAR Plant Profile." *ENERGY STAR Labeled Building Profile*. N.p., n.d. Ferndale Refinery 2013. Web. 25 Mar. 2014.
http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.showPlantProfile&OWNER_ID=&STR=&building_type_id=PETREF&PAGE=1&VIEW=&year=&MINI=&s_code=ALL&search_owner_id=&search_prop_manager_id=&FILTER_B_ID=&zip=&STARTNUM=1&search_spp_id=&city=&profiles=0&plantprofile_id=p_10041
and
McKenzie, Mike. "Cherry Point Steers Good Fortune and Vitality in Whatcom County." *Business Pulse Magazine*. Whatcom Business Alliance. Winter 2014.

3.3 Discounting and present values

We use a discount rate to convert future costs and benefits to present values, to represent and be able to compare total future value streams.

Typically, we use an average historic discount rate based on the rate of return on US Treasury I-Bonds, as these rates are both risk-free and adjusted for inflation. The current discount rate used for these calculations is 1.35 percent, based on I-Bond rates between September 1998 and May 2013.

However, some of the values estimated from the literature and used for this analysis were estimated using a 3-percent discount rate. Ecology, therefore, used a 3-percent discount rate throughout this report. This means future costs and benefits were valued less in present terms than they would have been using the typical discount rate. For this analysis, it means the net benefits (benefits minus costs) of the adopted rule presented here are lower than they would have been using the typical discount rate.

3.4 Emissions reduction costs

We did not have sufficient public data to develop refinery-specific estimates of costs based on technology and processes specific to each refinery. Due to the need to maintain the confidentiality of business data, within the petroleum refinery owner companies, and throughout the rule-making process (especially as regards recordkeeping), we did not have comprehensive data on specific facility attributes, emissions and energy efficiency, completed or planned projects, reports made to Solomon Associates, or evaluations and results provided by Solomon Associates.

Instead of making refinery-technology specific estimates, we estimated the results of complying with the adopted rule based on the incentives it creates: To demonstrate emissions reductions, and thus compliance with the energy efficiency standard in the first year, or invest in emissions-reduction and efficiency projects in subsequent years. To account for uncertainty as to which projects, and how many projects, would be done when, we estimated a range of values from all refineries complying immediately, to some of the refineries coming into compliance in 2024. We estimated the present value costs associated with, on the one hand, all five refineries complying immediately with the energy efficiency standard (two refineries already being in compliance), through, on the other hand, the remaining three refineries that are not currently in a compliance position investing in emissions-reduction and efficiency projects in 2024 (for the 2025 reporting year).

Based on estimated 2010 or 2011 emissions, we estimated the total reductions in emissions that would have to occur across the three refineries that are not currently in compliance position as 289,012 metric tons of CO2 equivalent emissions, or an average reduction per refinery of 96,337. Confident and viable estimates for emissions reduction technology at petroleum refineries were only available for reductions to steam systems (e.g. boilers), with associated efficiency improvements. While we do not expect that all reductions in emissions would arise from changes

to steam systems, we consider this unit cost of emissions reductions to represent a conservatively high estimate of the unit cost. This is a conservatively high estimate, as compared to other systems and programmatic modifications at a petroleum refinery not yet in compliance with the efficiency or emissions standard.

Using reductions in steam systems as an example, we calculated the average cost of a 1-percent reduction to steam-system emissions and used that to estimate the equivalent reduction to total emissions for all applicable technologies at the refinery, and total cost estimation for complying with a 10-percent reduction in total emissions at an average plant. We expect these estimates based on technologically based projects to generate conservatively high estimates of costs, as compared to other systems (that lacked representative data) and programmatic modifications.

We estimated that a 1-percent reduction in boiler emissions cost $108 thousand to $164 thousand, and represented at 0.08-percent reduction in total emissions at the plants across all technologies, based on relative 2010 emissions from boilers and from refineries as a whole.[8] Therefore, a 10-percent reduction in total emissions was equivalent to a reduction in emissions equivalent to 132-percent of boiler emissions.[9] This does not mean Ecology expects emission reductions at the refineries to come from only reductions, eliminations, or other changes to the steam system, but rather this is an estimate of conservatively high unit cost and its implicit quantity change in emissions.

Based on this, we estimated a total cost across the three plants not currently identified as being in a compliance position of $3.2 – 4.9 million, in nominal (at the time it is spent) value.[10] We then calculated the discounted present value of this compliance cost for data years 2014 through 2024, allowing for variance in the year the emissions reduction is achieved. Table 2 summarizes these discounted present values of this estimated compliance cost. In response to comments received during the public process of this rule making, we also estimated costs based on capital purchases being repaid over time (incurring interest) in Appendix A.

Ecology expects costs of efficiency improvements to fall over time, as new technological advances are made in efficiencies. Also as present-value costs of emissions reductions are lower for later years, Ecology expects refineries complying with the 10-percent reduction to delay installation of emissions reduction technology that is not currently in-use or planned.

[8] For emissions calculation basis, see Washington Oil Refinery RACT Final Technical Support Document (NWCAA, PSCAA, Ecology; 2013), Table 6-1 and Table 6-2. A one-percent reduction in total boiler emissions across the three refineries not currently in compliance position would have been 2,194 metric tons in 2010 (or an average of 731 per refinery). A reduction of 2,194 metric tons would have been a 0.08-percent reduction from total 2010 emissions of 2,890,120. For emissions-reduction cost basis, see Washington Oil Refinery RACT Final Technical Support Document (NWCAA, PSCAA, Ecology; 2013), Table 7-1. We limited the cost calculation to boiler options that had sufficient information to calculate the reduction-to-cost relationship range.

[9] If 1 percent of boiler emissions is equivalent to 0.08 percent of total emissions, then 1 percent of total emissions is equivalent to 13.18 percent of boiler emissions. Therefore 10 percent of total emissions is equivalent to 131.8 percent.

[10] 131.8 multiplied by the cost range of $108 thousand to $164 thousand per 1-percent reduction.

Table 2: Discounted Present-Value Costs of 10-percent Emissions Reduction

If Three Refineries:	Technological Costs LOW	Technological Costs HIGH
Meet EII® standard now	$0	$0
Meet the 10% reduction in 2014 (report 2015):	$3,240,500	$4,922,880
Meet in 2015 (report 2016):	$3,146,117	$4,779,495
Meet in 2016 (report 2017):	$3,054,482	$4,640,287
Meet in 2017 (report 2018):	$2,965,517	$4,505,133
Meet in 2018 (report 2019):	$2,879,142	$4,373,915
Meet in 2019 (report 2020):	$2,795,284	$4,246,520
Meet in 2020 (report 2021):	$2,713,868	$4,122,834
Meet in 2021 (report 2022):	$2,634,823	$4,002,752
Meet in 2022 (report 2023):	$2,558,081	$3,886,167
Meet in 2023 (report 2024):	$2,483,573	$3,772,978
Meet in 2024 (report 2025):	$2,411,236	$3,663,085

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

3.5 Reporting costs

We estimated reporting costs based on the EPA's past assumptions about the types of employees or outside contractors required for reporting greenhouse gas emissions, as well as the amounts of time those workers would require for the task.[11] We also included assumed hours required for a licensed professional engineer to review and certify reports and supporting data. These assumptions are summarized in Table 3, which also includes the associated wage by type of worker, and loading factors to account for overhead and current dollar values.[12] The loading factor accounts for 4.35-percent benefits loading, and 17-percent overhead loading.[13]

[11] See Environmental Protection Agency (2010), Table 4-3.

[12] See May, 2012 State Occupational Employment and Wage Estimates for Washington State (Bureau of Labor Statistics, 2013a). Wages updated to 2013-dollar values using the Consumer Price Index, as reported by the US BLS (2013b)

[13] See Environmental Protection Agency (2010).

Table 3: Inputs to Reporting Costs with Loading Factor

	First year hours	Subsequent Year hours	Wage 2012$	Loaded wage 2012$	Loaded wage 2013$
Senior Management	0.05	0.04	$51.76	$62.81	$64.06
Middle management	1.24	1.08	$49.69	$60.30	$61.50
Junior Engineer/Technician	4.13	3.73	$19.40	$23.54	$24.01
Senior Operator	13.81	13.1	$31.29	$37.97	$38.72
3rd-party Licensed Professional Engineer	8	8	$60.87	$73.87	$75.33

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

The resulting estimates of total reporting costs for all five refineries are listed in present values, based on year of expenditure, in Table 4. Unlike emissions reduction or efficiency technology or other measures, reporting costs are assumed to be spent in the reporting year. Per the adopted rule, reporting costs end the year compliance is reached.

Table 4: Total Present-Value Reporting Costs by Year

If All Five Plants Report the First Year, and Three Have Their Last Report in the Following Year	Cumulative Reporting Costs
2014	$6,580
2015	$10,275
2016	$13,862
2017	$17,344
2018	$20,725
2019	$23,007
2020	$27,195
2021	$30,289
2022	$33,293
2023	$36,209
2024	$39,041
2025	$41,790

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

3.6 Recordkeeping costs

We estimated recordkeeping costs based on the EPA's past assumptions about the types of employees required for recordkeeping in GHG reporting, as well as the amounts of time those

workers would require for the task.[14] These assumptions are summarized in Table 5, which also includes the associated wage by type of worker, and loading factors to account for overhead and current dollar values.[15] The loading factor accounts for 4.35-percent benefits loading, and 17-percent overhead loading.[16]

Table 5: Inputs to Recordkeeping Costs with Loading Factor

	First year hours	Subsequent Year hours	Wage 2012$	Loaded wage 2012$	Loaded wage 2013$
Senior Management	0.15	0.15	$51.76	$62.81	$64.06
Middle management	0.24	0.23	$49.69	$60.30	$61.50
Junior Engineer/Technician	2.74	2.6	$19.40	$23.54	$24.01
Senior Operator	0.52	0.52	$31.29	$37.97	$38.72

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

The resulting estimates of total recordkeeping costs for all five refineries are listed in present values, based on five years of expenditure following reported compliance, in Table 6. Recordkeeping costs are assumed to be spent during the five years following the final report (of compliance with emissions or efficiency standards).

Table 6: Total Present-Value Recordkeeping Costs by Year

If Two Plants Have Their Last Report in 2014, and Three Plants Have Their Last Report in the Following Year	Recordkeeping Costs
2014	$2,527
2015	$2,483
2016	$2,440
2017	$2,399
2018	$2,358
2019	$2,319
2020	$2,281
2021	$2,244
2022	$2,208
2023	$2,173
2024	$2,139
2025	$2,106

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

[14] See Environmental Protection Agency (2010), Table 4-3.

[15] See May, 2012 State Occupational Employment and Wage Estimates for Washington State (Bureau of Labor Statistics, 2013a). Wages updated to 2013-dollar values using the Consumer Price Index, as reported by the US BLS (2013b)

[16] See Environmental Protection Agency (2010).

Chapter 4: Likely Benefits of the Adopted Rule

4.1 Introduction

Ecology estimated the expected benefits associated with the adopted rule, as compared to the baseline described in section 2.2 of this document, and with impacts discussed in section 2.4 of this document. The baseline is what would happen in the absence of the adopted rule being. The benefits analyzed here are associated with:

- Emissions reduction
- Efficiency gains

4.2 Social cost of carbon emissions

We quantified the value of reduced GHG emissions using a federally-developed and used estimate of the social cost of carbon (SCC).[17] The estimate of the SCC rises each year, and we chose the modeled annual discount rate that was closest to the typical rate, using estimates of SCC based on a 3-percent discount. The SCC values used in this analysis are listed in Table 7 (note that these are in 2013-dollars per metric ton).

There exist many estimates of the social cost of carbon, each carrying its own assumptions regarding elements such as (but not limited to) the trajectory of worldwide emissions, expected development and growth rates, the rate at which we discount the future, and how much we value impacts that do not occur locally. As with each estimate available, the SCC we use in this document has been challenged, based on what is included in the scope of costs, how the future is discounted, and how costs are distributed. Ecology (as well as the federal workgroup that developed the SCC we use in this analysis) acknowledges the limitations of any quantitative estimate of the SCC. In particular, the workgroup states in its original analysis:

> As noted, any estimate of the SCC must be taken as provisional and subject to further refinement (and possibly significant change) in accordance with evolving scientific, economic, and ethical understandings. During the course of our modeling, it became apparent that there are several areas in particular need of additional exploration and research. These caveats, and additional observations in the following section, are necessary to consider when interpreting and applying the SCC estimates.[18]

And follows up in the technical update:

> The 2010 interagency SCC TSD discusses a number of important limitations for which additional research is needed. In particular, the document highlights the need to improve the quantification of both non-catastrophic and catastrophic damages, the

[17] See Interagency Workgroup on Social Cost of Carbon, US Government (2010 and 2013).
[18] See Interagency Workgroup on Social Cost of Carbon, US Government (2010).

> treatment of adaptation and technological change, and the way in which inter-regional and inter-sectoral linkages are modeled. While the new version of the models discussed above offer some improvements in these areas, further work remains warranted. The 2010 TSD also discusses the need to more carefully assess the implications of risk aversion for SCC estimation as well as the inability to perfectly substitute between climate and non-climate goods at higher temperature increases, both of which have implications for the discount rate used.[19]

Ecology finds that these issues, among others, exist for all estimates of the SCC, and indicate neither specific overestimation nor specific underestimation in overall estimates when all of the variables and assumptions are considered. For example, estimates require development in valuing catastrophic endpoints, which might indicate underestimation, but estimates also require development in how they include adaptation, which might indicate overestimation.

Uncertainty is ubiquitous in economic value estimates, and is tied to not only the certainty of their inputs and assumptions, but to the number of inputs dealt with. Understandably, models of climate change and their interrelationship with economic models and assumptions – with the sheer number of variables involved – will carry greater uncertainty. Ecology chose to use the federal SCC estimate in part because it attempts to broadly deal with some of these uncertainties, but also Ecology chose within the available estimates of SCC to use those inputs most-closely resembling those typically made in Ecology analyses, and to use those representing a mid-range set of costs.

Table 7: Social Cost of Carbon Emissions

Year	SCC per Metric Ton
2014	$41.78
2015	$42.91
2016	$44.04
2017	$45.17
2018	$46.30
2019	$47.43
2020	$48.56
2021	$49.69
2022	$50.82
2023	$51.95
2024	$53.08

[19] See Interagency Workgroup on Social Cost of Carbon, US Government (2013).

Comments received during the public process for this rule making expressed concern that global emissions contribution was not an appropriate measure of the benefits of this rule. Ecology believes, however, that while it is not possible to specify the local benefits to climate change resulting from control of local emissions, it is appropriate to acknowledge that local emissions contribute to the global pool of GHGs that cause global impacts including local impacts. These impacts affect local ecology, people, industry, agriculture, and infrastructure. Establishing a direct 100% relationship between local emissions and local impacts is inherently impossible. This is precisely why Ecology and other government agencies have chosen to represent the costs of GHG emissions and the benefits of reducing them on a global scale. We believe this is consistent with our analytic practices and the requirements of the Administrative Procedure Act for cost and benefit analysis (RCW 34.05.328).

For typical costs and benefits, Ecology uses Washington-State-only values, but GHG emissions are unique, and require a broader approach to valuation, especially as applies to the co-externality impacts of carbon emissions. The US Interagency Working Group on the Social Cost of Carbon describes this need as follows.

> Under current OMB guidance contained in Circular A-4, analysis of economically significant proposed and final regulations from the domestic perspective is required, while analysis from the international perspective is optional. However, the climate change problem is highly unusual in at least two respects. First, it involves a global externality: emissions of most greenhouse gases contribute to damages around the world even when they are emitted in the United States. Consequently, to address the global nature of the problem, the SCC must incorporate the full (global) damages caused by GHG emissions. Second, climate change presents a problem that the United States alone cannot solve. Even if the United States were to reduce its greenhouse gas emissions to zero, that step would be far from enough to avoid substantial climate change. Other countries would also need to take action to reduce emissions if significant changes in the global climate are to be avoided. Emphasizing the need for a global solution to a global problem, the United States has been actively involved in seeking international agreements to reduce emissions and in encouraging other nations, including emerging major economies, to take significant steps to reduce emissions. When these considerations are taken as a whole, the interagency group concluded that a global measure of the benefits from reducing U.S. emissions is preferable.
>
> When quantifying the damages associated with a change in emissions, a number of analysts … employ "equity weighting" to aggregate changes in consumption across regions. This weighting takes into account the relative reductions in wealth in different regions of the world. A per-capita loss of $500 in GDP, for instance, is weighted more heavily in a country with a per-capita GDP of $2,000 than in one with a per-capita GDP of $40,000. The main argument for this approach is that a loss of $500 in a poor country causes a greater reduction in utility or welfare than does the same loss in a wealthy nation. Notwithstanding the theoretical claims on behalf of equity weighting, the interagency group concluded that this approach would not be appropriate for estimating a SCC value used in

> domestic regulatory analysis. For this reason, the group concluded that using the global (rather than domestic) value, without equity weighting, is the appropriate approach.[20]

Ecology similarly considers it appropriate to use a broader scope when choosing estimates of SCC.

4.3 Avoided cost of emissions impact

We estimated the value of avoided (reduced) GHG emissions based on the year in which compliance with a 10-percent reduction would occur at the three refineries not currently indicating compliance with the efficiency/emissions standard. To calculate the value of these reductions, we used Ecology's estimates of 2010 or 2011 refinery emissions, and then multiplied 10 percent of those values by the SCC in each year they are avoided. We note that once reductions are achieved, those GHG emissions are avoided in subsequent years as well. Here we present both estimates of the avoided costs in the first year of 10-percent reduction in GHG emissions, as well as the value including subsequent years of reductions through the 20-year time span standard to Ecology analysis. Table 8 summarizes these estimated benefits.

Table 8: Total Present Value Benefits of Avoided GHG Emissions, Based on Year of Compliance

If All Five Plants Have Their Last Report in the Following Year	FIRST-YEAR BENEFITS (Year emission reduction occurs)	TOTAL BENEFITS (All Years Through 2033)
2014	$0	$0
2015	$12,075,987	$301,246,910
2016	$12,402,365	$289,170,923
2017	$12,728,743	$276,768,558
2018	$13,055,121	$264,039,816
2019	$13,381,499	$250,984,695
2020	$13,707,877	$237,603,196
2021	$14,034,255	$223,895,320
2022	$14,360,633	$209,861,065
2023	$14,687,011	$195,500,432
2024	$15,013,389	$180,813,421
2014	$15,339,767	$165,800,033

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

[20] See Interagency Workgroup on Social Cost of Carbon, US Government (2010).

4.4 Efficiency gains

A prospective benefit of the adopted rule is cost-savings at the refineries due to improved efficiency. The adopted rule would be the reason for such a benefit at plants that made additional efficiency gains to comply with the rule requirements, in addition to those improvements made between 2010 and 2014 that a refinery might use toward compliance. Due to the plant-specific and project-specific nature of this benefit, we could not develop a quantitative estimate of it.

Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Likely costs and benefits of the adopted rule

Ecology estimated the following ranges of costs and benefits of the adopted rule, based on the incentives created by the requirements of the rule, as well as varying by year of compliance.

Table 9: Total Estimated Benefits and Costs, Depending on Year of Compliance

Compliance Year (report following year)	FIRST-YEAR BENEFITS (In year reductions occur)	TOTAL BENEFITS (All Years)	TOTAL COSTS LOW	TOTAL COSTS HIGH
2013	$0	$0	$9,107	$9,107
2014	$12,075,987	$301,246,910	$3,253,258	$4,935,638
2015	$12,402,365	$289,170,923	$3,162,418	$4,795,797
2016	$12,728,743	$276,768,558	$3,074,225	$4,660,029
2017	$13,055,121	$264,039,816	$2,988,600	$4,528,216
2018	$13,381,499	$250,984,695	$2,904,469	$4,399,241
2019	$13,707,877	$237,603,196	$2,824,759	$4,275,995
2020	$14,034,255	$223,895,320	$2,746,400	$4,155,367
2021	$14,360,633	$209,861,065	$2,670,324	$4,038,253
2022	$14,687,011	$195,500,432	$2,596,463	$3,924,549
2023	$15,013,389	$180,813,421	$2,524,754	$3,814,158
2024	$15,339,767	$165,800,033	$2,455,133	$3,706,981

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

5.2 Conclusion

After evaluating the likely costs and benefits of the adopted rule, Ecology believes that the likely qualitative and quantitative benefits of the rule exceed their likely costs. The compliance costs likely to be accrued by petroleum refineries are, over 20 years, likely less than the benefits of reduced emissions and improved efficiency and information.

Chapter 6: Least-Burdensome Alternative Analysis

6.1 Introduction

Chapter 34.05.328(1)(e) requires Ecology to "…[d]etermine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection." Where the references subsections are:

(a) Clearly state in detail the general goals and specific objectives of the statute that the rule implements.

(b) Determine that the rule is needed to achieve the general goals and specific objectives stated under (a) of this subsection, and analyze alternatives to rule making and the consequences of not adopting the rule.

(c) Provide notification in the notice of proposed rule making under RCW 34.05.320 that a preliminary cost-benefit analysis is available. The preliminary cost-benefit analysis must fulfill the requirements of the cost-benefit analysis under (d) of this subsection. If the agency files a supplemental notice under RCW 34.05.340, the supplemental notice must include notification that a revised preliminary cost-benefit analysis is available. A final cost-benefit analysis must be available when the rule is adopted under RCW 34.05.360

In other words, Ecology is required to determine that the contents of the rule are the least burdensome set of requirements that still achieve the goals and objectives of the authorizing statute.

Ecology assessed alternatives to elements of the adopted rule, and determined whether they met the goals and objectives of the authorizing statute. Of those that would meet these objectives, Ecology determined whether those chosen for the adopted rule were the least burdensome.

6.2 Goals and objectives

The direct authorizing statute for the adopted rule is RCW 70.94.154, however RACT is defined in RCW 70.94.030(20) as:

> "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.

The goals and objectives of the authorizing statute include:

- The objective of developing RACT for covered sources (RCW 70.94.154(1)): RACT as defined in RCW 70.94.030 is required for existing sources except as otherwise provided in RCW 70.94.331(9).
- The objective of a set of considerations for determining RACT (RCW 70.94.154(5)): "In determining RACT, ecology and local authorities shall utilize the factors set forth in RCW 70.94.030 and shall consider RACT determinations and guidance made by the federal environmental protection agency, other states and local authorities for similar sources, and other relevant factors. In establishing or revising RACT requirements, ecology and local authorities shall address, where practicable, all air contaminants deemed to be of concern for that source or source category."
- The declarations of goals and purpose for the Washington Clean Air Act (RCW 70.94.011; author's bolding):

> It is declared to be the public policy to **preserve, protect, and enhance the air quality for current and future generations**. Air is an essential resource that must be protected from harmful levels of pollution. Improving air quality is a matter of statewide concern and is in the public interest. **It is the intent of this chapter to secure and maintain levels of air quality that protect human health and safety, including the most sensitive members of the population, to comply with the requirements of the federal clean air act, to prevent injury to plant, animal life, and property, to foster the comfort and convenience of Washington's inhabitants, to promote the economic and social development of the state, and to facilitate the enjoyment of the natural attractions of the state.**
>
> It is further the intent of this chapter to **protect the public welfare, to preserve visibility, to protect scenic, aesthetic, historic, and cultural values, and to prevent air pollution problems that interfere with the enjoyment of life, property, or natural attractions.**
>
> The legislature recognizes that air pollution control projects may affect other environmental media. In selecting air pollution control strategies state and local agencies shall support those strategies that **lessen the negative environmental impact** of the project on all environmental media, including air, water, and land.
>
> The legislature further recognizes that **energy efficiency and energy conservation can help to reduce air pollution** and shall therefore be considered when making decisions on air pollution control strategies and projects.

It is the policy of the state that the **costs of protecting the air resource** and operating state and local air pollution control programs **shall be shared as equitably as possible among all sources whose emissions cause air pollution**.

It is also declared as public policy that regional air pollution control programs are to be encouraged and supported to the extent practicable as essential instruments for the securing and maintenance of appropriate levels of air quality.

To these ends **it is the purpose of this chapter to safeguard the public interest through an intensive, progressive, and coordinated statewide program of air pollution prevention and control**, to provide for an appropriate distribution of responsibilities, and to encourage coordination and cooperation between the state, regional, and local units of government, to improve cooperation between state and federal government, public and private organizations, and the concerned individual, as well as to provide for the use of all known, available, and reasonable methods to reduce, prevent, and control air pollution.

The legislature recognizes that the problems and effects of air pollution cross political boundaries, are frequently regional or interjurisdictional in nature, and are dependent upon the existence of human activity in areas having common topography and weather conditions conducive to the buildup of air contaminants. In addition, the legislature recognizes that air pollution levels are aggravated and compounded by increased population, and its consequences. These changes often result in increasingly serious problems for the public and the environment.

The legislature further recognizes that air emissions from thousands of small individual sources are major contributors to air pollution in many regions of the state. As the population of a region grows, small sources may contribute an increasing proportion of that region's total air emissions. It is declared to be the policy of the state to achieve significant reductions in emissions from those small sources whose aggregate emissions constitute a significant contribution to air pollution in a particular region.

6.3 Allow credit for emissions reduction projects back to 2006

Ecology considered allowing refineries to use emissions reduction projects beginning in 2006 for credits toward compliance with the adopted rule. While we agree that this would potentially have

reduced the burden of compliance for some refineries, we do not believe this satisfies the goals and objectives of an "intense, progressive, and coordinated statewide program". Allowing the use of emission reductions resulting from projects that are included in the baseline emissions double counts those reductions. The 2010 limit for using past emissions-reduction projects is consistent with the baseline of 2010 emissions for compliance with the emissions-reduction standard.

6.4 Allow for a later baseline emissions year

Ecology considered allowing 2012 emissions as a baseline as well, as it was suggested that 2010 and 2011 emissions might not be representative. We determined, however, that all five plants had viably representative refinery operations and resulting emissions in either 2010 or 2011. Conceptually using 2012 would not reduce the burden, and even if it did (e.g., because 2012 emissions were lower than previous years, making 10 percent a smaller number), a later baseline would not be consistent with the analyses used in the Technical Support Document or the goals and objectives of setting an appropriate RACT standard and protection of human and environmental health to the maximum viable extent.

6.5 Define applicability using a more general SIC or NAICS definition

Ecology considered defining the petroleum refineries to which the adopted rule applies in a more general manner through use of either the Standard Industry Classification (SIC) or North American Industry Classification System (NAICS) codes for petroleum refineries. We determined that by defining applicability to the refineries, by name, that the rule would be clearer and easier to determine the process areas that are included. The compliance requirements for the covered refineries are no different in either case, but by defining the specific facilities and the processes they own, the adopted rule is overall less burdensome than this alternative.

6.6 Require 2.5-percent emissions reduction instead of 10

Ecology considered other emission reduction requirements. One specific reduction evaluated would require 2.5-percent reductions in emissions to meet the emissions-reduction standard. While we agree this would be less burdensome, we do not believe it satisfies the objectives listed in Section 6.2, above, or the statutes referenced therein. That is, Ecology believes a 10-percent reduction is viable, and is therefore appropriate for RACT. While this option had stakeholder support, we have not been presented evidence that it is not viable for Washington State petroleum refineries.

6.7 Conclusions

After considering alternatives to the adopted rule's contents, as well as the goals and objectives of the authorizing statute, Ecology determined that the adopted rule represents the least burdensome alternative of possible rule contents meeting these goals.

Appendix A: Sensitivity Analysis for Repayment of Capital Investments

In response to comments received during the public process of this rule making, we estimated an alternate set of costs based on capital projects requiring repayment over longer periods of time, and therefore incurring interest costs. Using the methodology in section 3.4 of this document, we included repayment of costs incurred over the 20-year timeframe. This means a cost incurred in a given year was converted to a series of subsequent annual repayment costs using an interest rate of 10 percent, then converted to a present value at the year of expenditure of $2.2 million to $4.8 million per oil refinery.[21] Those annual repayment costs were then converted to a present value cost using the same methodology as in section 3.4. Table 10 lists the present-value results of this calculation.

Table 10: Discounted Present-Value Costs of 10-percent Emissions Reduction

If Three Refineries:	Technological Costs LOW	Technological Costs HIGH
Meet EII® standard now	$0	$0
Meet the 10% in 2014 (report 2015):	$6,496,275	$14,513,450
Meet in 2015 (report 2016):	$6,307,063	$14,090,728
Meet in 2016 (report 2017):	$6,123,362	$13,680,319
Meet in 2017 (report 2018):	$5,945,012	$13,281,863
Meet in 2018 (report 2019):	$5,771,856	$12,895,012
Meet in 2019 (report 2020):	$5,603,744	$12,519,430
Meet in 2020 (report 2021):	$5,440,528	$12,154,786
Meet in 2021 (report 2022):	$5,282,066	$11,800,763
Meet in 2022 (report 2023):	$5,128,219	$11,457,052
Meet in 2023 (report 2024):	$4,978,854	$11,123,351
Meet in 2024 (report 2025):	$4,833,839	$10,799,370

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

If capital investments were repaid in this manner, the technological costs in Table 2 would be replaced with the costs in Table 10. While this would increase total costs, it would not affect the results of this analysis. Table 11 shows the overall cost-benefit comparison with the capital-repayment assumptions.

[21] We chose 10 percent to represent a typical rate of return to invested capital at a petroleum company, a typical industry-specific measure of opportunity cost.

Table 11: Comparison of Benefits and Costs of the Adopted Rule, Assuming Above Repayment of Capital Investments

Compliance Year (report following year)	FIRST-YEAR BENEFITS (In year reductions occur)	TOTAL BENEFITS (All Years)	TOTAL COSTS LOW	TOTAL COSTS HIGH
2013	$0	$0	$9,107	$9,107
2014	$12,075,987	$301,246,910	$6,509,033	$14,526,208
2015	$12,402,365	$289,170,923	$6,323,365	$14,107,030
2016	$12,728,743	$276,768,558	$6,143,105	$13,700,061
2017	$13,055,121	$264,039,816	$5,968,095	$13,304,946
2018	$13,381,499	$250,984,695	$5,797,182	$12,920,339
2019	$13,707,877	$237,603,196	$5,633,219	$12,548,905
2020	$14,034,255	$223,895,320	$5,473,061	$12,187,319
2021	$14,360,633	$209,861,065	$5,317,567	$11,836,264
2022	$14,687,011	$195,500,432	$5,166,602	$11,495,434
2023	$15,013,389	$180,813,421	$5,020,034	$11,164,531
2024	$15,339,767	$165,800,033	$4,877,735	$10,843,266

Costs and benefits are reported throughout this document in 2013-dollars, to allow interested parties readier comparison to those reported in the Preliminary Cost-Benefit Analysis (publication no. 13-02-033). To convert to 2014-dollars, all 2013-dollar values reported would be multiplied by a factor of 1.018 (BLS, 2014), scaling both costs and benefits uniformly.

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