DEPARTMENT OF ECOLOGY
State of Washington

Preliminary Cost-Benefit and Least-Burdensome Alternative Analysis

Chapter 173-442 WAC
Clean Air Rule

Chapter 173-441 WAC
Reporting of Emissions of Greenhouse Gases

June 2016
Publication no. 16-02-008

Publication and Contact Information

This report is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1602008.html

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Chapter 173-442 WAC
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Reporting of Emissions of Greenhouse Gases

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Executive Summary

This report presents the economic analyses performed by the Washington State Department of Ecology (Ecology) to estimate the costs and benefits of the proposed Clean Air Rule (Chapter 173-442 WAC), and corresponding amendments to the Reporting of Emissions of Greenhouse Gases rule (Chapter 173-441 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.

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."

The proposed rule creates a program that limits and reduces greenhouse gas (GHG) emissions from certain large emission contributors, referred to as covered parties, and allows various compliance options to meet those limitations. It also includes reporting and verification of compliance.

The proposed rule establishes GHG emissions standards for:

- Stationary sources
- Petroleum product producers and/or importers
- Natural gas distributors operating in Washington State

If they meet GHG emissions thresholds that begin at 100,000 metric tons (MT) per year of carbon-dioxide equivalent emissions in 2017, these parties have a compliance obligation to limit and reduce GHG emissions over time, through 2035. They must afterward maintain the reduction achieved in 2035. The threshold for coverage under the proposed rule drops 5,000 metric tons every three years through 2035, increasing the number of covered parties over time.

Covered parties with compliance obligations under the proposed rule must report compliance after every three-year compliance period, and have compliance verified by a third party. They have various options for compliance, including:

- Reducing their own GHG emissions.
- Acquiring emissions reduction units from another covered party that has reduced GHG emissions in excess of what is required of them.
- Acquiring or generating emissions reduction units from approved GHG reduction projects in Washington State.
- Generating emission reduction units from approved GHG reduction programs in Washington, such as acquiring renewable energy credits (RECs).
- Acquiring emissions reduction units from non-regulated parties that voluntarily participate.

- Purchasing allowances from established multi-sector carbon markets as approved by Ecology.

Ecology determined that, compared to business as usual, the proposed rule has the following costs and benefits:

Costs

- Average 20-year present value cost of permanent reductions is between approximately $1.3 billion and $2.8 billion.
- Average 20-year present value cost of reductions going toward the reserve is between approximately $30 million and $62 million.
- 20-year present value reporting costs of approximately $384,000.
- 20-year present value verification costs of between approximately $33 million and $34 million.
- 20-year present value costs of increased reporting fees of between approximately $2 million and $3 million.

Quantified external present-value costs, taking average emission reduction costs across multiple scenarios, total between $1.4 billion and $2.8 billion over 20 years.

In addition, Ecology will incur the costs of implementing the proposed rule. These costs could not be quantified at this time, and implementation would likely involve a combination of additional full-time employees and work by existing employees.

Benefits

- 20-year present value avoided social emissions costs of approximately $14.5 billion.
- Avoided emissions of associated pollutants, with avoided damages per MT of:

$PM_{2.5}$	$1.45 - 1.6 million
Volatile Organic Compounds (VOCs)	$1,120 - 1,220
Nitrogen Oxides (NOx)	$4,675 - 5,080

- Improved environmental conditions and possible health improvements for populations surrounding locations where emissions are reduced, especially on-site or in-state project emissions reductions.
- Potential co-benefits of emissions reduction projects, for example through:
  - Energy efficiency for households and businesses
  - Improved transportation efficiency and reduced traffic, reduced parking and maintenance costs for transportation.
  - 20-year present value reduced reporting fees, to transportation fuel suppliers, of approximately $630,000.

Quantified present-value benefits, regardless of compliance scenario, total at least $14.5 billion, and are likely significantly higher including the unquantifiable benefits listed above.

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

Chapter 1: Background and Introduction

1.1 Introduction

This report presents the economic analyses performed by the Washington State Department of Ecology (Ecology) to estimate the costs and benefits of the proposed Clean Air Rule (Chapter 173-442 WAC), and corresponding amendments to the Reporting of Emissions of Greenhouse Gases rule (Chapter 173-441 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.

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 Summary of the proposed rule

The proposed rule creates a program that limits and reduces greenhouse gas (GHG) emissions from certain large emission contributors, referred to as covered parties, and allowing various compliance options to meet those limitations. It also includes reporting and verification of compliance.

The proposed rule establishes GHG emissions standards for:

- Stationary sources
- Petroleum product producers and/or importers
- Natural gas distributors operating in Washington State

If they meet GHG emissions thresholds that begin at 100,000 metric tons (MT) per year of carbon-dioxide equivalent emissions in 2017, these parties have a compliance obligation to limit and reduce GHG emissions over time, through 2035. They must afterward maintain the reduction achieved in 2035. The threshold for coverage under the proposed rule drops 5,000 metric tons every three years through 2035, increasing the number of covered parties over time.

Covered parties with compliance obligations under the proposed rule must report compliance after every three-year compliance period, and have compliance verified by a third party. They have various options for compliance, including:

- Reducing their own GHG emissions.
- Acquiring emissions reduction units from another covered party that has reduced GHG emissions in excess of what is required of them.
- Acquiring or generating emissions reduction units from approved GHG reduction projects in Washington State.
- Generating emission reduction units from approved GHG reduction programs in Washington, such as acquiring renewable energy credits (RECs).
- Acquiring emissions reduction units from non-regulated parties that voluntarily participate.
- Purchasing allowances from established multi-sector carbon markets as approved by Ecology.

1.3 Reasons for the proposed rule

The reason for this proposed rule is to reduce GHG emissions to protect human health and the environment. GHG emissions as a result of human activities have increased to unprecedented levels, warming the climate.[1] Washington has experienced long-term climate change impacts consistent with those expected from climate change.[2] Washington faces serious economic and environmental disruption from the effects of these long-term changes. For instance:

- An increase in pollution-related illness and death due to poor air quality.
- Declining water supply for drinking, agriculture, wildlife, and recreation.
- An increase in tree die-off and forest mortality because of increasing wildfires, insect outbreaks, and tree diseases.
- The loss of coastal lands because of sea level rise.
- An increase in ocean temperature and ocean acidification.
- An increase in disease and mortality in freshwater fish (salmon, steelhead, and trout), because of warmer water temperatures in the summer and more fluctuation of water levels (river flooding and an increase of water flow in winter while summer flows decrease).
- Heat stress to field crops and tree fruit will be more prevalent because of an increase in temperatures and a decline in irrigation water.

Compliance actions to reduce GHG emissions, such as producing cleaner energy and increasing energy efficiency, have the dual benefit of reducing other types of air pollution.

[1] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

[2] Snover, A.K, G.S. Mauger, L.C. Whitely Binder, M. Krosby, and I. Tohver. 2013. Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers. State of Knowledge Report prepared for the Washington State Department of Ecology. Climate Impacts Group, University of Washington, Seattle.

In 2008, Washington's Legislature required the specific statewide GHG emission reductions (RCW 70.235.020) below:

- By 2020, reduce overall emissions of greenhouse gases in the state to 1990 levels
- By 2035, reduce overall emissions of greenhouse gases in the state to 25 percent below 1990 levels
- By 2050, reduce overall emissions of greenhouse gases in the state to 50 percent below 1990 levels or 70 percent below the state's expected emissions that year.

Consistent with the Legislature's intent to reduce GHG emissions, Ecology is using its existing authority under the State Clean Air Act (Chapter 70.94 RCW) to adopt a rule that limits GHG emissions.

1.4 Document organization

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

- Business as Usual (BAU)[3] and the proposed rule (Chapter 2): Description and comparison of BAU (what would occur in the absence of the proposed rule) and the proposed rule requirements.
- Likely costs of the proposed rule (Chapter 3): Analysis of the types and sizes of costs we expect impacted parties to incur as a result of the proposed rule.
- Likely benefits of the proposed rule (Chapter 4): Analysis of the types and sizes of benefits we expect to result from the proposed 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 proposed rule.

[3] Ecology economic analyses typically use the term "baseline" to refer to the regulatory context in the absence of the proposed rule. Because the proposed rule uses "baseline" as a term referring to specific emissions quantities, we chose to use "business as usual" or "BAU" to avoid confusion.

Chapter 2: Business as Usual and the Proposed Rule

2.1 Introduction

Ecology analyzed the impacts of the proposed rule relative to business as usual (BAU), within the context of all existing requirements (federal and state laws and rules). This context for comparison is called BAU, and reflects the most likely regulatory circumstances that parties would face if the proposed rule were not adopted. It is discussed in Section 2.2, below.

2.2 Business as usual

BAU for our analyses generally consists of existing rules and laws, and their specific requirements. For economic analyses, BAU also includes the implementation of those regulations, including any guidelines and policies that result in behavior changes and real impacts. This is what allows us to make a consistent comparison between conditions that exist with or without the proposed new rule (Chapter 173-442 WAC) and proposed amendments to the existing GHG reporting rule (Chapter 173-441WAC).

For this proposed rulemaking, BAU includes:

- No existing GHG cap and reduction program at the state level.
- The existing GHG reporting rule (Chapter 173-441 WAC), which covers a subset of the parties covered by the proposed rule, and requires annual reporting and payment of fees.
- The federal and Washington State Clean Air Acts.
- Existing federal and state regulations, including those covering GHG reporting at the federal level, as well as those establishing energy policy.
- Existing federal and state permitting requirements and processes.

While they might otherwise have been considered part of BAU, the proposed rule explicitly exempts compliance with Washington's Emissions Performance Standard (Chapter 80.80 RCW) requirements from being considered part of BAU. The state's carbon dioxide mitigation standard and commute trip reduction programs are also excluded.

The proposed rule also considers future compliance with state implementation of the federal Clean Power Plan (CPP) as compliance with proposed rule requirements. However, since the state has not yet completed rulemaking determining the specific requirements of the CPP, and since the CPP is currently being held in a stay by the Supreme Court, we exclude its requirements from the BAU in this analysis. This means that impacts estimated in this analysis are likely overestimated for power producers that will be required to comply with the CPP.

2.3 Proposed rule requirements

This rulemaking sets out:

- Who must comply (coverage) – section 2.3.1
- Thresholds – section 2.3.2
- Requirements – section 2.3.3
- Compliance options – section 2.3.4
- Corresponding changes to other rules – section 2.3.5

2.3.1 Who must comply (coverage)

The proposed rule establishes standards for limiting and reducing GHG emissions for:

- Certain stationary sources
- Petroleum product producers or importers
- Natural gas distributors in Washington State

2.3.1.1 Covered stationary sources

Covered emissions are GHG emissions that are reported under Chapter 173-441 WAC (Reporting of Emissions of Greenhouse Gases) from stationary sources. This includes emissions voluntarily reported under Chapter 173-441 WAC.

The following types of emissions are not covered as stationary sources by the proposed rule:

- GHG emissions from manure management, suppliers of coal-based liquid fuels, suppliers of industrial greenhouse gases, or importers and exporters of fluorinated greenhouse gases contained in pre-charged equipment or closed-cell foams.
- Carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals, as provided in RCW 70.235.020(3).
- Carbon dioxide that is converted into mineral form and that is not emitted into the atmosphere.
- Emissions from a coal-fired baseload electric generation facility in Washington that emitted more than one million tons of GHGs in any calendar year prior to 2008, as provided in RCW 80.80.040(3).

The above exemptions are based on existing federal and state laws or definitions, or based on coverage under other parts of the proposed rule.[4]

2.3.1.2 Covered petroleum product producer or importer emissions

The proposed rule covers CO_2 emissions that would result from the complete combustion or oxidation of products covered under the Suppliers of Petroleum Products, 40 Code of Federal Regulations (CFR) Part 98, Subpart MM,[5] for producers or importers distributing petroleum

[4] See applicable federal and state law provisions codified at 40 CFR Part 98, Subpart MM; 40 CFR Part 98, Subpart NN; 40 CFR Part 98, Subpart JJ; RCW 70.235.020(3); RCW 80.80.040(3)(c)
[5] http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40tab_02.tpl

products in Washington State. This includes emissions voluntarily reported under and using methods established in Chapter 173-441 WAC.

Emissions from the following types of petroleum products are not covered by the proposed rule:

- Kerosene-type jet fuel
- Residual Fuel Oil No. 5 (Navy Special)
- Residual Fuel Oil No. 6 (known as "Bunker C")
- Petrochemical feedstocks: naphthas (< 401 °F)
- Petrochemical feedstocks: other oils (> 401 °F)
- Lubricants
- Waxes
- Asphalt and road oil
- Fuels exported from Washington State, where the final distribution of the product occurs outside of Washington State

2.3.1.3 Covered natural gas distributor emissions

The proposed rule covers CO_2 emissions that would result from the complete combustion or oxidation of products covered under 40 CFR Part 98, Subpart NN, from natural gas distributors distributing products in Washington State that are reported to Ecology under Chapter 173-441 WAC. This includes emissions voluntarily reported under Chapter 173-441 WAC.

This does not include GHG emissions from natural gas supplied to another covered party if that covered party has a compliance obligation for those emissions as a stationary emitter under the proposed rule or units or processes exempted because they are covered under the Clean Power Plan.

2.3.2 Thresholds for compliance obligation under the proposed rule

2.3.2.1 Existing emitters

If their covered GHG emissions are at least 100,000 metric tons (MT) per year, in carbon dioxide-equivalent units (CO_2e), parties with covered GHG emissions must comply with the proposed rule starting in 2017. Emissions used for threshold comparisons are determined using a baseline emissions calculation based on past emissions during 2012 – 2016, or other relevant emissions data.

2.3.2.2 New emitters

Parties with covered GHG emissions must comply with the proposed rule starting in their first year of operation, if they exceed the following thresholds:

- 100,000 MT per year in years 2017 through 2019
- 95,000 MT per year in years 2020 through 2022
- 90,000 MT per year in years 2023 through 2025
- 85,000 MT per year in years 2026 through 2028
- 80,000 MT per year in years 2029 through 2031
- 75,000 MT per year in years 2032 through 2034

- 70,000 MT per year in 2035 and thereafter

Emissions are compared to thresholds using a three-year baseline of annual total covered GHG emissions.

2.3.3 Clean Air Rule requirements

The proposed rule establishes the following requirements not required elsewhere in existing laws or rules:

- GHG emissions standards and reductions over time
- Compliance reporting
- Verification of compliance
- Development of an emissions reduction registry and reserve

2.3.3.1 GHG emissions standards and reductions over time

The proposed rule requires parties that exceed the thresholds discussed above in section 2.3.2 to meet GHG emissions standards starting in 2017 or the first year that GHG emissions exceed the relevant threshold. Covered parties meeting the definition of Energy Intensive and Trade Exposed (EITE), however, would instead be subject to output-based carbon intensity requirements and reductions.

Under the proposed rule, Ecology must assign a GHG emission reduction pathway (series of standards over time) for each GHG emissions contributor in Washington State that is covered by the proposed rule.

- In the first year a covered party has a compliance obligation under the proposed rule, the emission reduction pathway establishes allowable emissions at the baseline GHG emissions calculated for the covered party.[6]
- In subsequent years in which a covered party must comply with the proposed rule (excluding voluntary participants), the emission reduction pathway sets out allowable GHG emissions based on three-year compliance periods, each with an annual emissions reduction of 1.7 percent of the baseline GHG emissions for that covered party.[7]

EITEs covered under the proposed rule would instead be required to meet output-based carbon intensity requirements. Under the proposed rule:

- EITE covered parties would be required to report annual production data.
- Ecology would calculate the output-based baseline of the EITE party.
- Ecology would determine the efficiency intensity distribution for each sector of covered EITE.
- Ecology would determine each covered EITE's efficiency reduction rate, grouping covered EITEs into:

[6] See WAC 173-442-060 for specific data and processes to be used.

[7] This 1.7 percent corresponds to a reduction of 1 2/3 percent of baseline emissions each year, plus an additional two percent of that reduction contributing to a reserve that will facilitate new covered parties and covered party growth compliance with the proposed rule's requirements. Overall reductions each year equal 1.7 percent of baseline because (1 2/3 percent) + (2% x 1 2/3 percent) = (1 2/3 percent) + (1/30 percent) = 1.7 percent.

- Below the 25th percentile emissions intensity for its product. This group is required to reduce emissions at a rate greater than if it had a mass-based reduction pathway.
- Between the 25th and 75th percentile emissions intensity for its product. This group is required to reduce emissions at a rate consistent with a mass-based reduction pathway.
- Above the 75th percentile emissions intensity for its product. This group is required to reduce emissions at a rate less than if it had a mass-based reduction pathway.

- Covered EITEs would not be required to reduce emissions until at least the 2020-2022 compliance period and afterward.

Generally, the three tiered set of emissions reduction requirements would reduce carbon emissions from EITE parties, as a whole, in line with other covered parties' emissions reduction pathways.

2.3.3.2 Compliance reporting

Under the proposed rule, each covered party must submit a compliance report in the emission year following each compliance period. The report must contain records of:

- Emission reduction units generated: For each emission reduction unit or block of units, the report must list the source of units, and the source of emissions data or computational method used to generate the unit.
- Emission reduction units banked: The report must document all emission reduction units currently being banked by the regulated party. This documentation must include each unit's vintage and origination source.
- Emission reduction unit transactions: The report must document transactions of emission reduction units, including unit origin, transfer destination, and the names and contact information of any third parties who facilitated, brokered, or otherwise provided liaison services between the regulated parties making the exchange.

2.3.3.3 Verification of compliance

The proposed rule requires emissions reductions to be verified by a third party. Covered parties' annual GHG reports under Chapter 173-441 WAC must be verified by a third party, with an in-depth verification on the third year. Covered parties' reports for each three-year compliance period under Chapter 173-442 WAC must also be verified by a third party. This also holds for parties voluntarily participating in the reduction program. Verification addresses compliance report information, requirements, methods, and any discrepancies, errors, omissions, and/or misreporting.

Verification involves documentation of:

- Reporting party information.
- Verifier information.
- Compliance with the proposed rule requirements limiting extended use of the same verifier (no more than six years, with no fewer than three years between six-year uses), and prohibiting verifier conflict of interest.
- Verification plan including data and methodologies.
- Corrections to the compliance report.
- Supporting information of findings.

- Certification of accuracy, completeness, and truth.
- On-site visit.

2.3.3.4 Development of an emission reduction unit registry

The proposed rule requires Ecology to develop an emission reduction unit registry, using information reported by covered parties as part of their compliance with the proposed rule under Chapter 173-442 WAC.[8] The registry's initial balance will be based on reporting under Chapter 173-441 WAC.

2.3.4 Clean Air Rule compliance

Covered parties with compliance obligations, may comply with the proposed rule by reducing emissions in any of the following ways.

- **Own emissions reductions:** Reduction of a covered party's own emissions below the emissions level set in the covered party's reduction pathway.
- **Others' emissions reductions:** Other parties' reductions of emissions below their emissions reduction pathways. Reductions can also come from those voluntarily participating in the program.
- **Emissions reduction projects:** Emissions reductions using projects, activities, or programs recognized by Ecology as capable of generating emission reduction units under the proposed rule.
    - **Emission reductions from projects** can come from ownership of a project or from greenhouse gas credits available in markets for environmental commodities.
    - **Emission reductions from programs** can come from several state-run programs, including acquiring renewable energy credits (RECs), i.e., existing energy credits generated by power producers using renewable energy production,
    - **External emissions markets:** A covered party may use allowances when Ecology determines:
        - the allowances are issued by an established multi-sector GHG emission reduction program,
        - the covered party is allowed to purchase allowances within that program, and
        - the allowances are derived from methodologies congruent with chapter 173-441 WAC.

2.3.4.1 Own emissions reductions

Covered parties may meet their GHG reduction pathway under the proposed rule by reducing emissions at the covered party location they own or operate. Upon providing verified reporting data for a compliance year, if a covered party's reported emissions level is lower than their established GHG emission reduction pathway under the proposed rule, the covered party may also generate emission reduction units for banking or exchange, equal to the difference between the reported covered emissions level and the GHG reduction pathway.

[8] See proposed WAC 173-442-240 for additional information.

2.3.4.2 Others' emissions reductions

Covered parties may meet their GHG emission reduction pathway under the proposed rule by acquiring emission reduction units generated by other covered parties whose reported covered emissions were lower than their established GHG emissions reduction pathway. These units are generated when other covered parties report emissions below their pathways, and may be banked or traded in the same way that a covered party's own excess reductions may be converted to GHG emission reduction units under the proposed rule.

Parties voluntarily participating in the program may also generate emissions reductions, which may be used by covered parties to comply with the proposed rule. When voluntary participants reduce their GHG emissions, these reductions from their baseline may be banked or traded in the same way as other emission reduction units under the proposed rule.

2.3.4.3 Emissions reduction projects

GHG emission reduction units may be generated by projects, activities, or programs recognized by Ecology.

Projects include certain actions related to:

- Transportation
- Energy
- Livestock
- Waste and wastewater
- Industrial sector activities
- Combined Heat and Power

These projects must meet all of the following criteria.

- **GHG emissions reductions must be real.** A specific, identifiable, and quantifiable reduction of GHG emissions must be demonstrable.
- **GHG emissions reductions must be permanent.** They may not be reversible.
- **GHG emissions reductions must be enforceable.**
- **GHG emissions reductions must be verifiable.** They must be verified according to the reporting and verification procedures required under the proposed rule.
- **GHG emissions reductions must not be required by other laws, rules, or other legal requirement, except where allowed under the proposed rule.** This generally means the reductions are not likely to have occurred under BAU, except where explicitly allowed under the proposed rule. The proposed rule explicitly accepts as reductions, for the purposes of this rule, reductions resulting from:
  - The federal Clean Power Plan
  - Washington's Emission Performance Standard
  - Carbon Dioxide Mitigation Standard for New Power Plants
  - Commute Trip Reduction programs

- The industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals is treated as carbon-neutral when considering how to calculate greenhouse gas emission reductions from these project types.

2.3.4.4 External emissions markets

A covered party may use allowances when Ecology determines the allowances are issued by an established multi-sector GHG emission reduction program, the covered party is allowed to purchase allowances within that program, and the allowances are derived from methodologies congruent with Washington's greenhouse gas reporting program.

2.3.5 Corresponding amendments to other rules

Ecology is also proposing amendments to Chapter 173-441 WAC (Reporting of Emissions of Greenhouse Gases). These amendments correspond to and facilitate requirements and compliance set by the proposed rule. They include:

- Updating adoption by reference dates and citations as required by statute
- Updating terminology and references.
- Adding GHG reporting requirements for petroleum product producers and importers and natural gas distributors
- Adding GHG reporting requirements for suppliers of coal-based liquid fuels, suppliers of industrial greenhouse gases, and importers and exporters of fluorinated greenhouse gases contained in pre-charged equipment or closed-cell foams.
- Adding corresponding third-party verification of GHG reporting requirements for covered parties subject to Chapter 173-442 WAC (the proposed rule).
- Adding a procedure for Ecology to assign a GHG emissions level to covered parties that have not fulfilled their reporting requirements
- Reallocating of fees
    - The existing GHG emissions reporting rule (Chapter 173-441 WAC) requires 75 percent of the reporting program's budget be paid for through facility reporter fees and 25 percent to be paid for through transportation fuel supplier reporter fees.
    - The proposed rule reallocates fees based on full payment by covered facilities, and sets a zero fee for transportation fuel suppliers. It also removes the obligation for voluntary reporters to pay the fee.

Chapter 3: Likely Costs of the Proposed Rule

3.1 Introduction

Ecology estimated the likely costs associated with the proposed rule, as compared to BAU. The proposed rule and BAU are discussed in detail in Chapter 2 of this document. Likely costs of the proposed rule to covered parties arise from:

- Meeting GHG emissions reduction pathways
- Reporting
- Verification
- Changes to reporting fees

Costs to Ecology, in excess of regular business, arise from implementation of the program.

This Chapter also discusses:

- **Compliance cost variability:** How the choice of compliance method affects costs.
- **Compliance cost transfers:** How the choice of compliance method affects which and where compliance expenditures create transfers (benefits to those providing goods, services, or transferring emissions reduction units for compliance).
- **Pass-through costs:** How compliance costs might be passed on or distributed to the public and other parties that are not required to comply with the proposed rule, through interactions in the Washington State economy.

Ecology's standard practice in complying with the APA is to use the following parameters when analyzing a proposed rule:

- A 20-year timeframe. This timeframe allows for inclusion of short-term and long-term impacts.
- Appropriate discount rates. Present values are based on a 2.5 percent discount rate. Ecology would typically use a broader risk-free discount rate for calculating present values, which is currently approximately one percent.[9] To correspond to discount rates for available benefits, however, Ecology chose to use the 2.5 percent discount rate. (See discussion of the discount rate in Appendix B of this document.)

    It is standard practice to use the most appropriate discount rate for the values being discounted over time. Present value calculations on other subjects use a higher discount rate, reflecting contextually appropriate rates such as the rate of return to capital, or inflation rates on bonds used to fund compliance. In this analysis, Ecology could also have used a higher discount rate to reflect, for example, the rate of return covered parties receive from their own capital (the implied interest rate on borrowing from their own

[9] US Treasury Department (2015). Historic rates of return and inflation rates for I-Bonds.

invested capital to pay for compliance activities). Doing so might have caused confusion due to multiple discount rates being used in the analysis, but primarily would have excessively discounted costs passed through to consumers and ratepayers (see section 3.7 for more information on pass-through costs). By using the lower 2.5-percent discount rate, we avoid underestimating the present value of costs to consumers, but potentially overestimate the present value of costs to covered parties.

- Direct impacts of the proposed rule. Cost and benefit considerations are made based on direct impacts. These are typically the primary impacts of a rule, whereas secondary impacts are neither gains nor losses, but transfers within or between industries and professions.
- Indirect and induced impacts of the proposed rule, where appropriate. While the APA does not consider distributional impacts (costs to one party are transferred as benefits to another party), these impacts can be important information for decision makers to understand the context of a rulemaking for parties that are not directly affected by the proposed rule.

3.2 Costs of meeting GHG reduction pathways

To meet their respective GHG emission reduction pathways under the proposed rule, covered parties will need to reduce emissions using some combination of activities that:

- Reduce emissions on-site at the covered party, or obtain the equivalent of similar reductions from other covered or voluntarily participating parties.
- Offset emissions using an in-state emissions reduction project or program, including RECs, as allowed by the proposed rule.
- Purchase emissions allowances through existing carbon markets if allowed by the proposed rule.

Depending on which methods covered parties choose, the range of unit costs (the cost of reducing emissions by one MT) will vary. Ecology expects covered parties to:

- Reduce emissions in a cost-minimizing fashion.
- Account for the types and timing of reductions that are viable on-site (for some covered parties, these might be limited or not exist), the complexity and timing of projects, and the availability of GHG emissions allowances in existing markets.

3.2.1 Unit costs of compliance

There are multiple options available for compliance with the proposed rule, including:

- **On-site emissions reductions.** (This cost range includes the cost of emission reduction units obtained from other covered parties or voluntary participants, created internally.)
- **Emissions reduction projects.** (This cost range includes the cost of emission reduction units obtained from other covered parties or voluntary participants, created through projects.)
- **Market emissions reductions.** Purchasing allowances from existing carbon markets.

- **Emission reduction programs.** (This cost range includes the costs of emission reduction units derived from program activities, with the purchase of RECs as the assumed option.[10])

Each general type of compliance option is associated with a set of unit costs (cost per MT of carbon-equivalent emissions reduction). Ecology surveyed literature, publications, markets, reports, and marginal abatement cost curves to determine a likely range of compliance costs per MT CO_2e, for each of the four groups of compliance options:

- **On-site emissions reductions: $23 – $57 per MT CO_2e**
  Using industry-based marginal costs of GHG emissions reduction reported by the Intergovernmental Panel on Climate Change,[11] Ecology assumed marginal costs of on-site emissions reductions that might be available to covered parties. These included changes to processes and energy use, reductions in non-CO_2 gases, and energy conservation. Ecology then converted reported unit costs of $20 to $50 per MT CO_2e to 2015 US dollars using an index of inflation[12].
- **Emissions reduction projects: $5 – $29 per MT CO_2e**
  Ecology approximated the cost of emissions reduction projects using the existing voluntary market for carbon credits as a proxy. These costs are likely to reflect the breadth of project design and implementation costs. The per-MT low and high prices of voluntary credits in Oregon ($6 to $9 per MT CO_2e) and California ($6 to $10.50 per MT CO_2e) were used to represent ranges of potential costs that might be incurred by projects developed in Washington.[13] Ecology then converted reported unit costs to 2015 dollars using an index of inflation[14].
- **Market emissions reductions: $13 – $14 per MT CO_2e**[15]
  Based on average historic regulatory market prices in California and Quebec, as well as market minimum price regulations, Ecology estimated a range of unit costs per MT purchased from the external markets. Prices in these markets are likely to represent price

[10] Note that the proposed rule includes other programmatic emission reduction options, such as generating ERUs from energy conservation and utilizing the Commute Trip Reduction program to generate ERUs. However, it is assumed that the available quantities of reductions (at least on a cost-effective basis) from these will be small relative to the REC option and as such the REC option is a reasonable proxy for all program-based reductions.
[11] Bernstein, L., J. Roy, K. C. Delhotal, J. Harnisch, R. Matsuhashi, L. Price, K. Tanaka, E. Worrell, F. Yamba, Z. Fengqi, 2007: Industry. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[12] US Bureau of Labor Statistics. Consumer Price Index.
[13] Peters-Stanley, M (2012). Bringing it Home: Taking Stock of Government Engagement with the Voluntary Carbon Market. Forest Trends' Ecosystem Marketplace, March 2012.
[14] US Bureau of Labor Statistics. Consumer Price Index.
[15] There are lower current market prices than this range, but they are in markets with significant volatility and price trajectories that indicate possible significant price growth before stabilization. The Regional Greenhouse Gas Initiative (RGGI; credits from this market are not accepted as emissions reductions under the proposed rule), for example, currently sells emissions allowances for under $7. Historic RGGI prices since its creation, however, and accounting for inflation, indicate that real prices could continue to increase significantly, depending on when they stabilize. Based on a rough calculation of year-over-year price changes, and allowing for 2 percent inflation, for example, RGGI prices would be nearing $11 if they stabilize in 2025. Ecology therefore chose to include the medium-term forecast in this analysis, which is in the $10 – $15 per MT range. If, however, these existing price trajectories continue into 2035, prices could exceed $20 per MT in current dollars.

ranges in markets from which covered parties may purchase credits for compliance with the proposed rule. California carbon futures prices 2011 – 2015 ranged from $11.55 to $23.75 per MT CO_2e, with a median value of $12.84 per MT CO_2e. Quebec minimum prices 2013 – 2015 ranged from CA$10.75 to CA$11.85 per MT CO_2e. Where necessary, we then converted reported unit costs to 2015 US dollars using historic exchange rates[16] and an index of inflation[17].

- **Emission reduction programs (Renewable Energy Credits): $3 – $11 per MT CO_2e**
  This is based on an assumed Renewable Energy Credit (REC) price of $1.50 to $5 per megawatt-hour (MWh). While REC prices before 2012 for wind power in the western US greatly fluctuated and were between $3 and $8 per MWh, these prices fell below $3 per MWh in late 2011, and have stabilized around $1 per MWh through 2016. National REC prices have consistently been near $1 per MWh since 2010. Both sets of prices most recently fell and remained below $1 per MWh since mid-2015. They have since continued to fall.[18] Ecology calculated the implied price of emissions reductions per MT CO_2e for RECs using a value of 970 lbs./MWh (as stated in the proposed rule).

3.2.2 Emission reduction pathway

Emission reduction pathways are defined by the proposed rule. They are based, for individual covered parties, on baseline emissions. To develop the emission reduction pathways, these baseline emissions are then reduced 1.7 percent of baseline emissions each year – 1 2/3 percent permanent reduction, with the remainder going to an emissions reserve. The emissions reserve portion is intended to facilitate compliance by new covered parties, as well as to account for growth in existing covered parties. In this way, the specific emissions reductions required for a covered party are based on that party's individual baseline emissions.

Ecology estimated reduction pathways for likely covered parties in the following ways.

- For parties with recorded emissions data:
  - Based on 2012 through 2015 emissions.[19]
- For petroleum product producers and natural gas distributors:
  - Based on emissions totals from EPA's GHG Reporting Program.[20]
  - Adjusted for Washington conditions.
  - Based on 2012 through 2015 emissions when available.
- For petroleum product importers, for which Ecology does not currently have emissions data:
  - As a group, representing total emissions likely arising from imported products emissions were based on existing data on products being imported to the state.[21]

[16] Canadian Foreign Exchange Services (2015). Yearly Average Exchange Rates for Currencies, from 1990 to 2015.
[17] US Bureau of Labor Statistics. Consumer Price Index.
[18] All historic REC prices: US Department of Energy (2016). Renewable Energy Certificates, REC Prices. http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=5 Voluntary Markets for RECs.
[19] Ecology GHG Reporting Program records.
[20] https://ghgdata.epa.gov/ghgp/main.do
[21] WA Department of Ecology (2015). Preliminary release table of the Washington State Greenhouse Gas Inventory Report for years 2012 and 2013.
WA Department of Commerce (2013). Petroleum Supply and Use in Washington State. October 2013.
WA Department of Commerce (2015). Updated percentage of fuels that is imported to the state. Communication from Neil Caudill on 12/3/2015.

Because the specific emissions intensities per unit of product produced by EITEs is unknown at the time of this rulemaking, Ecology estimated their equivalent emission reduction pathways assuming that their reduction pathways will be set to reduce emissions from EITEs as a whole in line with the requirements for non-EITEs. We therefore assumed annual reductions in units of MT of emissions for all likely covered parties. However, we assumed that reductions among likely EITEs were not required until 2020 and beyond.

Ecology estimated compliance costs tied to required emissions reductions based on these individual emission reduction pathways, and their sums.

3.2.3 Cost of meeting GHG reduction pathways

For each likely covered party, we assumed annual reductions of 1.7 percent, the sum of 1 2/3 percent permanent reduction, and 1/30 percent going toward an emissions reserve. The ultimate fate of these emissions reductions differs – the 1 2/3 percent being a permanent reduction, and the 1/30 percent potentially being eventually emitted by a new covered party or a growing existing covered party. They are therefore reported as separate estimates in this report. Covered parties would incur the costs associated with the entire 1.7 percent at the time of compliance.

3.2.3.1 Permanent emissions reduction

In estimating the cost of the permanent component of emissions reductions, we made the following assumptions:

- Covered parties would need to reduce their emissions by 1 2/3 percent of their baseline emissions each year, beginning in their first year of coverage. Some covered parties enter the program in 2017, and begin emissions reductions in 2018, while other covered parties may not begin reductions until as late as 2033.
- EITE covered parties do not begin emissions reductions until 2020, or their first year of coverage thereafter, and reduce emissions in mass-equivalents of an average of 1 2/3 percent of their baseline each year.
- BAU emissions for each covered party grow in line with expected demand growth. As grouped for this analysis, this average growth was assumed to be:
  - -0.24 percent annually for power producers.[22]
  - +0.75 percent annually for natural gas local distribution companies.[23]
  - -0.42 percent annually for petroleum product producers.[24]
  - +0.25 percent annually for all other covered parties (including EITEs).

[22] Draft Greenhouse Gas Emissions Forecast for Washington, Department of Ecology (updated December 31, 2015). Washington load forecast used for electricity consumption is from Northwest Power and Conservation Council 7th Power Plan: http://www.nwcouncil.org/energy/powerplan/7/technical. Projected reductions from the Energy Independence Act are incorporated into this forecast.

[23] Draft Greenhouse Gas Emissions Forecast for Washington, Department of Ecology (updated December 31, 2015). Energy consumption data are derived from the Pacific Region forecast from the Annual Energy Outlook US Energy Information Administration forecast, as apportioned to WA by the US EPA projection tool: https://www.epa.gov/statelocalclimate/state-inventory-and-projection-tool

[24] Ibid.

- To meet emissions reduction pathways, covered parties would need to reduce the required 1 2/3 percent of baseline each year, plus reduction equivalent to any growth in BAU emissions each year.

Covered party groups, their estimated baselines, and each year's emissions reductions are summarized below. They are followed by each group's estimated baseline emissions growth.

Table 1: Permanent emissions reductions from baseline, by year (MT Co_2e)

Covered Party	Estimated Baseline Emissions	2017 reduction from BL	2018 reduction from BL	2019 reduction from BL	2020 reduction from BL	2021 reduction from BL	2022 reduction from BL	2023 reduction from BL	2024 reduction from BL	2025 reduction from BL	2026 reduction from BL
EITEs	4,127,060	0	0	0	0	62,018	124,035	186,053	249,612	313,171	376,730
Direct Emitters (non-EITE)	7,616,077	0	117,151	234,302	351,453	470,192	588,931	707,671	826,410	945,149	1,063,888
Power Producers covered under CPP	4,369,193	0	72,820	145,640	218,460	291,280	364,099	436,919	509,739	582,559	655,379
Natural Gas LDCs	7,134,371	0	118,906	237,812	356,719	475,625	594,531	713,437	832,343	951,249	1,070,156
Petroleum Producers and Importers	39,159,427	0	551,681	1,103,363	1,655,044	2,307,701	2,960,358	3,613,015	4,265,673	4,918,330	5,570,987
TOTAL	**62,406,127**	**0**	**860,558**	**1,721,117**	**2,581,675**	**3,606,815**	**4,631,956**	**5,657,096**	**6,683,777**	**7,710,459**	**8,737,140**
Covered Party	**Estimated Baseline Emissions**	**2027 reduction from BL**	**2028 reduction from BL**	**2029 reduction from BL**	**2030 reduction from BL**	**2031 reduction from BL**	**2032 reduction from BL**	**2033 reduction from BL**	**2034 reduction from BL**	**2035 reduction from BL**	**2036 reduction from BL**
EITEs	4,127,060	441,772	506,814	571,856	636,897	701,939	766,981	834,578	902,176	969,773	969,773
Direct Emitters (non-EITE)	7,616,077	1,184,074	1,304,259	1,424,445	1,550,200	1,675,955	1,801,711	1,927,466	2,053,221	2,178,977	2,178,977
Power Producers covered under CPP	4,369,193	728,199	801,019	873,839	946,658	1,019,478	1,092,298	1,165,118	1,237,938	1,310,758	1,310,758
Natural Gas LDCs	7,134,371	1,189,062	1,307,968	1,426,874	1,545,780	1,664,687	1,783,593	1,902,499	2,021,405	2,140,311	2,140,311
Petroleum Producers and Importers	39,159,427	6,223,644	6,876,301	7,528,958	8,181,615	8,834,272	9,486,930	10,139,587	10,792,244	11,444,901	11,444,901
TOTAL	**62,406,127**	**9,766,750**	**10,796,361**	**11,825,971**	**12,861,152**	**13,896,332**	**14,931,512**	**15,969,248**	**17,006,984**	**18,044,719**	**18,044,719**

Table 2: Emissions growth from baseline (MT CO_2e)

Covered Party	2017 BL growth	2018 BL growth	2019 BL growth	2020 BL growth	2021 BL growth	2022 BL growth	2023 BL growth	2024 BL growth	2025 BL growth	2026 BL growth
EITEs	0	0	0	37,211	46,513	55,816	66,737	76,271	85,805	97,563
Direct Emitters (non-EITE)	17,573	35,145	52,718	71,244	89,054	106,865	124,676	142,487	160,298	180,278
Power Producers	-10,268	-20,535	-30,803	-41,070	-51,338	-61,606	-71,873	-82,141	-92,408	-102,676
Natural Gas LDCs	53,508	107,016	160,523	214,031	267,539	321,047	374,554	428,062	481,570	535,078
Petroleum Producers and Importers	-139,024	-278,047	-417,071	-657,878	-822,348	-986,818	-1,151,287	-1,315,757	-1,480,226	-1,644,696
TOTAL	**-74,740**	**-149,481**	**-224,221**	**-362,581**	**-453,227**	**-543,872**	**-632,899**	**-723,313**	**-813,727**	**-899,748**
Covered Party	**2027 BL growth**	**2028 BL growth**	**2029 BL growth**	**2030 BL growth**	**2031 BL growth**	**2032 BL growth**	**2033 BL growth**	**2034 BL growth**	**2035 BL growth**	**2036 BL growth**
EITEs	107,319	117,075	126,832	136,588	146,344	162,233	172,373	182,513	196,035	206,353
Direct Emitters (non-EITE)	198,306	216,334	245,223	264,086	282,949	301,813	320,676	339,539	361,764	380,804
Power Producers	-112,944	-123,211	-133,479	-143,746	-154,014	-164,282	-174,549	-184,817	-195,084	-205,352
Natural Gas LDCs	588,586	642,093	695,601	749,109	802,617	856,124	909,632	963,140	1,016,648	1,070,156
Petroleum Producers and Importers	-1,809,166	-1,973,635	-2,138,105	-2,302,574	-2,467,044	-2,631,513	-2,795,983	-2,960,453	-3,124,922	-3,289,392
TOTAL	**-989,722**	**-1,079,697**	**-1,158,811**	**-1,247,950**	**-1,337,089**	**-1,420,096**	**-1,508,852**	**-1,597,608**	**-1,679,619**	**-1,768,020**

3.2.3.2 Emissions reduction going to emissions reserve

In estimating the cost of the component of emissions reductions that would go to a reserve for new and growing covered parties, we made the following assumptions:

- Covered parties would need to reduce their emissions by 1/30 percent of their baseline emissions each year, beginning in their first year of coverage. Some covered parties enter the program in 2017, and begin emissions reductions in 2018, while other covered parties may not begin reductions until as late as 2033.
- EITE covered parties do not begin emissions reductions until 2020, or their first year of coverage thereafter, and reduce emissions in mass-equivalents of an average of 1/30 percent of their baseline each year.

Covered party groups and each year's emissions reductions going toward the emissions reserve are summarized below.

Table 3: Emissions reductions toward reserve (MT CO_2e)

Covered Party	**2017 reservation**	**2018 reservation**	**2019 reservation**	**2020 reservation**	**2021 reservation**	**2022 reservation**	**2023 reservation**	**2024 reservation**	**2025 reservation**	**2026 reservation**
EITEs	0	0	0	0	1,240	2,481	3,721	4,992	6,263	7,535
Direct Emitters (non-EITE)	0	2,343	4,686	7,029	9,404	11,779	14,153	16,528	18,903	21,278
Power Producers	0	1,456	2,913	4,369	5,826	7,282	8,738	10,195	11,651	13,108
NG LDCs	0	2,378	4,756	7,134	9,512	11,891	14,269	16,647	19,025	21,403
Petroleum Products	0	11,034	22,067	33,101	46,154	59,207	72,260	85,313	98,367	111,420
TOTALS	0	17,211	34,422	51,634	72,136	92,639	113,142	133,676	154,209	174,743
Covered Party	**2027 reservation**	**2028 reservation**	**2029 reservation**	**2030 reservation**	**2031 reservation**	**2032 reservation**	**2033 reservation**	**2034 reservation**	**2035 reservation**	**2036 reservation**
EITEs	8,835	10,136	11,437	12,738	14,039	15,340	16,692	18,044	19,395	19,395
Direct Emitters (non-EITE)	23,681	26,085	28,489	31,004	33,519	36,034	38,549	41,064	43,580	43,580
Power Producers	14,564	16,020	17,477	18,933	20,390	21,846	23,302	24,759	26,215	26,215
NG LDCs	23,781	26,159	28,537	30,916	33,294	35,672	38,050	40,428	42,806	42,806
Petroleum Products	124,473	137,526	150,579	163,632	176,685	189,739	202,792	215,845	228,898	228,898
TOTALS	195,335	215,927	236,519	257,223	277,927	298,630	319,385	340,140	360,894	360,894

3.2.3.3 Total present value costs of emissions reductions

Based on estimated reduction pathways for each likely covered party, and the assumptions listed above in sections 3.2.3.1 and 3.2.3.2, we estimated the following ranges of compliance costs for GHG emissions reductions required under the proposed rule. Present values are a means of converting future flows of costs over time to current values. This calculation entails multiplying each year's GHG emission reductions by the unit cost of reductions and converting these values to current dollars using a 2.5 percent discount rate. These values for each year are then summed to calculate the present value.

Using the unit cost ranges discussed in Section 3.2.1 of this document, a 2.5-percent present discount rate, and reductions equal to the sum of pathway emissions reductions and growth (two tables above), we estimated ranges of emissions reduction 20-year present value costs summarized below.

Table 4: 20-year present value costs of permanent emissions reductions

20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction			
ON SITE LOW-PRICE		**MARKET LOW**	
EITEs	$169,936,888	EITEs	$95,928,339
Direct Emitters	$432,919,113	Direct Emitters	$244,380,203
Power Producers	$189,542,030	Power Producers	$106,995,322
NG LDCs	$552,841,511	NG LDCs	$312,075,667
Petroleum Products	$1,356,241,826	Petroleum Products	$765,590,254
TOTAL	$2,701,481,367	TOTAL	$1,524,969,786
ON SITE HIGH-PRICE		**MARKET HIGH**	
EITEs	$424,842,220	EITEs	$102,301,826
Direct Emitters	$1,082,297,781	Direct Emitters	$260,616,845
Power Producers	$473,855,076	Power Producers	$114,104,101
NG LDCs	$1,382,103,777	NG LDCs	$332,810,001
Petroleum Products	$3,390,604,564	Petroleum Products	$816,456,136
TOTAL	$6,753,703,419	TOTAL	$1,626,288,909
PROJECT LOW		**REC LOW**	
EITEs	$46,096,949	EITEs	$25,259,112
Direct Emitters	$117,433,304	Direct Emitters	$64,348,315
Power Producers	$51,415,025	Power Producers	$28,173,185
NG LDCs	$149,963,361	NG LDCs	$82,173,364
Petroleum Products	$367,893,108	Petroleum Products	$201,589,337
TOTAL	$732,801,746	TOTAL	$401,543,314
PROJECT HIGH		**REC HIGH**	
EITEs	$80,669,660	EITEs	$84,147,658
Direct Emitters	$205,508,281	Direct Emitters	$214,368,582
Power Producers	$89,976,293	Power Producers	$93,855,538
NG LDCs	$262,435,881	NG LDCs	$273,750,562
Petroleum Products	$643,812,940	Petroleum Products	$671,570,342
TOTAL	$1,282,403,055	TOTAL	$1,337,692,682

Table 5: 20-year present value costs of emissions reductions toward reserve

20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction			
ON SITE LOW-PRICE		**MARKET LOW**	
EITEs	$2,741,082	EITEs	$1,547,324
Direct Emitters	$7,378,897	Direct Emitters	$4,165,343
Power Producers	$4,501,930	Power Producers	$2,541,312
NG LDCs	$7,351,115	NG LDCs	$4,149,660
Petroleum Products	$38,449,141	Petroleum Products	$21,704,306
TOTAL	$60,422,166	TOTAL	$34,107,945
ON SITE HIGH-PRICE		**MARKET HIGH**	
EITEs	$6,852,706	EITEs	$1,650,129
Direct Emitters	$18,447,243	Direct Emitters	$4,442,088
Power Producers	$11,254,825	Power Producers	$2,710,157
NG LDCs	$18,377,787	NG LDCs	$4,425,363
Petroleum Products	$96,122,854	Petroleum Products	$23,146,342
TOTAL	$151,055,415	TOTAL	$36,374,080
PROJECT LOW		**REC LOW**	
EITEs	$743,544	EITEs	$407,430
Direct Emitters	$2,001,594	Direct Emitters	$1,096,786
Power Producers	$1,221,190	Power Producers	$669,159
NG LDCs	$1,994,058	NG LDCs	$1,092,656
Petroleum Products	$10,429,684	Petroleum Products	$5,715,011
TOTAL	$16,390,070	TOTAL	$8,981,042
PROJECT HIGH		**REC HIGH**	
EITEs	$1,301,202	EITEs	$1,357,302
Direct Emitters	$3,502,789	Direct Emitters	$3,653,809
Power Producers	$2,137,083	Power Producers	$2,229,221
NG LDCs	$3,489,601	NG LDCs	$3,640,052
Petroleum Products	$18,251,948	Petroleum Products	$19,038,864
TOTAL	$28,682,622	TOTAL	$29,919,247

Actual costs depend on the method of compliance chosen, and Ecology assumes that covered parties will choose the lowest-cost option available to them. In order, these are RECs, in-state emissions reduction projects, market purchases, and on-site emissions reductions. Overall, regardless of emissions reduction method chosen:

- Average 20-year present value cost of permanent reductions, across the four compliance options, is between approximately $1.3 billion and $2.8 billion.
- Average 20-year present value cost of reductions going toward the reserve, across the four compliance options, is between approximately $30 million and $62 million.

Present values are based on likely GHG emissions reductions under the proposed rule, through 2036, across all likely covered parties. Emissions levels achieved in 2035 would need to be maintained afterward. The total number of likely covered parties depends on estimated volumes of covered products for importers, and they are included in this calculation as a group based on total likely emissions from imported products.

These estimated cost ranges are based on the assumption that all compliance will be achieved using a single compliance method. In reality, covered parties as a whole will likely use a

combination of these methods, resulting in total compliance costs between the costs depicted in the tables above. Some covered parties – such as natural gas distributors – may have little or no options for on-site compliance, but may still combine project-based, market, and REC reductions.

However, the proposed rule limits the use of allowances (market purchases) for compliance, as summarized below.

Table 6: Maximum use of allowances per covered party, by compliance period

Compliance Period	Allowance Limit per Covered Party
One (2018 – 2020)	100%
Two (2021 – 2023)	100%
Three (2024 – 2026)	50%
Four (2027 – 2029)	25%
Five (2030 – 2032)	15%
Six (2033 – 2035)	10%
After Period Six (2036 +)	5%

This means after the first two compliance periods (six years) access to market allowances is limited, and typical compliance costs are likely to move toward the ranges of costs represented in estimates for in-state project based and on-site emissions reductions, moving typical average costs toward the higher end of the range if primarily on-site reductions are used, or possibly moving costs toward the lower end of the range if low-cost projects are used.

3.2.4 New parties meeting GHG reduction pathways

New parties that meet the definition of covered parties will also need to calculate baseline emissions and meet assigned emissions reduction pathways. Ecology could not confidently estimate the number and emissions attributes of such parties, but assumed they would be similar to existing covered parties. Their individual costs would be in line with those of existing covered parties, scaled by the year they must begin reducing GHG emissions, as well as their baseline emissions. They would face the same sets of emission reduction unit costs discussed above in section 3.2.1, and their entry into the Clean Air Rule program would be facilitated by emissions set aside in the reserve.

3.2.5 Growth in existing covered parties

Because the proposed rule is not an efficiency standard (e.g., setting a maximum amount of GHG emissions allowed per unit of output that a covered party produces) for covered parties that are not EITE parties, the growth of a covered party does not affect the party's compliance obligation under the proposed rule. If the existing covered parties experience growth that is associated with higher GHG emissions, in excess of what is estimated in section 3.2.3 above, it will increase the amount by which they must reduce GHG emissions or acquire GHG emissions reduction units or offsets under the proposed rule. This means costs would be higher than those estimated for this analysis. It also means that the amount of GHG reduction achieved because of the proposed rule would be larger (a larger reduction to reach the GHG emission reduction pathway), so the benefits of the proposed rule would also be correspondingly higher than those estimated in this

analysis. They would face the same sets of emission reduction unit costs discussed above in section 3.2.1, and their emissions growth would be facilitated by emissions set aside in the reserve.

3.3 Costs of reporting

Most covered parties are already required to report GHG emissions under Chapter 173-441 WAC, the Reporting of Emissions of Greenhouse Gases rule. Other covered parties are not current reporters, and future covered parties may also not be current reporters. Parties that do not currently report emissions, but are covered by the proposed rule, will incur the additional costs of submitting an annual GHG emissions report to Ecology.

3.3.1 Business as usual reporting

There are currently 144 parties that report GHG emissions under BAU. There are also 28 transportation fuel suppliers that report GHG emissions under BAU.[25] These parties, regardless of whether they have a compliance obligation under the proposed rule, would continue to report under BAU.

3.3.2 New reporting under the proposed rule

Under the proposed rule, one new natural gas distributor would be a covered party and required to report, as well as between 11 and 18 petroleum product importers.

Ecology estimated reporting costs based on the Environmental Protection Agency's (EPA) estimates of reporting costs[26], adjusted for state-specific wage rates[27] and overhead (loaded wage), and to 2015-dollars[28].

Table 7: First- and Subsequent-Year Reporting Costs per Covered Party

	First year hours	Subsequent Year hours	Loaded wage 2015$	First year total cost	Subsequent year total cost
Senior Management	0.05	0.04	$65.40	$3.27	$2.62
Middle management	1.24	1.08	$62.79	$77.86	$67.81
Junior Engineer/Technician	4.13	3.73	$24.51	$101.24	$91.43
Senior Operator	13.81	13.1	$39.53	$545.93	$517.86
3rd-party Licensed Professional Engineer	8	8	$76.91	$615.27	$615.27
			TOTAL	**$1,343.56**	**$1,294.99**

[25] Ecology GHG Reporting Program records.
[26] Environmental Protection Agency, US (2010). Economic Impact Analysis for the Mandatory Reporting of Greenhouse Gas Emissions Under Subpart W Final Rule (GHG Reporting). November 2010.
[27] US Bureau of Labor Statistics (2014). May 2014 State Occupational Employment and Wage Estimates for Washington State.
[28] US Bureau of Labor Statistics. Consumer Price Index.

3.3.3 Present value cost of reporting

Ecology estimated the total reporting costs arising from the proposed rule. Present values were estimated using a 2.5 percent discount rate.

Table 8: Reporting costs and 20-year present values

REPORTING COSTS						
Entity type	**Quantity**	**Cost per unit**	**Total cost impact**	**Frequency**	**Notes**	**PV 2017-2036**
Facility – Natural Gas distributor	1	$1,344	$1,344	once	First year	$20,235
	1	$1,295	$1,295	annual after 1st year	Subsequent year	
Facility - petroleum product importers	18	$1,344	$24,184	once	First year	$364,233
	18	$1,295	$23,310	annual after 1st year	Subsequent year	

Total present value reporting costs were estimated to be approximately $384,000 over 20 years.

3.3.4 Reporting costs to new covered parties

New parties such as those beginning operations in Washington State, or whose future GHG emissions exceed coverage thresholds, that meet the definition of covered parties will also need to submit annual reports of their GHG emissions. Ecology could not confidently estimate the number and emissions attributes of such parties. Their reporting costs would be in line with those of existing covered parties, scaled by the year their GHG emissions exceed the coverage threshold.

3.4 Costs of Verification

Under the existing GHG reporting rule (Chapter 173-441 WAC), no parties are required to verify their GHG reports to Ecology, so under the proposed rule, all covered parties under Chapter 173-442 WAC will incur the costs of verification. Parties that report under Chapter 173-441 WAC, but are not covered parties under Chapter 173-442 WAC, would not need to verify their reports in either case.

3.4.1 Verification frequency

Verification of reports is required every reporting period under Chapter 173-442 WAC. Covered parties would also need to verify their annual emissions under Chapter 173-441 WAC using a less in-depth procedure during the first two years of each reporting period, and an in-depth verification the third year.

3.4.2 Unit costs of verification

Using a survey of compliance costs[29], Ecology converted typical costs to 2015 dollars using an inflation index.[30] The survey analysis also confirmed approximate costs of verification that had been previously assumed. Regular verification was assumed to cost approximately $600. In-depth verification including a site visit was assumed to cost approximately $19,000.

3.4.3 Verification cost trajectory

The proposed rule requires one in-depth verification for every three-year compliance period under Chapter 173-442 WAC. Covered parties would also need to verify their annual emissions under Chapter 173-441 WAC using a less in-depth procedure during the first two years of the cycle.

3.4.4 Present value of verification costs

Ecology estimated the present value of verification costs using a 2.5 percent discount rate. Assuming the per-verification costs and cycles above, Ecology estimated a total 20-year present value verification cost of the proposed rule of between $33 million and $34 million. The variation is based on how many of the 11 to 18 importers become covered parties.

Table 9: Verification costs and 20-year present values

VERIFICATION COSTS						
Entity type	**Quantity**	**Cost per unit**	**Total cost impact**	**Frequency**	**PV 2017-2036**	**Notes**
All covered entities	184	$554	$101,992	Years 1 and 2 of each cycle	$32,702,702	LOW
	184	$18,846	$3,467,734	Year 3 of each cycle		
All covered entities	191	$554	$105,872	Years 1 and 2 of each cycle	$33,946,826	HIGH
	191	$18,846	$3,599,659	Year 3 of each cycle		

3.4.5 Verification costs to new covered parties

New parties that meet the definition of covered parties will also need to verify their reports of GHG emissions and compliance with emission reduction pathways. Ecology could not confidently estimate the number and specific emissions attributes of such parties, but generally assume they would be similar to existing covered parties. Their verification costs would be in line with those of existing covered parties, with cycles of two lower-cost verifications and one high-cost in-depth verification, scaled by the year their GHG emissions exceed the coverage threshold.

[29] Massachusetts Department of Environmental Protection (2015).Massachusetts Greenhouse Gas Reporting Program: 2014 Verification Review. September, 2015

[30] US Bureau of Labor Statistics. Consumer Price Index.

3.5 Costs of reporting fee reallocation

The proposed rule includes a reallocation of reporting fees:

- Under BAU, 75 percent of the program budget is paid for through facility reporter fees, and 25 percent is paid through transportation fuel supplier reporter fees.
- Under the proposed rule, this distribution shifts to 100 percent of the program budget being paid for through fees paid by reporting covered parties, excluding transportation fuel suppliers.

The total program budget is not dictated by rule, and is not affected by the proposed rule. Any change in total costs will result from additional sources required to report. In addition, costs to some individual sources will increase, while costs for some sources will decrease as a result of the choice. These elements of the proposed rule are inseparable, so Ecology chose to mitigate overestimation caused by including growth in total costs, by assuming future total program costs would grow at the same rate as the present value discount rate, 2.5 percent.

3.5.1 BAU reporting fees

Under BAU, the parties required to comply with the GHG reporting rule (Chapter 173-441 WAC) are:

Table 10: BAU reporting fees

	Count	Individual Fee ($/yr.)	Total ($/yr.)
Current Facilities	144	1,147	165,168
Current Transportation Fuel Suppliers	28	1,444	40,432

3.5.2 Covered parties with higher reporting fees

Under the proposed rule and associated amendments to Chapter 173-441 WAC, there would be:

Table 11: Proposed rule reporting fees

	Count	Individual Fee ($/yr.)	Total ($/yr.)
Facilities	156 to 163 (1 new NG Distributor, 11 to 18 new importers)	2,055 to 2,147 (based on 11 to 18 new importers)	335,000
Transportation Fuel Suppliers	28	0	0

Based on the proposed rule's expansion of fee coverage, fee reallocation, and fee increases, the proposed rule would create costs in the form of increased fees to facilities with BAU reporting coverage, and new fees to newly covered parties.

Table 12: Costs of fee changes, and present values

FEE CHANGES						
Entity type	**Quantity**	**Cost per unit**	**Total cost impact**	**Frequency**	**Notes**	**PV 2017-2036**
Facility - NG distributor	1	$2,055	$2,055	Annual	Low	$32,036
	1	$2,147	$2,147	Annual	High	$33,470
Facility - petroleum product importers	11	$2,147	$23,617	Annual	Low	$368,169
	18	$2,055	$36,990	Annual	High	$576,643
Facilities - Existing coverage	144	908	$130,752	Annual	Low	$2,038,314
	144	1000	$144,000	Annual	High	$2,244,839

Total estimated 20-year present value costs of fee changes are between approximately $2 million (total low) and $3 million (total high).

3.6 Compliance cost transfers

Ecology analyses typically address only direct costs and benefits, but in the case of this rulemaking, multiple comments have already been heard and received concerning the indirect impacts of the proposed rule. For that reason, Ecology chose to discuss payments of costs to other entities, called transfers. Where transfers go – and whether they contribute to the state economy – depends on how covered parties comply with the proposed rule, as well as how they report and verify reports:

- The costs of reporting performed internally may be transferred as additional income to employees, which is re-spent in the state economy on goods and services. Reporting might also be done using consultants, and costs are transferred to consulting firms that re-spend them on goods and services, operating costs, and employee pay in the state economy.
- Verification done by qualified firms creates transfers of verification costs to those firms, who re-spend them on goods and services, operating costs, and employee pay.
- GHG emissions reduction cost transfers depend on the method(s) used by covered parties to reduce their emissions:
    - On-site reductions might employ additional internal labor, contracted services, or purchased goods. Compliance costs would be mitigated by positive economic activity and employment in these other sectors of the state economy.
    - Project-based reductions might employ consultants in contracted design, engineering, partnership, and development services. Compliance costs would be mitigated by positive economic activity in these other sectors of the state economy.
    - Market-based purchases of emissions allowances from external carbon markets would be transfers out of the state. These compliance costs would not likely be mitigated by positive economic activity in other sectors of the state economy.

3.7 Pass-through costs

Ecology analyses typically address only direct costs to the parties that incur them, and benefits to the parties that receive them, but in the case of this rulemaking, multiple comments have already been submitted concerning the likelihood of compliance costs being passed on to consumers and other purchasers of fuels and energy. For this reason, Ecology chose to discuss the issue of pass-through costs in Appendix A of this document.

The appendix provides a technical discussion of how pass-through costs are typically determined, based on measures of the relative responsiveness (elasticity) of supply and demand to changes in price. While many elasticities could not be quantitatively determined (for supply, demand, or both), our review of relative elasticities indicates a high level of pass-through for:

- Petroleum product importers
- Natural gas distributors (long run)
- Petroleum and natural gas systems
- Power plants
- Pulp and paper
- Refineries and petroleum product producers
- Waste facilities

It is important to note that pass-through costs are not in addition to other costs, but are reallocations of costs to other entities. If a covered party in one of the above sectors incurs a compliance cost, it is likely to pass some or all of those costs on to its customers, and the costs will be borne by those parties instead of the covered party. If, for example, an energy supplier incurs costs for reducing GHG emissions, it is likely to pass those costs on to ratepayers.

3.8 Costs of associated emissions increases

There is potential, in certain circumstances, that in the process of reducing GHG emissions to reach the emissions levels in their pathways, covered parties might increase emissions of criteria or toxic air pollutants. While reducing GHG emissions is generally associated with reducing criteria or toxic air pollutant emissions, methods such as capturing methane emissions and combusting the collected product may reduce carbon-equivalent GHG emissions, but increase emissions of chemicals such as nitrogen oxides and fine particulates.[31]

Ecology could not confidently predict the methods covered parties will use to achieve compliance under the proposed rule, but identified some circumstances in which an increase in associated criteria or toxic air pollutant emissions might occur. For example, if GHG emissions from a landfill are captured and combusted, the reduction in carbon-equivalent GHG emissions could be accompanied by increased combustion emissions of nitrogen oxides. A rise in emissions of air pollutants may incur costs, however Ecology is unable to quantify these costs due to

[31] All regulated emissions would still need to meet applicable state and federal air quality regulations.

uncertainty surrounding their source or quantity. Example scenarios under which this might occur, however, are limited, and are constrained by existing air quality regulations.

3.9 Implementation costs to Ecology

The proposed rule requires Ecology to undertake various tasks as part of implementation. Some of these tasks may be "absorbed" into Ecology's existing workload and staffing, but many will likely require additional staffing. Ecology typically does not include internal costs of proposed rules in its analyses, but the proposed rule requires specific, and possibly significant actions be taken by Ecology.

At the time of this publication, Ecology has not yet determined the specific needs for additional implementation staffing, so we cannot estimate this cost quantitatively. However, the likely tasks include efforts to:

- Develop, maintain, and cooperate with technical staff on an on-line registry and reporting tool.
- Register and provide technical support to regulated entities.
- Establish reporting guidance and standards; analyze and publish compliance data.
- Develop and administer GHG third-party verifier program - track and verify certification status, train verifiers on specifics/distinctions of Washington program.
- Analyze and respond to petitions and subsequent appeals from energy intensive and trade exposed entities to modify or exempt their compliance obligation(s).
- Review and verify compliance reports by EPA-mandatory GHG emissions reporting entities, non-EPA, CAR-only entities, and voluntary CAR participants.
- Review with engineering staff third-party verifier reports of emission reduction units generated.
- Validate, monitor and track compliance obligations, the generation, banking, trading, expiration and clear legal ownership of emission reduction units and emission allowances.
- Develop guidance and criteria for the allocation of reserve credits; monitor, track and account for distribution of reserve credits.
- Work with engineering staff to establish baselines, output-based intensity (for EITE entities) benchmark emissions, Ecology-assigned reduction pathways and the development and issuing of regulatory orders.
- When used for compliance, verify emission reductions generated under EPA's Clean Power Plan and Washington's Emission Performance Standard.
- Conduct field work/site visits
- Conduct enforcement activities and issue penalties, as appropriate.
- Coordinate and collaborate with out of state GHG emission reduction programs along with other Washington state agencies to review, monitor and align program policies, strategies, and methodologies, as appropriate for Washington.

- Evaluate and negotiate policy-related issues associated with the development, implementation, and validation of alternative emission reduction projects, activities, programs, and GHG offset protocols.
- Develop, facilitate and monitor strategies and protocols for reporting and tracking acquisition and expiration of allowances from external emission credit programs, registries or exchanges.
- Audit third party verification bodies; review audit reports and conduct independent verification, as needed.
- Identify, collect and evaluate data and calculation methodologies used to determine GHG emissions from various obligated stationary source, motor fuels and natural gas entities' baseline emissions or product-based GHG intensity benchmarks.
- Calculate covered parties' baseline and/or output-based intensity (for EITE entities) benchmark emissions, confirm Ecology-assigned reduction pathway and develop and issue regulatory orders.
- Develop and/or evaluate quantification methods, data quality assessment, and calculation methodologies necessary to qualify and validate transportation, energy, livestock/agricultural, waste and waste water, and industrial sector projects, activities and/or programs used or intended to generate emission reduction units.
- Coordinate with technical staff on review of third-party verifiers' evaluations, quantification methods, data quality assessment, and calculation methodologies used to generate emission reductions derived from Independent Qualified Organizations, or via methodologies that meet the GHG protocol for project accounting.
- Audit third-party verification reports of allowances from other established multi-sector carbon markets that assert to generate emission reduction units.
- Providing management and supervisory support to a new unit or section.

3.10 Summary of the likely costs of the proposed rule

Ecology estimated the costs of the proposed rule relative to BAU. Likely 20-year present value (if quantified) costs included:

- Average 20-year present value cost of permanent reductions is between approximately $1.3 billion and $2.8 billion. (See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.)
- Average 20-year present value cost of reductions going toward the reserve is between approximately $30 million and $62 million. (See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.)
- 20-year present value reporting costs of approximately $384,000.
- 20-year present value verification costs of between approximately $33 million and $34 million.
- Increased reporting fees of between approximately $2 million and $3 million.

Quantified external present-value costs, taking average emission reduction costs across multiple scenarios, total between $1.4 billion and $2.8 billion over 20 years. For a more specific listing of emissions reduction costs by covered party type and compliance method, see Section 3.2.3.3. For

some of the covered parties, these costs are likely to be passed through and borne by their customers.

In addition, Ecology will incur the costs of implementing the proposed rule, as discussed in section 3.10. These costs could not be quantified at this time, and implementation would likely involve a combination of additional full-time employees and work by existing employees.

3.10.1 Average annual emissions reduction costs

Actual costs incurred by a covered party in each year will depend on:

- Their baseline emissions.
- Whether they are an EITE party.
- Which methods they choose to use to meet GHG emissions reduction pathways.

For illustrative purposes, however, Ecology estimated the average likely costs for each group of covered parties, and averaged them over 20 years. Based on this broad simplification, typical covered parties would incur the average annual present-value costs below. Choice of compliance method will determine actual costs, but Ecology assumes that covered parties will reduce emissions using the lowest-cost method available, in the following order: RECs, in-state projects, market purchases, and on-site reductions.

Table 13: Annual average present-value cost of emissions reductions

Annual Average Present Value Cost of Emissions Reductions			
ON SITE LOW-PRICE		**MARKET LOW**	
EITEs	$454,416	EITEs	$256,515
Direct Emitters	$1,223,050	Direct Emitters	$690,404
Power Producers	$970,220	Power Producers	$547,683
NG LDCs	$7,002,408	NG LDCs	$3,952,817
Petroleum Products	$4,358,409	Petroleum Products	$2,460,296
ALL PARTIES	$2,061,122	ALL PARTIES	$1,163,491
ON SITE HIGH-PRICE		**MARKET HIGH**	
EITEs	$1,136,039	EITEs	$273,558
Direct Emitters	$3,057,625	Direct Emitters	$736,275
Power Producers	$2,425,550	Power Producers	$584,071
NG LDCs	$17,506,020	NG LDCs	$4,215,442
Petroleum Products	$10,896,023	Petroleum Products	$2,623,758
ALL PARTIES	$5,152,805	ALL PARTIES	$1,240,793
PROJECT LOW		**REC LOW**	
EITEs	$123,264	EITEs	$67,544
Direct Emitters	$331,764	Direct Emitters	$181,792
Power Producers	$263,181	Power Producers	$144,212
NG LDCs	$1,899,468	NG LDCs	$1,040,825
Petroleum Products	$1,182,259	Petroleum Products	$647,826
ALL PARTIES	$559,098	ALL PARTIES	$306,361
PROJECT HIGH		**REC HIGH**	
EITEs	$215,713	EITEs	$225,013
Direct Emitters	$580,586	Direct Emitters	$605,618
Power Producers	$460,567	Power Producers	$480,424
NG LDCs	$3,324,069	NG LDCs	$3,467,383
Petroleum Products	$2,068,953	Petroleum Products	$2,158,154
ALL PARTIES	$978,422	ALL PARTIES	$1,020,606

Chapter 4: Likely Benefits of the Proposed Rule

4.1 Introduction

Ecology estimated the likely benefits associated with the proposed rule, as compared to BAU (both described in Chapter 2 of this document). Likely benefits include:

- Avoided costs of GHG emissions
- Avoided costs of associated criteria or toxic air pollutant emissions
- Profits from emissions reduction unit sales
- Co-benefits of offset GHG emissions reduction projects
- Benefits of reporting fee reallocation

This Chapter also discusses:

- Carbon benefit variability: Avoided carbon emissions variability and unquantified avoided costs.
- Emission reduction unit sale variability: How the choice of compliance method affects which and where emissions reduction sale benefits occur.
- Co-benefit variability: How the choice of compliance method affects which and where co-benefits of GHG emissions reduction projects occur.
- Pass-through benefits: How compliance expenditures might be passed on or distributed to the public and other parties that are not required to comply with the proposed rule, through interactions in the Washington State economy.

4.2 Avoided costs of GHG emissions

As covered parties reduce their GHG emissions, society will benefit by avoiding various impacts of climate change. Ecology estimated this value using estimates of the social cost of carbon (SCC), and the expected trajectory of GHG reductions as covered parties meet their GHG emission reduction pathways.

4.2.1 The social cost of carbon (SCC)

Ecology quantified the value of reduced GHG emissions using an estimate of the social cost of carbon (SCC) developed and used by the federal government.[32] The SCC is an estimate of the value of the negative impacts to society caused by GHG emissions. The estimate of the SCC

[32] Interagency Working Group on Social Cost of Carbon (2010). Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. February 2010. United States Government. http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf
and
Interagency Working Group on Social Cost of Carbon (2013) Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. May 2013. United States Government.

rises each year, and Ecology chose the model with the annual discount rate of 2.5 percent (see Appendix B for rationale).

Many estimates of the social cost of carbon exist, 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.
- 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 cite 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.[33]

The workgroup follows up in the technical update:

> The 2010 interagency SCC TSD [technical support document] 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 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.[34]

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

[33] Interagency Working Group on Social Cost of Carbon (2010). Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. February 2010. United States Government. http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf

[34] Interagency Working Group on Social Cost of Carbon (2013) Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. May 2013. United States Government.

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 common 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 in discounting social values.

4.2.2 Scope of the SCC for Washington State

Comments received on past rulemaking analyses involving the SCC 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-percent 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.[35] Ecology believes 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

[35] For clarity and consistency, both global costs and benefits are included, where all costs are incurred locally or by entities that operate locally but are located in other states or countries.

> 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.[36]

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

[36] Interagency Working Group on Social Cost of Carbon (2010). Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. February 2010. United States Government. http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf

4.2.3 SCC by year carbon is emitted[37]

Table 14: Interagency Work Group Social Cost of Carbon, per MT, by Year

Year	Average 2007$ at 2.5% discount rate	In 2015$	Year	Average 2007$ at 2.5% discount rate	In 2015$
2015	$58.00	$66.53	2026	$71.00	$81.44
2016	$60.00	$68.82	2027	$72.00	$82.59
2017	$61.00	$69.97	2028	$73.00	$83.74
2018	$62.00	$71.12	2029	$74.00	$84.88
2019	$63.00	$72.27	2030	$76.00	$87.18
2020	$65.00	$74.56	2031	$77.00	$88.33
2021	$66.00	$75.71	2032	$78.00	$89.47
2022	$67.00	$76.85	2033	$79.00	$90.62
2023	$68.00	$78.00	2034	$80.00	$91.77
2024	$69.00	$79.15	2035	$81.00	$92.91
2025	$70.00	$80.30	2036	$82.00	$94.06

4.2.4 GHG emissions reduction trajectory

Ecology estimated total cumulative reductions in GHG emissions from covered parties over the upcoming 20 years. These are the sums of individual party GHG emissions reductions in each year, based on 2012 – 2015 reported emissions and estimates. (See section 3.2.2 for more information on GHG emissions reduction pathways and baseline calculations.)

Table 15: Total permanent emissions reductions by year

Total Permanent Emissions Reductions in Each Year (MT)				
2017	**2018**	**2019**	**2020**	**2021**
-74,740	711,078	1,496,896	2,219,094	3,153,589
2022	**2023**	**2024**	**2025**	**2026**
4,088,084	5,024,197	5,960,464	6,896,732	7,837,392
2027	**2028**	**2029**	**2030**	**2031**
8,777,028	9,716,664	10,667,161	11,613,202	12,559,243
2032	**2033**	**2034**	**2035**	**2036**
13,511,417	14,460,396	15,409,376	16,365,100	16,276,699

[37] There are multiple historic values found for the SCC, varying based on assumptions, inputs, weighting, and discount rates chosen. For other SCC values and surveys of ranges, see for example:

- Tol (2008). The Social Cost of Carbon: Trends, Outliers, and Catastrophes. Economics Vol. 2, 2008-25. August 12, 2008. Mean of peer-reviewed SCCs of $88 to $127, depending on distributional assumptions and sample range among 211 studies, in "around 1995" dollars.
- Clarkson and Deyes (2002). Estimating the Social Cost of Carbon Emissions. Department for Environment, Food, and Rural Affairs, HM Treasury, UK. Available through http://www.hm-treasury.gov.uk. SCC range approximately $2 to $200 (1990$).
- Moore and Diaz (2015). Temperature impacts on economic growth warrant stringent mitigation policy. Nature Climate Change. Published online 12 January 2015. CSS of $220 (2015$).
- Ackerman and Stanton (2012). Climate risks and carbon prices: Revising the social cost of carbon, Economics: The Open-Access, Open-Assessment EJournal, Vol. 6, Iss. 2012-10, pp. 1-25, http://dx.doi.org/10.5018/economics-ejournal.ja.2012-10. SCC of potentially $900 in 2010 and $1,500 in 2050.

Ecology only included the reductions of 1 2/3 percent of baseline emissions in benefits calculations. The additional 1/30 percent (summing to 1.7 percent annual emissions reductions), while not emitted at the time of each required reduction, is potentially emitted by a new covered party or by a growing existing covered party in a future year. Note that negative emissions reductions in 2017 represent circumstances in which negative growth rates reduce emissions in excess of reductions required by the emission reduction pathway, and to meet the pathway, covered parties could have higher emissions if necessary, but could also bank excess emissions reductions for future use.

4.2.5 Present value of avoided GHG emissions

Ecology used standard present value calculations to estimate the present value of avoided GHG emissions over 20 years under the proposed rule, as compared to BAU. Present value calculations convert a stream of future impacts to current values, using a 2.5 percent discount rate. Each year's 2015-dollar value of the SCC (see Section 4.2.4, above) is multiplied by the total estimated GHG emissions reduction in that year (in MT CO2e; see Section 4.2.5, above), and the resulting values for each year are summed.

Based on estimated emissions reductions across covered parties, Ecology calculated a present value benefit using the SCC. The total benefit of the proposed rule, for reductions in GHG emissions, is estimated to be approximately $14.5 billion.[38]

4.2.6 Value of avoided GHG emissions at new covered parties

New parties that meet the definition of covered parties will also need to calculate baseline emissions and meet emissions reduction pathways. Ecology could not confidently estimate the number and emissions attributes of such parties, but assumed they would be similar to existing covered parties. The benefits of their avoided GHG emissions would be in line with the value of other avoided GHG emissions, the SCC discussed above in this Chapter, and would be scaled by the year they must begin reducing GHG emissions, their baseline emissions, and whether emissions reductions from the emissions reserve are used to achieve compliance.

4.3 Avoided costs of associated emissions

Depending on how covered parties meet their GHG emission reduction pathways, there may be associated reductions in other emissions, such as criteria pollutants and toxic air pollutants. It is important to note, however, that there is potential for some means of compliance to increase certain air pollutants as well (see Chapter 3), depending on GHG reduction measures taken.

Associated emissions that might also be reduced include nitrogen oxides, sulfur oxides, fine particulates, and various toxic air pollutants. Avoiding or reducing these emissions may improve air quality and reduce associated health endpoints, such as asthma and other lung disorders, and contributors to certain cancers.

[38] Ecology performed a sensitivity analysis of this result, based on varying the SCC to those calculated using a 3-percent discount rate and a 5-percent discount rate. These alternative sets of SCC values yielded total present value benefits of $10.0 billion and $3.1 billion, respectively.

4.3.1 Quantifiable benefits of avoided emissions

While estimation of actual avoided costs of associated emissions would require knowledge (or confident estimates) of the methods and locations of GHG emissions reduction activities, Ecology provides illustrative estimates of the magnitude of damage per MT of certain criteria pollutants.

The estimates provided here are based on damage costs reported in EPA rulemakings,[39] and are heavily dependent on the location of the avoided emissions:

- On-site reductions in associated emissions benefit local populations. Benefits of these reductions, especially of fine particulate matter ($PM_{2.5}$), depend on variables such as the population density of the area benefitting.
- Off-site projects, or purchased emissions reductions from other covered parties, benefit populations near those reductions.
- Purchases of emissions reduction allowances from out-of-state markets benefit populations near the projects or reductions that created the allowance in the first place.

Ecology provides additional information about populations potentially affected by associated emissions in sections 4.3.2 and 4.3.3 below.

Table 16: Value of damages from select criteria pollutants as reported in EPA rulemakings

Criteria Pollutant	Damages per MT in 2015$
$PM_{2.5}$	$1.45 - 1.6 million
Volatile Organic Compounds (VOCs)	$1,120 - 1,220
Nitrogen Oxides (NOx)	$4,675 - 5,080

4.3.2 Benefitting populations for on-site reductions

When evaluating benefits of on-site reductions of associated emissions, Ecology examined the populations within a three-mile radius of stationary GHG emissions sources expected to be covered and have compliance obligations under the proposed rule.[40] Environmental justice variables were noted.

- **Population:** Surrounding population of stationary sources ranges from roughly 200 to nearly 129,000. (Note: one covered stationary GHG emissions source with a surrounding population of 11 was excluded from the analysis as an outlier; this party is not likely to have on-site reductions of associated emissions.)
- **Minority population:** Two covered stationary GHG emissions sources (with surrounding populations of nearly 2,000 and 129,000) have surrounding minority populations (as a

[39] ICF International (2014). California's Low Carbon Fuel Standard: Compliance Outlook & Economic Impacts. In turn, this cites specifically:
- — US Environmental Protection Agency (2010). Diesel Emissions Quantifier Health Benefits Methodology, EPA, EPA-420-B-10-034, August 2010.
- — EUS Environmental Protection Agency and National Highway Traffic Safety Administration (2011). Draft Joint Technical Support Document: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-D-11-901, November 2011.

[40] US Environmental Protection Agency (2015). EJSCREEN. www.epa.gov/ejscreen. Accessed November 9, 2015.

percentage of total population) in at least the 80th percentile in the state. This means they have higher percentages of minority populations than 80 percent of the state as a whole.

- **Low-income population:** Four covered stationary GHG emissions sources (with surrounding populations between 1,700 and 33,000) have surrounding low-income populations (as a percentage of total population) in at least the 80th percentile in the state. This excludes one outlier party that is not likely to have on-site reductions of associated emissions.
- **Linguistically isolated populations[41]:** Three covered stationary GHG emissions sources (with surrounding populations between 1,200 and 129,000) have surrounding linguistically isolated populations (as a percentage of total population) in at least the 80th percentile in the state. This excludes one outlier party that is not likely to have on-site reductions of associated emissions.
- **Less than high school educated population:** Two covered stationary GHG emissions sources (with surrounding populations of 1,700 and 25,000) have surrounding populations with less than a high school education (as a percentage of total population) in at least the 80th percentile in the state. This excludes one outlier party that is not likely to have on-site reductions of associated emissions.
- **Vulnerable young populations:** One covered party is located in an area that is in the 82nd percentile of vulnerable young populations – children under age 5 as a percentage of total population.
- **Vulnerable elderly populations:** Three covered stationary GHG emissions sources are located in areas in at least the 80th percentile of vulnerable elderly populations – adults over age 64 as a percentage of total population.

The extent to which these populations benefit depends on the types of emissions projects that covered parties use to comply with their GHG reduction pathways.

4.3.3 Benefitting populations for off-site reductions

Off-site GHG emissions reductions might also benefit populations near such projects, through reductions in associated emissions. The extent of this benefit depends on the types of emissions projects that covered parties use to comply with their GHG emission reduction pathways.

Projects that reduce transportation emissions – such as commute trip reduction programs – would benefit primarily populations living near highways and roads. Populations living along major transportation corridors may be disproportionally minority and low-income as compared to the state as a whole. These are some of the same populations that overlap with populations benefitting from on-site reductions.

Other types of transportation emission reduction projects would also benefit vulnerable communities. For example, projects that improve transit service as a means to reduce emissions could offer valuable benefits to these communities since they frequently are more dependent on transit services for mobility than the general population.

[41] Households with all adults speaking a language other than English, and with reduced or limited proficiency in English language.

4.4 Transfers from emission reduction unit sales and reduction services

Covered parties that reduce GHG emissions in excess of what is required under their respective GHG emission reduction pathway, will likely benefit under the proposed rule from sales of those emission reduction units and offsets. Parties that develop GHG reduction programs or offsets for other covered parties will likely benefit from the sales of those offsets.

Ecology typically addresses only direct costs and benefits of proposed rules, but in the case of this rulemaking, multiple comments have already been provided about the indirect impacts of the proposed rule. For this reason, Ecology chose to discuss these payments of costs to other entities, called transfers. Where transfers go – and whether they contribute to the state economy – depends on how covered parties comply with the proposed rule, as well as how they report and verify reports. If transfers of compliance costs occur to entities in state, providing the goods, labor, and services required to reduce GHG emissions on-site or through projects, or to perform reporting or verification tasks, costs are mitigated by positive economic activity in the industries receiving these transfers.

4.5 Co-benefits of emissions reduction projects

Offset projects used to meet GHG emission reduction pathways may also carry co-benefits in forms not directly connected to emissions. Ecology could not confidently identify which reduction methods covered parties would choose under the proposed rule, but identified examples of projects that would provide co-benefits to the public and environment.

For example, energy efficiency projects, such as home insulation improvements for select populations (e.g., low-income households) would reduce energy demand and associated GHG emissions, but could also:

- Relax income and spending constraints for low-income families.
- Improve quality of life.
- Reduce incidence of illness.
- Address lead or mold contamination.
- Reduce use of wood as a fuel and local emissions source, reducing local incidence or exacerbation of asthma and air-quality-related illness. This is particularly notable in areas with high numbers of homes using wood as their primary heat source, or pressed by cost to use wood for heat despite burn bans, in low-income areas.[42]

[42] Tonn, Bruce, et al. (2014). Weatherization Works—Summary of Findings from the Retrospective Evaluation of the US Department of Energy's Weatherization Assistance Program. Oak Ridge National Laboratory. Sept 2014.

Transportation projects, such as commute trip reduction programs, could contribute to co-benefits for those using the program, as well as other commuters, such as:

- Lower fuel costs.
- Contribution to reduced traffic.
- Lower parking and automotive maintenance costs.
- Lower employee stress and improved quality of life.

Other types of emission reduction projects also provide similar co-benefits. Methane management projects can reduce odor issues for communities. Industrial process improvements can have a wide variety of other benefits, including improving safety and reducing the generation of waste. Regardless of the project type, co-benefits are common to emission reduction activities.

4.6 Benefits of reporting fee reallocation

As part of the proposed rulemaking, Ecology is proposing a reallocation of reporting fees in the associated GHG reporting rule (Chapter 173-441 WAC):

- Under BAU, 75 percent of the program budget is paid for through facility reporter fees, and 25 percent is paid through transportation fuel supplier reporter fees.
- Under the proposed rule, this distribution shifts to 100 percent of the program budget being paid for through fees paid by covered party facilities, excluding transportation fuel suppliers.

The total program budget is not dictated by rule, and is not affected by the proposed rule. Any change in total costs will result from additional sources required to report. In addition, costs to some individual sources will increase, while costs for some sources will decrease as a result of the choice Ecology is making to change the proportional share of the budget covered by mandatory versus voluntary reporters. These elements of the proposed rule are inseparable, so Ecology chose to mitigate overestimation caused by including growth in total costs, by assuming future total program costs would grow at the same rate as the present value discount rate, 2.5 percent.

4.6.1 Covered parties with lower reporting fees

Under the proposed rule and associated amendments to Chapter 173-441 WAC, 30 existing transportation fuel suppliers would pay lower fees than under BAU:

- BAU fee: $1,444 per year
- Proposed estimated fee: $0 per year

Table 17: Benefits of reduced fees, and present value

FEE CHANGES					
Entity type	**Quantity**	**Cost per unit**	**Total cost impact**	**Frequency**	**PV 2017-2036**
Transportation fuel suppliers	28	-$1,444	-$40,432	annual	-$630,301

Ecology estimated a total present value benefit of fee reductions of approximately $630,000, over 20 years.

4.6.2 Reporting fee reallocation and new covered parties

New transportation fuel suppliers required to report GHG emissions to Ecology would also have lower fees under this rulemaking than under BAU. They would incur zero fees under the proposed rule. Ecology could not confidently estimate how many such parties might enter the program in the next 20 years.

4.7 Growth in existing covered parties

Because the proposed rule is not an efficiency standard for most covered parties (e.g., setting a maximum amount of GHG emissions allowed per unit of output that a covered party produces), the growth of a covered party does not affect the party's compliance obligation under the proposed rule. If the existing covered parties experience growth that is associated with higher GHG emissions, it will increase the amount by which they must reduce GHG emissions under the proposed rule. This means benefits would be higher than those estimated for this analysis. It also means that the costs of the proposed rule would also be correspondingly higher than those estimated in this analysis.

For EITE covered parties, the proposed rule sets efficiency standards. This means growth in those parties would not increase their required GHG emissions reductions, as long as the efficiency standard was still met.

4.8 Summary of the likely benefits of the proposed rule

The proposed rule provides the following likely benefits, as compared to BAU. Likely benefits include, in 20-year present values where quantified:

- 20-year present value avoided social emissions costs of approximately $14.5 billion.
- Avoided emissions of associated pollutants, with avoided damages per MT of:

Table 18: Value of damages from select criteria pollutants as reported in EPA rulemakings

$PM_{2.5}$	$1.45 - 1.6 million
Volatile Organic Compounds (VOCs)	$1,120 - 1,220
Nitrogen Oxides (NOx)	$4,675 - 5,080

- Improved environmental conditions and possible health improvements for populations surrounding locations where emissions are reduced, especially on-site or in-state project emissions reductions.
- Potential co-benefits of emissions reduction projects, for example through:
  - Energy efficiency for households and businesses
  - Improved transportation efficiency and reduced traffic, reduced parking and maintenance costs for transportation.

- 20-year present value reduced reporting fees, to transportation fuel suppliers, of approximately $630,000.

Quantified present-value benefits, regardless of compliance scenario, total at least $14.5 billion, and are likely significantly higher including the unquantifiable benefits listed above.

Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Summary of the costs and benefits of the proposed rule

Ecology determined that, compared to BAU discussed in Chapter 2 of this document, the proposed rule has the following costs and benefits:

Costs
Likely 20-year present value (if quantified) costs included:

- Average 20-year present value cost of permanent reductions is between approximately $1.3 billion and $2.8 billion. (See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.)
- Average 20-year present value cost of reductions going toward the reserve is between approximately $30 million and $62 million. (See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.)
- 20-year present value reporting costs of approximately $384,000.
- 20-year present value verification costs of between approximately $33 million and $34 million.
- Increased reporting fees of between approximately $2 million and $3 million.

Quantified external present-value costs, taking average emission reduction costs across multiple scenarios, total between $1.4 billion and $2.8 billion over 20 years. For a more specific listing of emissions reduction costs by covered party type and compliance method, see Section 3.2.3.3. For some of the covered parties, these costs are likely to be passed through and borne by their customers.

In addition, Ecology will incur the costs of implementing the proposed rule, as discussed in section 3.10. These costs could not be quantified at this time, and implementation would likely involve a combination of additional full-time employees and work by existing employees.

Benefits
Likely benefits include, in 20-year present values where quantified:

- 20-year present value avoided social emissions costs of approximately $14.5 billion.
- Avoided emissions of associated pollutants, with avoided damages per MT of:

Table 19: Value of damages from select criteria pollutants as reported in EPA rulemakings

$PM_{2.5}$	$1.45 - 1.6 million
Volatile Organic Compounds (VOCs)	$1,120 - 1,220
Nitrogen Oxides (NOx)	$4,675 - 5,080

- Improved environmental conditions and possible health improvements for populations surrounding locations where emissions are reduced, especially on-site or in-state project emissions reductions.
- Potential co-benefits of emissions reduction projects, for example through:
  - Energy efficiency for households and businesses
  - Improved transportation efficiency and reduced traffic, reduced parking and maintenance costs for transportation.
- 20-year present value reduced reporting fees, to transportation fuel suppliers, of approximately $630,000.

Quantified present-value benefits, regardless of compliance scenario, total at least $14.5 billion, and are likely significantly higher including the unquantifiable benefits listed above.

5.2 Conclusion

Ecology concludes, based on reasonable understanding of the quantified and qualitative costs and benefits likely to arise from the proposed rule, that the benefits of the proposed rule are likely greater than the costs.

Chapter 6: Least-Burdensome Alternative Analysis

6.1 Introduction

RCW 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." The referenced 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;
> (d) 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 statute being implemented;

In other words, to be able to propose and adopt the rule, 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(s).

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

6.2 Goals and objectives of the authorizing statutes

Ecology has developed the proposed rule under Chapter 70.94 RCW (the Washington Clean Air Act) and consistent with Chapter 70.235 RCW (Limiting Greenhouse Gas Emissions).

Chapter 70.94 RCW includes the following sections:

- RCW 70.94.011 states that it is the intent of this Chapter to maintain levels of air quality that protect human health and to comply with the requirements of the Federal Clean Air Act.
- RCW 70.94.141 states the powers of any activated authority in addition to any other powers vested in them by law. This section gives Ecology the authority to issue orders to execute the purposes of this Chapter.
- RCW 70.94.151 directs Ecology to adopt greenhouse gas reporting rules.
- RCW 70.94.331 requires Ecology to adopt rules establishing emission standards, air quality objectives, and air quality standards.
- RCW 70.94.850 allows Ecology to establish an emissions credit-banking program.

Chapter 70.235 RCW includes the following sections:

- RCW 70.235.005 notes that, "It is the intent of the legislature that the state will: (a) Limit and reduce emissions of greenhouse gas consistent with the emission reductions established in RCW 70.235.020; (b) minimize the potential to export pollution, jobs, and economic opportunities; and (c) reduce emissions at the lowest cost to Washington's economy, consumers, and businesses."
- RCW 70.235.020 establishes statewide GHG emission reductions.
- RCW 70.235.040 requires Ecology to consult with the Climate Impacts Group at the University of Washington within eighteen months of the next and each successive global or national assessment of climate change science, and provide a report to the legislature summarizing that science and make recommendations regarding whether the GHG emissions reductions required under RCW 70.235.020 need to be updated.

6.3 Alternatives considered and why they were not included

As part of this rulemaking, Ecology considered alternatives to the rule content being proposed. Ecology considered the alternatives below; the rationale behind not including them in the proposed rule is also given.

- **Broader applicability (e.g., to include all products)**
  - GHG emissions from mobile sources are indirectly covered as part of petroleum product producers' and importers' compliance obligation.
  - Long range marine and aviation sources are excluded because the vast majority of the emissions occur outside the state, and in-state emissions represent a small percentage of statewide emissions.
  - Emissions associated with electricity that is imported into the state generally occur out-of-state.
- **Broader baseline-determination range**
  - While using a larger number of years to determine baseline emissions might be less burdensome for some covered parties, representative, verifiable data is not available for years before 2012. Washington's first reporting year was 2012.

- EPA GHG reporting data begins in 2010, but due to interim changes, is not sufficiently representative of actual emissions until the 2012 reporting year.

- **Require all emissions be on site**
  - Allowing compliance only through on-site emissions reductions would be more burdensome, and would limit the ability to comply with the proposed rule. Emission reduction projects and programs give covered parties choices to make reductions at the lowest cost.
  - Petroleum product producers, importers, and natural gas distributors cannot reduce emissions from their products, except through reduced production or consumption.
- **Not including natural gas or petroleum products as covered emissions categories**
  - Excluding natural gas and petroleum would dramatically reduce the scope of the GHG emissions reduction program.
  - Limiting coverage would severely limit the ability to achieve the goals and objectives of the authorizing statutes.
- **Linking the Washington State program directly to existing market programs**
  - The rule provides the possibility for one-way linkage to existing systems.
  - The rule is not able to establish an allowance system, which would be required for full linkage between this program and cap-and-trade systems.
  - Existing market programs differ fundamentally in their definitions, requirements, restrictions, and standards, as compared to the Washington GHG reporting program and the proposed rule.
- **Efficiency-based emissions standards for all covered parties**
  - Under a standard that sets maximum GHG emissions per unit of output or product, total emissions could increase. There would be no cap.
  - This would limit the ability to meet the goals and objectives of the authorizing statutes.
  - Efficiency-based emissions standards for EITEs are intended to efficiently achieve emissions reductions similar to reductions required for other covered parties, as a whole. Limiting this approach to a small percentage of total emissions and adding a reserve allows the program to still have an overall cap.
- **Excluding petroleum product importers from coverage**
  - Inclusion of petroleum product importers expands the coverage of the program, and limits behaviors that would reduce its effectiveness.
  - Excluding petroleum product imports from coverage would create incentives to move production out of state, or to export and re-import products to avoid coverage under the proposed rule.
  - This would limit the ability to meet the goals and objectives of the authorizing statutes.
- **Include petition system for energy-intensive and trade-exposed (EITE) covered parties.**
  - A petition system provides additional uncertainty for EITE coverage under the proposed rule which does not aid in long-term business planning. Uncertainty may create incentives to move production out of the state.
  - If covered parties are forced to close facilities or move them out of state, it limits the ability of the proposed rule to meet the goals and objectives of the authorizing statute,

especially if covered parties move to locations without GHG emissions reduction programs. This would also inherently be more burdensome.

- **A different threshold for coverage**
  - Based on known emissions below the proposed threshold, a lower threshold would be more administratively burdensome through expanding the number of covered parties while not appreciably reducing emissions. It would also not increase the quantity of covered emissions in a way that significantly improved ability to meet the goals and objectives of the authorizing statutes.
- **A higher rate of emission reductions over time**
  - A rate of GHG emissions reduction that is higher than 1 2/3 percent would be more burdensome to covered parties. A higher rate would also drive larger reductions sooner, and increase incentives to acquire out-of-state emissions. Allowing more time to spread out emissions reductions also allows time for development of on-site and in-state emissions reduction projects that will benefit the local economy and local populations.[43]
- **A lower rate of emission reductions over time**
  - A rate of GHG emissions reduction that is lower than 1 2/3 percent would achieve fewer reductions. The proposed rule is intended to at a minimum achieve the statutory reductions in Chapter 70.235 RCW, which would not be possible with a lower rate.

6.4 Conclusion

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

[43] While we might have assumed that covered entities will choose the compliance option of acquiring all GHG emissions reductions from out-of-state markets, there are inherent benefits to reducing GHG emissions locally that may mitigate higher direct compliance costs. These include, but are not limited to, community and public relations (marketing) benefits, as well as reduced annual operating costs of efficiency improvements. For this reason, we assumed that covered entities would also consider higher direct cost GHG emissions projects that also benefit local populations or the entities themselves. Not setting a higher rate of GHG emissions reductions over time supports the development of such projects.

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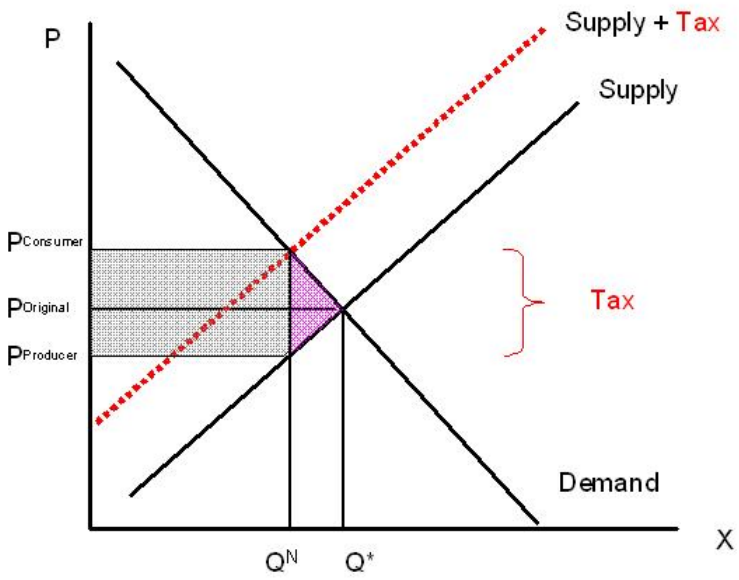
Appendix A: Pass-Through Costs

Cost pass-through describes the process of a firm increasing the price of goods or services it provides to consumers in response to any increase in its costs. Pass-through is usually measured as a percentage of the cost increase. Generally, a firm attempting to maximize its profits will pass through as much of their cost increases as possible. How much pass-through occurs depends on several factors, primarily how responsive the seller and buyer are to changes in price. This is called the price elasticity of supply and the price elasticity of demand respectively.

A.1 Economic Discussion - Theory and Practice

The concept of cost pass-through is usually discussed in the area of tax incidence in the supply/demand paradigm. If a per-unit tax is levied on an industry, it acts to shift the supply curve for the firm (or industry) straight upward by exactly the amount of the tax as shown below in Figure 1.[44] This is true for any increase in the per-unit costs or production.

Figure 1: Pass-through



The difference between P(original), the pre-tax price, and P(consumer), the after-tax price charged to consumers is the amount passed through to the consumer. Pass-through is measured as a percentage of the total cost increase of the tax. It should be noted that this difference is less than the entire amount of the cost increase. If a firm is acting to maximize profits, it will attempt to pass through as much of the cost increase as possible in all cases.

[44] http://www.econport.org/econport/request?page=web_experiments_modules_taxes_lecture

The share of cost increases able to be passed on to consumers is impacted by several factors. These factors are captured by the concept of elasticity. Elasticity measures how price responsive the firm is (in the case of the Price elasticity of Supply, Es) and the consumers are (in the case of the Price elasticity of Demand, Ed).

The more price responsive demand is, the less able the firm is to pass along cost increases. The more price responsive firms are, the more able they are to pass along cost increases. The final share of pass-through is determined by comparing the price responsiveness of demanders and suppliers. A general relationship between pass-through and price responsiveness can be written as follows:

$$Pass-through = \frac{Price\ responsiveness\ of\ Supplier}{Price\ responsiveness\ of\ Demander + Price\ responsiveness\ of\ Supplier} = \frac{Es}{Ed + Es}$$

Note that Es and Ed are numbers. Therefore, the ratio can be written as a percentage. Percentages closer to zero are called inelastic; percentages closer to or above one are called elastic. The more elastic, or the higher the percentage, the greater share of the cost increase that is passed through to consumers.

While there are several things that will impact the price elasticities of supply and demand, a few are most relevant to the current discussion. On the demand side, the availability of substitutes, or lack thereof, will make an item more or less price responsive. On the supply side, capacity constraints will make the item less price responsive. On both sides, the more general your definition of the good or service in question, the less responsive it will be. Time will also impact responsiveness, in the long run, goods are more responsive than in the short run. For a full discussion of pass-through, please see RBB Economics (2014).

When discussing industry-specific pass-through, it is necessary to discuss the relevant Ed and Es. Estimates exist for these measures for many industries, more so on the demand side than the supply side. However, it must be noted that these will only act as estimates. The true responsiveness of a given industry for a specific geographic location (e.g. the refining industry for Washington State) could differ from estimates from a different or larger sample.

A.2 Industry-specific pass-through discussion

For the current analysis, pass-through shares are estimated based on available data. Where data is not available, discussion is offered on the likely price responsiveness. The key determinant of pass-through rates is how responsive one side is when compared to the other.

Each of the relevant industries are limited to activities that occur within Washington State. The industry categories include:

- Chemicals
- Food Production
- Petroleum Product Importers
- Manufacturing
- Metals
- Minerals
- Natural Gas Distributors
- Petroleum and Natural Gas Systems

- Power Plants
- Pulp and Paper
- Refineries and Petroleum Product Producers
- Waste

A.2.1 Chemicals

The firm in this category deals in fertilizer. Hansen (2004) found the Ed for this industry to be 0.45. No estimates of Es were found. It is unclear whether Ed or Es would be more responsive in this case.

A.2.2 Food Production

At this extreme level of aggregation, estimates of Es and Ed could not be found.

A.2.3 Petroleum Product Importers

There are two scenarios where petroleum products would be imported into Washington State:

1. Imported products are cheaper than non-imported products
2. There is not enough non-imported products available to the market.

Each case indicates that Es is significantly more responsive than Ed.

This indicates a high level of pass-through.

A.2.4 Manufacturing

At this extreme level of aggregation, estimates of Es and Ed could not be found.

A.2.5 Metals

At this extreme level of aggregation, estimates of Es and Ed could not be found.

A.2.6 Minerals

At this extreme level of aggregation, estimates of Es and Ed could not be found.

A.2.7 Natural Gas Distributors

Aurora (2014) discusses available estimates in the literature for both Ed and Es. He finds short-run Ed ranges from .10 to .16 and long-run Ed ranges from .24 to .29. Also, Es ranges from 0.01 to 0.26 in the short-run and 0.08 to 0.96 in the long-run.

Given the ranges of estimates (as well of overlap in the ranges), it is unclear how much pass-through would occur in the short-run. However, in the long-run, a significant level of pass-through is likely.

A.2.8 Petroleum and Natural Gas Systems

The demand facing these industries illustrate derived demand, meaning that their demand follows directly from the demand for gasoline, natural gas, and electricity (for which natural gas is an input for production). Each of these industries has a very inelastic Ed. EIA (2014) place the short-run Ed at .02, with the long-run Ed at 0.6. Genc (2004) analyses available estimates for

power and found a range of .02 - .08 for Ed. Aurora (2014) discusses available estimates for both Ed and Es in the natural gas industry and found short-run Ed ranges from .10 to .16 and long-run Ed ranges from .24 to .29.

No viable estimates for Es in the petroleum and natural gas systems industry were found, however they are likely much more responsive than Ed.

This indicates a high level of pass-through.

A.2.9 Power Plants

Genc (2004) analyses available estimates for power and found a range of .02 - .08 for Ed. Though no viable estimates for Es were found, capacity constraints likely make it somewhat inelastic. However, the extreme inelasticity of Ed makes it very likely that Es is much more responsive than Ed.

This indicates a high level of pass-through.

A.2.10 Pulp and Paper

The pulp and paper industry has faced significant competition in recent years from electronic alternatives to print media. Those demanders that were able to use substitutes have likely done so at this point, leaving a demand that has few viable alternatives, indicating a fairly inelastic demand. Brown (2004) estimates a short-run Es of roughly 1 and a long-run Es of 2.2 for the industry.

This indicates a high level of pass-through.

A.2.11 Refineries and Petroleum Product Producers

The demand facing refineries and product producers is a *derived* demand, meaning that their demand follows directly from the demand for gasoline. EIA (2014) place the short-run Ed at .02, with the long-run Ed at 0.6. Though no viable estimates for Es were found, capacity constraints likely make it inelastic. However, the extreme inelasticity of Ed makes it very likely that Es is much more responsive than Ed.

This indicates a high level of pass-through.

A.2.12 Waste

The primary firms in this category are landfills. OECD (2004) found that available estimates of the Ed for landfills clustered tightly around 0.2, indicating a highly unresponsive demand. No relevant estimates for Es were found. It is highly likely that Es is inelastic, given the strict regulatory environment for the industry, particularly in the short-run. However, the extreme inelasticity of Ed makes it very likely that Es is much more responsive than Ed.

This indicates a high level of pass-through.

A.3 Appendix Sources

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Appendix B: Discount rates for SCC

In choosing a discount rate for the broad set of social values underlying the SCC, Ecology chose the rate nearest the social rate of time preference (SRTP) typically used for Ecology analyses. There are also additional arguments in favor of using the 2.5 percent discount rate (the lowest rate for which the federal government estimated SCC), made in the Washington State Department of Commerce memo quoted extensively below.[45]

> "Below are five justifications for why we recommend using a 2.5% discount rate.
>
> 1. **Align with OFM Real Discount Rate**: RCW 39.35.030(9) "'Life-cycle cost' means the initial cost and cost of operation of a major facility over its economic life. This shall be calculated as the initial cost plus the operation, maintenance, and energy costs over its economic life, reflecting anticipated increases in these costs discounted to present value at the current rate for borrowing public funds, as determined by the office of financial management." When choosing the discount rate column for public decision-making processes it can be argued that agencies should choose the column of data that most closely matches the current real discount rate established by the Washington State Treasury and published by the Office of Financial Management within the Washington State Life Cycle Cost Tool. The current real discount rate of .9% indicates that the column of data associated with the 2.5% discount is the closest match.
>
> 2. **Anticipate Additional External Costs**: The federal SCC values do not include all expected external costs of carbon dioxide equivalent emissions. Instead they focus just on the impacts which could be clearly monetize (sic) at the time of the study. For this reason the SCC is expected to increase over time as additional impacts are monetized and a greater scope of social costs are applied to those impacts already monetized. This trend can be seen in the 2013 revision of the 2010 SCC values. Note the 2013 3% column is roughly equal to the 2010 2.5% column. An argument could be made that we can stay ahead of this trend by choosing the higher SCC values represented by the 2.5% discount rate.

[45] Washington State Department of Commerce (2014). The Social Cost of Carbon: Washington State Energy Office Recommendation for Standardizing the Social Cost of Carbon when used for Public Decision-Making Processes. Interagency memo from Tony Usibelli, Washington State Energy Office. Dated 11/04/2014.

2010 Published SCC (2007$)

Discount Rate	5%	3%	2.5%	3%
Year	Avg	Avg	Avg	95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

2013 Published SCC (2007$)

Discount Rate	5.0%	3.0%	2.5%	3.0%
Year	Avg	Avg	Avg	95th
2010	11	32	51	89
2015	11	37	57	109
2020	12	43	64	128
2025	14	47	69	143
2030	16	52	75	159
2035	19	56	80	175
2040	21	61	86	191
2045	24	66	92	206
2050	26	71	97	220

3. **Incorporate Intergenerational Discount Rates**: The discount rate applied to GHG emissions is an "intergenerational discount rate" applied to society as a whole. An intergenerational discount rate is not well represented by private sector discount rates which seek profit, or the cost of governments to obtaining capital in a low-risk environment. The papers below discuss some of the scientific thinking surrounding the challenge of discounting intergenerational costs. There is no clear conclusion on what value should be used but generally it is agreed that the value should be much lower than private sector discount rates. This is why the SCC tables do not present data for discount rates above 5% despite the fact many profit-seeking institutions use discount rates from 8-15%.

   ...

4. **Recognize Public Responsibility**: Overestimating the SCC for public asset decision-making processes will result in more energy efficient buildings and vehicles which reduce operational costs, increase resiliency to price

spikes, and reduce the government's contribution to climate change. However, these benefits are obtained at a higher upfront capital cost than was warranted due to the overestimation. Underestimating the SCC results in less energy efficient buildings and vehicles, larger operation costs, and a greater contribution to climate change. Both overestimating and underestimating the SCC lead to a net economic loss to society.

Game Theory		Value Chosen	
		2.5%	3%
Correct Value	2.5%	Optimal Desgin	Wasted money, higher operational costs, higher costs to society
	3%	Wasted money, lower operational costs, lower costs to society	Optimal Design

Game theory points out that there is a higher risk associated with underestimating the SCC than there is with overestimating the SCC as it is easier to operate an efficient asset in a low cost environment than it is to operate an inefficient asset in a high cost environment. As much of the risk associated with underestimating the SCC falls on society, public entities are under a unique responsibility to mitigate the risk associated with underestimation.

5. **Washington State Leads on Climate Issues**: The federal interagency working group that developed the SCC table provided no guidance as to which discount rate should be used for government design and procurement processes. However, many federal processes reference the 3% discount rate as the "central estimate". This may simply mean that it is the middle of the three proposed discount rates but it has led to the 3% rate being the more commonly quoted value for federal processes. As Washington State wants to lead on climate issues it makes sense for us to adopt the lower 2.5% discount rate column, and the higher associated social cost of carbon, for our public building design and vehicle acquisition processes."