DEPARTMENT OF
ECOLOGY
State of Washington

Final Cost-Benefit and Least-Burdensome Alternative Analysis

Chapter 173-442 WAC,
Clean Air Rule

Chapter 173-441 WAC
Reporting of Emissions of Greenhouse Gases

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Final Cost-Benefit and Least-Burdensome Alternative Analyses

Chapter 173-442 WAC
Clean Air Rule

Chapter 173-441 WAC
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 adopted 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 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 Clean Air Rule (CAR) establishes GHG emissions standards for:

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

The threshold that determines whether a party must comply with this rule changes over time. For 2017, if a party's average carbon-dioxide equivalent emissions for the last 3 years are 100,000 metric tons (MT) or higher, they are considered a covered party, and have a compliance obligation under this rule. The covered party will need to limit and reduce GHG emissions over time, through 2035. They must afterward maintain the reduction achieved in 2035. The threshold for determining for coverage under the rule drops 5,000 MT every three years through 2035, increasing the number of covered parties over time.

Covered parties with compliance obligations under the rule must report compliance after every three-year compliance period, and have their 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 in order to generate ERUs as approved by Ecology.

Ecology determined that, compared to business as usual, the rule has the following costs and benefits, and that the likely benefits exceed the likely costs.

Costs

Average costs of permanent reductions

Table 1: 20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction

20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction			
ON SITE (including purchases from other covered parties)		**MARKET**	
Low	$2,701,481,367	Low	$1,524,969,786
High	$6,753,703,419	High	$1,626,288,909
PROJECT		**RECs**	
Low	$732,801,746	Low	$401,543,314
High	$1,282,403,055	High	$1,337,692,682

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types.

Average cost of reductions going toward the reserve

Table 2: 20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction

20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction			
ON SITE (including purchases from other covered parties)		**MARKET**	
Low	$60,422,166	Low	$34,107,945
High	$151,055,415	High	$36,374,080
PROJECT		**RECs**	
Low	$16,390,070	Low	$8,981,042
High	$28,682,622	High	$29,919,247

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.

Additional costs

- 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.
- Ecology will also incur the costs of implementing the rule. Implementation of the Clean Air Rule will involve a combination of additional full-time employees and work by existing employees. Ecology currently estimates additional costs of approximately $1.3 million in the current biennium, with $4.5 million in ensuing biennia.

Benefits

- 20-year present value avoided social cost of carbon impacts of approximately $10 billion (at a 2.5-percent discount rate comparable to cost calculations; the full range is $2 – 18.6 billion, depending on discount rate and focus on severe impacts). This quantified value excludes impacts to elements of:
  - Health
  - Agriculture
  - Oceans
  - Forests
  - Ecosystems
  - Productivity
  - Water availability
  - Flooding
  - Transportation
  - Energy supply
  - Catastrophic and tipping point impacts
  - Inter- and intra-regional conflict

Table 3: 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

- 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.

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

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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 adopted 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, as well as input received during the public comment period for this rulemaking.

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 adopted rule

The 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 Clean Air Rule (CAR) establishes GHG emissions standards for:

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

The threshold that determines whether a party must comply with this rule changes over time. For 2017, if a party's average carbon-dioxide equivalent emissions for the last 3 years are 100,000 metric tons (MT) or higher, they are considered a covered party, and have a compliance obligation under this rule. The covered party will need to limit and reduce GHG emissions over time, through 2035. They must afterward maintain the reduction achieved in 2035. The threshold for determining for coverage under the rule drops 5,000 MT every three years through 2035, increasing the number of covered parties over time.

Covered parties with compliance obligations under the rule must report compliance after every three-year compliance period, and have their 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 in order to generate ERUs as approved by Ecology.

1.3 Reasons for the rule

The reason for this 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.[1,2] Washington has experienced long-term climate change impacts consistent with those expected from climate change.[3] 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.

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[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] *Massachusetts, et al., Petitioners v. Environmental Protection Agency, et al.*(2007). 549 U.S. 497, 127 S. Ct. 1438, 167 L. Ed. 2d 248.
[3] 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.

- 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.

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

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

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Chapter 2: Business as Usual and the Adopted Rule

2.1 Introduction

Ecology analyzed the impacts of the adopted rule relative to business as usual (BAU), within the context of all existing requirements (federal and state laws and rules). This BAU context reflects the most likely regulatory circumstances that parties would face if the rule was 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 new rule (Chapter 173-442 WAC) and amendments to the existing GHG reporting rule (Chapter 173-441WAC).

For this 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 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 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 rule also considers future compliance with state implementation of the federal Clean Power Plan (CPP) as compliance with 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.

2.3 Rule requirements

This rulemaking establishes:

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

The following types of emissions are not covered as stationary sources by the 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 (CO_2) 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).

Exemptions may be based on existing federal and state laws or definitions, or based on coverage under other parts of the rule.[5] Exemptions may also be for protocols that are less established or for CO_2 that is not actually emitted.

[5] 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)

2.3.1.2 Covered petroleum product producer or importer emissions

The 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,[6] for producers or importers distributing petroleum 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 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 destination of the product is outside of Washington State

2.3.1.3 Covered natural gas distributor emissions

The rule covers CO2 emissions from the complete combustion or oxidation of certain natural gas products. These are products from natural gas distributors that are covered under 40 CFR Part 98, Subpart NN 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 rule, or
- Units or processes exempted because they are covered under the Clean Power Plan.

2.3.2 Thresholds for compliance obligation under the 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), most parties with covered GHG emissions must comply with the rule starting in 2017, with the exception of EITEs and petroleum product importers who must comply starting in 2020. Emissions used for threshold comparisons are determined using a three-year rolling average of their actual emissions beginning in 2012.

[6] http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40tab_02.tpl

2.3.2.2 New emitters

Parties with covered GHG emissions must comply with the rule starting in their first year of operation, if they exceed the following thresholds:[7]

- 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 rolling average of annual total covered GHG emissions.

2.3.3 Clean Air Rule requirements

The rule establishes the following new 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 rule requires parties that exceed the thresholds discussed above (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, can instead choose to be subject to output-based carbon intensity requirements and reductions. Also, the compliance obligation begins in 2020 for EITE covered parties and petroleum importers.

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

- In the first year a covered party has a compliance obligation under the rule, the emission reduction pathway establishes allowable emissions at the baseline GHG emissions calculated for the covered party.[8]
- In subsequent years in which a covered party must comply with the 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.[9]

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[7] Emissions in the first year of operation may be based on emissions data or an engineering analysis.
[8] See WAC 173-442-060 for specific data and processes to be used.
[9] 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 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.

Parties covered as EITEs are instead required to meet output-based carbon intensity requirements. Under the rule:

- EITE covered parties will be required to report annual production data.
- Ecology will calculate the output-based baseline of the EITE party.
- Ecology will determine the efficiency intensity distribution for each sector of covered EITE.
- Ecology will determine each covered EITE's efficiency reduction rate, grouping covered EITEs into:
    - 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 75^{th} 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.[10]
- Covered EITEs are not required to reduce emissions until at least the 2020-2022 compliance period.

Generally, the three-tiered set of emissions reduction requirements will 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 rule, each covered party must submit a compliance report in the emission year following each compliance period. The report must contain the following records:

- **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 transaction.

2.3.3.3 Verification of compliance

The rule requires that emissions reductions 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

[10] EITE reductions under the adopted rule must be within 1 percentile of the average reduction. The least efficient EITEs will not be required to reduce more than 2.7% per year, and the most efficient will have to achieve at least 0.7% per year.

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 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 rule requires Ecology to develop an emission reduction unit registry, using information reported by covered parties as part of their compliance with the rule under Chapter 173-442 WAC.[11] 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 rule by reducing emissions in any of the following ways.

- **On-site emissions reductions:** This can include the following types of reductions:
    - **Reductions of th**eir own emissions: Reduction of a covered party's own emissions below the emissions level set in the covered party's reduction pathway.
    - Others' emissio**ns reductions:** A covered party may acquire emissions reduction units from another covered party that has reduced GHG emissions in excess of what is required of them. 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 rule. Emission reductions from projects can come from ownership of a project or from greenhouse gas credits available in markets for environmental commodities.

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

- **Market emissions reductions** A covered party may purchase allowances derived from emission market trading programs in other jurisdictions when Ecology determines:
  - The allowances are issued by an approved 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.
- **Emissions reduction programs:** Emission reduction programs can come from several state-run programs, including acquiring renewable energy credits (RECs), i.e., existing energy credits generated by power producers using in-state renewable energy production.

2.3.4.1 On-site reductions: Reducing their own emissions

Covered parties may satisfy requirements of their GHG reduction pathway under the 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 emission reduction pathway under the 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.

2.3.4.2 On-site Reductions: Others' emissions reductions

Covered parties may meet their GHG emission reduction pathway under the 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 rule.

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

2.3.4.3 Emissions reduction projects

GHG emission reduction units may be generated by in-state projects and activities 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 rule.
- **GHG emissions reductions must not be required by other laws, rules, or other legal requirement, except where allowed under the rule.** They also must meet supplementary requirements found in the protocols that exist for different types of projects. This generally means the reductions are not likely to have occurred under BAU, except where explicitly allowed under the rule. The rule explicitly accepts 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. Emissions reductions programs

GHG emission reduction units may be generated by projects and activities recognized by Ecology. Emission reduction programs can come from several state-run programs, including acquiring renewable energy credits (RECs), i.e., existing energy credits generated by power producers using in-state renewable energy production. As with emissions reduction projects, they 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 rule.
- **GHG emissions reductions must not be required by other laws, rules, or other legal requirement, except where allowed under the rule.** They also must meet supplementary requirements found in the protocols that exist for different types of projects. This generally means the reductions are not likely to have occurred under BAU, except where explicitly allowed under the rule. The rule explicitly accepts 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

2.3.4.5 Market emissions reductions

A covered party may use allowances to obtain emission reductions when Ecology determines the allowances are issued by an approved 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

As part of this rulemaking, Ecology is also adopting amendments to Chapter 173-441 WAC (Reporting of Emissions of Greenhouse Gases). These amendments correspond to and facilitate requirements and compliance set by the new Chapter 173-442 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 new 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
    - Prior to these amendments, the GHG emissions reporting rule (Chapter 173-441 WAC) required 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 amended rule reallocates fees based on full payment by covered facilities (as covered in section 120 of the rule), and sets a zero fee for transportation fuel suppliers (covered in section 130). It also removes the obligation for voluntary reporters to pay the fee.

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Chapter 3: Likely Costs of the Rule

3.1 Introduction

Ecology estimated the likely costs associated with the rule, as compared to BAU. The rule contents and BAU are discussed in detail in Chapter 2 of this document. Likely costs of the 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 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 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 risk-free discount rate for calculating present values, which is currently approximately one percent.[12] 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 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

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

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 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 rule, where appropriate**. While the APA does not consider distributional impacts (where 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 rule.

3.2 Costs of meeting GHG reduction pathways

To meet their respective GHG emission reduction pathways under the 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 rule.
- Purchase emissions allowances through existing carbon markets if allowed by the 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 rule, including:

- **On-site emissions reductions.** This cost range includes the cost of emission reduction units obtained from other covered parties or voluntary participants.
- **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 Renewable Energy Credits (RECs) as the assumed option.[13]

[13] Note that the 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

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,[14] Ecology assumed marginal costs of on-site emissions reductions that might be available to covered parties and voluntary participants. 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[15].
- **Emissions reduction projects: $6 – $11 per MT CO_2e**
  Ecology approximated the cost of emissions reduction projects based on prices from one compliance program (Oregon CO_2 standard) that utilizes the “voluntary” market for carbon credits (like the CAR), and another that did so in its formative stage (California cap-and-trade).[16] These costs are likely to reflect the breadth of project design and implementation costs. The per-MT low and high prices of compliance credits in Oregon ($6 to $9 per MT CO_2e) and pre-compliance credits in 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.[17] Ecology then converted reported unit costs to 2015 dollars using an index of inflation[18].
- **Market emissions reductions: $13 – $14 per MT CO_2e**[19]
  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 ranges in markets from which covered parties may be able to purchase credits for compliance with the rule. California carbon futures prices 2011 – 2015 ranged from

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.

[14] 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.

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

[16] Current prices for offset credits from the California cap-and-trade program are not a good proxy because, (1) offset credit prices are now heavily influenced by the allowance price rather than solely the costs of the projects (which wasn’t the case initially) and, (2) the CAR does not accept offset credits from the California program.

[17] Peters-Stanley, M (2012). Bringing it Home: Taking Stock of Government Engagement with the Voluntary Carbon Market. Forest Trends’ Ecosystem Marketplace, March 2012.

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

[19] 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 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. If, however, these existing price trajectories continue into 2035, prices could exceed $20 per MT in current dollars.

$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[20] and an index of inflation[21].

- **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.[22] Ecology calculated the implied price of emissions reductions per MT CO_2e for RECs using a conversion of 2 ¼ RECs per metric ton of emission reduction (as stated in the rule).

3.2.2 Emission reduction pathway

Emission reduction pathways are defined by the rule. They are based on baseline emissions for each covered party. To develop the emission reduction pathways, baseline emissions are reduced 1.7 percent of baseline emissions each year – 1 2/3 percent permanent reduction, plus 1/30 percent 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 all likely covered parties in the following ways.

- For parties with recorded emissions data as part of the GHG Reporting Program:
    - Based on 2012 through 2015 emissions.[23]
- For petroleum product producers and natural gas distributors where data was available:
    - Based on emissions totals from the Environmental Protection Agency's (EPA's) GHG Reporting Program.24
    - Adjusted for Washington conditions.
    - Based on 2012 through 2015 emissions.
- 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.[25]

[20] Canadian Foreign Exchange Services (2015). Yearly Average Exchange Rates for Currencies, from 1990 to 2015.
[21] US Bureau of Labor Statistics. Consumer Price Index.
[22] 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.
[23] Ecology GHG Reporting Program records.
[24] https://ghgdata.epa.gov/ghgp/main.do
[25] WA Department of Ecology (2015). Preliminary release table of the Washington State Greenhouse Gas Inventory Report for years 2012 and 2013.

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

Energy Intensive Trade Exposed (EITE) covered party emissions reductions

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. This is consistent with the intent of the EITE provisions in the rule, to impose more-stringent requirements on carbon-inefficient covered parties, less-stringent requirements on highly carbon-efficient covered parties, and regulate those that have carbon efficiency between the 25th and 75th percentile for their industry to fall in line with the mass-based reductions required for non-EITE covered parties.[26] We assumed that all covered parties that are likely to be EITEs will choose to be covered as EITEs. Reductions among EITEs are not required until 2020 and beyond.

We did not assume that covered parties were more likely to shut down as a result of the rule. The EITE provisions are specifically intended to provide flexibility for covered parties vulnerable to costs of energy use and competition, to prevent resulting shutdown. Moreover, incremental production costs are one of a number of factors influencing covered party operations, including existing and planned capital investments, tax, land-use, and other regulatory structure, geographic and transportations considerations, and other components of production cost such as labor and resource access.

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.[27] Some covered parties enter the program in 2017, and begin emissions reductions from baseline in 2018, while other covered parties may not begin reductions until as late as 2033. Note that this means

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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.

[26] EITE emissions reductions under the adopted rule have to be within 1 percentile of the average reduction. The least efficient EITEs will not be required to reduce more than 2.7% per year, and the most efficient will have to achieve at least 0.7% per year.

[27] Note that required reductions will be based on actual emissions relative to baseline, and reductions will not be required if actual emissions are below the baseline emissions average.

covered parties with positive growth in emissions in 2017 would need to reduce emissions sufficiently to meet their baseline target.

- EITE covered parties[28] 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.29
    - +0.75 percent annually for natural gas local distribution companies.30
    - -0.42 percent annually for petroleum product producers.31
    - +0.25 percent annually for all other covered parties (including EITEs).[32]
- 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.

[28] Covered parties choosing to be covered as EITEs.
[29] 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.
[30] 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
[31] Ibid.
[32] Ibid. provides an average emissions growth rate of -0.6 percent growth for total industrial emissions, and does not provide non-fuel-based and non-energy-based emissions growth rates for non-industrial covered parties. Ecology therefore assumed a small positive growth rate for all other covered party emissions to conservatively allow for growth at those unrepresented parties.

Table 4: 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 Reductio n from BL	2025 Reductio n 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 Reductio n from BL**	**2035 Reductio n 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	10,792,24 4	11,444,90 1	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**	**17,006,98 4**	**18,044,71 9**	**18,044,719**

Table 5: 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.[33] Some covered parties enter the program in 2017, and begin emissions reductions from baseline in 2018, while other covered parties may not begin reductions until as late as 2033. Note that this means covered parties with positive growth in emissions in 2017 would need to reduce emissions sufficiently to meet their baseline target.
- 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.

[33] See section 3.2.3 for discussion of total 1.7 percent emissions reductions, including reductions for the reserve.

Table 6: 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 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 7: 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 (including purchases from other covered parties)		**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 (including purchases from other covered parties)		**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		**PROGRAM (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		**PROGRAM (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 8: 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 (including purchases from other covered parties)		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 (including purchases from other covered parties)		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		PROGRAM (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		PROGRAM (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

Present values are based on likely GHG emissions reductions under the 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 petroleum 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 emissions reduction purchases from other covered parties and voluntary participants, and from project-based, market, and REC reductions.

However, the rule limits the use of allowances (market purchases) to generate emission reductions for compliance, as summarized below.

Table 9: Maximum use of allowances per covered party, by compliance period

Compliance Period	Allowance Limit per Covered Party
One (2017-2019)	100%
Two (2020 – 2022)	100%
Three (2023 – 2025)	50%
Four (2026 – 2028)	25%
Five (2029 – 2031)	15%
Six (2032 – 2034)	10%
After Period Six (2035 +)	5%

This means after the first two compliance periods (six years) access to market allowances is limited. If market-based compliance was the primary method of compliance during those periods, typical compliance costs in subsequent compliance periods are likely to move toward the ranges of costs represented in estimates for in-state project/program and on-site emissions reductions. This would move typical average costs up if primarily on-site reductions are used instead of market-based purchases, or moving costs down if low-cost projects and programs are used instead.

Because we do not assume a specific compliance mix, these limitations do not affect the costs estimated in this analysis. Since we report low-end and high-end costs for different types of compliance pathway, these limitations mean that the allowance purchase-based compliance cost range becomes less likely to represent actual compliance costs over time, as parties move to comply using other compliance options such as project-based emissions reductions, or on-site (including purchasing from other covered parties and voluntary participants) with costs better represented by the estimated cost ranges for those compliance pathways.

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 reductions set aside in the reserve.

3.2.5 Growth in existing covered parties

Because the rule is not an efficiency standard (it does not set a maximum amount of GHG emissions allowed per unit of output) for non-EITE covered parties, the growth of a covered party does not affect the party's compliance obligation under the 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 under the 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 rule would be larger (a larger reduction to reach the GHG emission reduction pathway), so the benefits of the 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.

3.2.6 Supply of emissions reduction units

Ecology did not produce a formal projection of credit availability. Instead, Ecology used professional judgement, state agency expertise, and widely available data sources to provide context for the range of ERU-generation opportunities available to covered parties. Examples of data sources include information from the Energy Information Administration, Washington Department of Agriculture, Washington State University Energy Extension, Climate Action Reserve, American Carbon Registry, and the State of California. Appendix D contains examples of existing and future ERUs.

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 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.[34] These parties, regardless of whether they have a compliance obligation under the rule, would continue to report under BAU.

[34] Ecology GHG Reporting Program records.

3.3.2 New reporting under the rule

Under the 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[35], adjusted for state-specific wage rates[36] and overhead (loaded wage), and to 2015-dollars[37].

Table 10: 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**

3.3.3 Present value cost of reporting

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

Table 11: Reporting Costs and 20-Year Present Values

<table>
<tr><th colspan="7">REPORTING COSTS</th></tr>
<tr><th>Entity type</th><th>Quantity</th><th>Cost per unit</th><th>Total cost impact</th><th>Frequency</th><th>Notes</th><th>Present Value 2017-2036</th></tr>
<tr><td rowspan="2">Facility – Natural Gas distributor</td><td>1</td><td>$1,344</td><td>$1,344</td><td>once</td><td>First year</td><td rowspan="2">$20,235</td></tr>
<tr><td>1</td><td>$1,295</td><td>$1,295</td><td>annual after 1st year</td><td>Subsequent year</td></tr>
<tr><td rowspan="2">Facility - petroleum product importers</td><td>18</td><td>$1,344</td><td>$24,184</td><td>once</td><td>First year</td><td rowspan="2">$364,233</td></tr>
<tr><td>18</td><td>$1,295</td><td>$23,310</td><td>annual after 1st year</td><td>Subsequent year</td></tr>
</table>

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

[35] US Environmental Protection Agency (2010). Economic Impact Analysis for the Mandatory Reporting of Greenhouse Gas Emissions Under Subpart W Final Rule (GHG Reporting). November 2010.

[36] US Bureau of Labor Statistics (2014). May 2014 State Occupational Employment and Wage Estimates for Washington State.

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

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 are expected to 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

As part of this rulemaking, a new section on third party verification is added to the GHG reporting rule (Chapter 173-441 WAC). Previously, no parties were required to verify their GHG reports to Ecology. 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, do 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 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[38], Ecology converted typical costs to 2015 dollars using an inflation index.[39] The survey analysis also confirmed approximate costs of verification that had been previously assumed. A regular verification was assumed to cost approximately $600. An in-depth verification including a site visit was assumed to cost approximately $19,000.

3.4.3 Verification cost trajectory

The 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 rule of between $33 million and $34 million. The variation is based on how many of the 11 to 18 importers become covered parties.

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

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

Table 12: 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		

* Includes 11 importers covered.

** Includes 18 importers covered.

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.

3.5 Costs of reporting fee reallocation

The 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 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 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 how they choose to comply. These elements of the rule are inseparable, so Ecology chose to mitigate overestimation caused by including growth in total costs, by assuming future total reporting 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 13: 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 rule and associated amendments to Chapter 173-441 WAC, parties and their fees per year are:

Table 14: 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 rule's expansion of fee coverage, fee reallocation, and fee increases, the rule it creates costs in the form of increased fees to facilities with BAU reporting coverage, and new fees to newly covered parties.

Table 15: 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, we heard and received multiple comments concerning the indirect impacts of the rule. For this reason, we are choosing to discuss in this analysis 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 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 Indirect costs (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, Ecology received multiple comments concerning the secondary impacts to Washington's economy, through industry interrelationships, market adjustments, and energy prices. For this reason, Ecology chose to discuss the issue of secondary costs in Appendix A of this document.

The appendix provides ranges of macroeconomic, income, and employment impacts associated with the direct costs estimated in this document. It also contains 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.

It is important to note that pass-through costs are not in addition to other costs, but are reallocations of costs to other entities within the state, or transferred out of the state.

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.[40]

Ecology could not confidently predict the methods covered parties will use to achieve compliance under the 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 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 rule requires Ecology to undertake various tasks as part of implementation. Some of these tasks may be accomplished by shifting existing workload and staffing, but many will likely require additional resources and staffing. Ecology typically does not include internal costs of rules in its analyses, but the 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 mandatory GHG emissions reporting parties, and voluntary CAR participants.
- Review with engineering staff third-party verifier reports of emission reduction units generated.

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

- 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.
- 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.
- Provide management and supervisory support to a new unit or section.

Implementation of the Clean Air Rule will involve a combination of additional full-time employees and work by existing employees. Ecology currently estimates additional costs of approximately $1.3 million in the current biennium, with $4.5 million in ensuing biennia.[41]

3.10 Summary of the likely costs of the rule

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

Average costs of permanent reductions

Table 16: 20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction

20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction			
ON SITE (including purchases from other covered parties)		MARKET	
Low	$2,701,481,367	Low	$1,524,969,786
High	$6,753,703,419	High	$1,626,288,909
PROJECT		RECs	
Low	$732,801,746	Low	$401,543,314
High	$1,282,403,055	High	$1,337,692,682

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types.

Average cost of reductions going toward the reserve

Table 17: 20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction

20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction			
ON SITE (including purchases from other covered parties)		MARKET	
Low	$60,422,166	Low	$34,107,945
High	$151,055,415	High	$36,374,080
PROJECT		RECs	
Low	$16,390,070	Low	$8,981,042
High	$28,682,622	High	$29,919,247

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.

Additional Costs

- 20-year present value reporting costs of approximately $384,000.

[41] Ecology internal estimates, based on types of work required, and comparison to existing carbon reduction programs in other jurisdictions.

- 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.
- Ecology will also incur the costs of implementing the rule. Implementation of the Clean Air Rule will involve a combination of additional full-time employees and work by existing employees. Ecology currently estimates additional costs of approximately $1.3 million in the current biennium, with $4.5 million in ensuing biennia.

3.10.1 Average annual emissions reduction costs

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

- Their baseline emissions.
- Which type of covered party they are:
    - EITE[42]
    - Direct Emitter
    - Power Producer
    - Natural gas local distribution companies (NG LDCs)
    - Petroleum Products
- Actual emissions in a given year.
- 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.

[42] EITE covered parties were assumed to reduce emissions in line with the mass-based reductions required of non-EITE covered parties, with emissions reductions not required before 2020.

Table 18: Annual Average Present-Value Cost of Emissions Reductions

Annual Average Present Value Cost of Emissions Reductions			
ON SITE LOW-PRICE (including purchases from other covered parties)		**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 (including purchases from other covered parties)		**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		**PROGRAM (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		**PROGRAM (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 Rule

4.1 Introduction

Ecology estimated the likely benefits associated with the rule, as compared to BAU (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 and reduction services
- Co-benefits of GHG emissions reduction projects and programs
- 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 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.[43] The SCC is an estimate of the value of the negative impacts to society caused by GHG emissions. The estimate of the SCC rises each year, and Ecology chose the model with the annual discount rate of 2.5 percent (see Appendix B for rationale), and discounted both costs and benefits to present values accordingly. For context of the range of possible results, we also provide estimates based on SCC for 3% and 5% discount rates, as well as the upper 95th percentile SCC estimates for the 3% discount rate, better representing catastrophic impacts. See Section 4.2.3 for SCC estimates.

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, some parties question the use of the SCC Ecology uses here, 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 Interagency Workgroup (IWG) 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

[43] 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. Revised July 2015.

> the following section, are necessary to consider when interpreting and applying the SCC estimates.[44]

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.[45]

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

Uncertainty is 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 because it attempts to broadly deal with some of these uncertainties, because it was developed by a wide range of federal experts, and because Ecology wanted to use the estimate that utilizes the inputs most-closely resembling those typically made in Ecology analyses in discounting social values.

[44] 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 Several federal agencies contributed to the Working Group, including the Council of Economic Advisors, the Council on Environmental Quality, the Department of Agriculture, the Department of Commerce, the Department of Energy, the Department of Transportation, the Environmental Protection Agency, the National Economic Council, the Office of Energy and Climate Change, the Office of Management and Budget, the Office of Science and Technology Policy, and the Department of the Treasury.

[45] 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.

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.[46] 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. Ecology believes the use of a global SCC is the appropriate carbon cost to use in analyses, because of the unique nature of carbon and climate change. This has been reaffirmed at the federal level multiple times:

- The Interagency Working Group addresses global SCC (as well as OMB guidance), and states in its 2015 revised Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis:[47]

> Under current OMB guidance contained in Circular A-4, analysis of economically significant proposed and final regulations from the domestic perspective is required, while analysis from the international perspective is optional. However, the climate change problem is highly unusual in at least two respects. First, it involves a global externality: emissions of most greenhouse gases contribute to damages around the world even when they are emitted in the United States. Consequently, to address the global nature of the problem, the SCC must incorporate the full (global) damages caused by GHG emissions. Second, climate change presents a problem that the United States alone cannot solve. Even if the United States were to reduce its greenhouse gas emissions to zero, that step would be far from enough to avoid substantial climate change. Other countries would also need to take action to reduce emissions if significant changes in the global climate are to be avoided. Emphasizing the need for a global solution to a global problem, the United States has been actively involved in seeking international agreements to reduce emissions and in encouraging other nations, including emerging major economies, to take significant steps to reduce emissions. When these considerations are taken as a whole, the interagency group

[46] 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.

[47] Interagency Working Group on Social Cost of Carbon (2015) Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. May 2013. United States Government. May 2013, revised July 2015.

> concluded that a global measure of the benefits from reducing U.S. emissions is preferable.

- The 2015 Technical Support Document refers back to the 2010 Technical Support Document – Social Cost of Carbon for Regulatory Impact Analysis for further discussion, including the topic of whether it is permissible under law:[48]

> As a matter of law, consideration of both global and domestic values is generally permissible; the relevant statutory provisions are usually ambiguous and allow selection of either measure.[6] [Footnote 6: It is true that federal statutes are presumed not to have extraterritorial effect, in part to ensure that the laws of the United States respect the interests of foreign sovereigns. But use of a global measure for the SCC does not give extraterritorial effect to federal law and hence does not intrude on such interests.]

- Regarding the 7 to 23 percent scaling to domestic (US) SCC, the 2010 TSD states outright that, "It is recognized that these values are approximate, provisional, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time." The same is true for any output-based scaling to state, region, county, or other geographic level.

- The IWG responded to support of global SCC:[49]

> A number of commenters supported the IWG's decision to base the SCC estimates on global damages. Commenters explained that climate change is a global commons problem because carbon pollution does not remain within one country's borders, and that the use of global damages in the SCC is consistent with the economic theory of the commons. One commenter further stated that if damage estimates are limited to only those within each country's borders, any actions based on those estimates would lead to a collective failure to optimally mitigate GHG emissions. Another commenter referred to the importance of this effect by stating that the consideration of global damages in domestic rulemaking can be based on an expectation of reciprocity from other countries. Several commenters stressed the importance of the use of global SCC estimates as a tool in international negotiations. Finally, some commenters offered other reasons for considering damages in regions outside of the United States, including liability, national security concerns, trade-related "spillover effects", and the principle in international environmental law of reducing cross-border harm.

[48] 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.

[49] Interagency Working Group on Social Cost of Carbon (2015). Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis. July 2015.

Response

The IWG agrees that a focus on global SCC estimates in RIAs is appropriate. As discussed in the 2010 TSD, the IWG determined that a global measure of SCC is appropriate in this context because emissions of most greenhouse gases contribute to damages around the world and the world's economies are now highly interconnected. To reflect the global nature of the problem, the SCC incorporates the full damages caused by CO2 emissions and we expect other governments to consider the global consequences of their greenhouse gas emissions when setting their own domestic policies.

The IWG also agrees that if all countries acted independently to set policies based only on the domestic costs and benefits of carbon emissions, it would lead to an economically inefficient level of emissions reductions which could be harmful to all countries, including the United States, because each country would be underestimating the full value of its own reductions. This is a classic public goods problem because each country's reductions benefit everyone else and no country can be excluded from enjoying the benefits of other countries' reductions, even if it provides no reductions itself. In this situation, the only way to achieve an economically efficient level of emissions reductions is for countries to cooperate in providing mutually beneficial reductions beyond the level that would be justified only by their own domestic benefits. By adopting a global estimate of the SCC, the U.S. government can signal its leadership in this effort. In reference to the public good nature of mitigation and its role in foreign relations, thirteen prominent academics noted that these "are compelling reasons to focus on a global SCC" in a recent article on the SCC (Pizer et al., 2014). In addition, as noted by commenters, there is no bright line between domestic and global damages. Adverse impacts on other countries can have spillover effects on the United States, particularly in the areas of national security, international trade, public health and humanitarian concerns.

- In its response to public comments (Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis, July 2015), the IWG also responded to concerns regarding domestic damages:

> A number of commenters suggested that the use of global damages creates a mismatch between estimates of costs and benefits in agency RIAs. Use of a global rather than domestic SCC may overstate the net benefits to the United States of reducing emissions, because global benefits are compared to domestic costs. A policy that appears cost-justified from a global perspective may not be from a purely domestic U.S. perspective. Therefore, these commenters suggest that a global SCC is only appropriate when the analysis considers global costs and benefits in the context of a global carbon mitigation program.

Other commenters indicated that the IWG should update and report domestic climate damages separately from global estimates for several reasons, including the public's right to know the domestic benefits of domestic regulatory actions. A few comments stated that the IWG should more clearly articulate that the SCC includes global damages, which they felt was particularly unclear in the 2013 TSD.

Finally, commenters also addressed the provisional range of domestic damages that was presented in the 2010 TSD. Several comments stated that the range discussed in the 2010 TSD for the domestic SCC was too high. Two commenters suggested a range for the domestic share of total global damages of 6 to 8.7 percent based on a paper by Nordhaus (2011). One commenter stated that the methods used to estimate the domestic damages as 7 to 23 percent of global damages is too speculative for quantification of the SCC.

Response
As stated in the prior section, GHG emissions in the United States will have impacts abroad, some of which may, in turn, affect the United States. For this reason, a purely domestic measure is likely to understate actual impacts to the United States. Also, as stated above, the IWG believes that accounting for global benefits can encourage reciprocal action by other nations, leading ultimately to international cooperation that increases both global and U.S. net benefits relative to what could be achieved if each nation considered only its own domestic costs and benefits when determining its climate policies.

Further, as explained in the 2010 TSD, from a technical perspective, the development of a domestic SCC was greatly complicated by the relatively few region-or country-specific estimates of the SCC in the literature, and impacts beyond our borders have spillover effects on the United States, particularly in the areas of national security, international trade, and public health. As a result, it was only possible to include an “approximate, provisional, and highly speculative” range of 7 to 23 percent for the share of domestic benefits in the 2010 TSD. This range was based on two strands of evidence: direct domestic estimates resulting from the FUND model, and an alternative approach under which the fraction of GDP lost due to climate change is assumed to be similar across countries. We note that the estimated U.S. share of global damages based on the Nordhaus (2011) study cited by several commenters largely falls within the provisional range offered in the 2010 TSD.

> In conclusion, the IWG believes that the only way to achieve an efficient allocation of resources for emissions reduction on a global basis is for all countries to base their policies on global estimates of damages and will therefore continue to recommend the use of global SCC estimates in regulatory impact analyses. The IWG will also continue to review developments in the literature, including more robust methodologies for estimating SCC values based on purely domestic damages, and explore ways to better inform the public of the full range of carbon impacts, both global and domestic.

- On August 8^{th}, 2016, the US Court of Appeals for the Seventh Circuit issued a ruling supporting not only the use of SCC, but the use of global SCC values (Zero Zone, Inc., et al. v. United States Department of Energy, et al., Nos. 14-2147, 14-2159, & 14-2334, Argued September 30, 2015 — Decided August 8, 2016)

> AHRI and Zero Zone next contend that DOE arbitrarily considered the *global* benefits to the environment but only considered the *national* costs. They emphasize that the EPCA only concerns "national energy and water conservation." 42 U.S.C. § 6295(o)(2)(B)(i)(VI). In the New Standards Rule, DOE did not let this submission go unanswered. It explained that climate change "involves a global externality," meaning that carbon released in the United States affects the climate of the entire world. 79 Fed. Reg. at 17,779. According to DOE, national energy conservation has global effects, and, therefore, those global effects are an appropriate consideration when looking at a national policy. *Id.* Further, AHRI and Zero Zone point to no global costs that should have been considered alongside these benefits. Therefore, DOE acted reasonably when it compared global benefits to national costs.

- Additionally, the US EPA and NHTSA have consistently used the global SCC in multiple joint regulatory impact analyses, including:
    - "Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Regulatory Impact Analysis". EPA-420-R-11-901, August 2011.
    - "Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Regulatory Impact Analysis", for years 2012-2016. EPA-420-R-10-009, April 2010.
    - "Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards". EPA-420-R-12-016, August 2012

4.2.3 SCC by year carbon is emitted[50]

Table 19: Interagency Work Group Social Cost of Carbon, Per MT, By Year (2015$)

Year	Average SCC at 5% discount rate	Average SCC at 3% discount rate	Average SCC at 2.5% discount rate	95th percentile SCC at 3% discount rate
2015	$12.62	$41.29	$64.24	$120.44
2016	$12.62	$43.59	$65.38	$123.88
2017	$12.62	$44.74	$67.68	$128.47
2018	$13.76	$45.88	$68.82	$133.06
2019	$13.76	$47.03	$69.97	$137.65
2020	$13.76	$48.18	$71.12	$141.09
2021	$13.76	$48.18	$72.27	$144.53
2022	$14.91	$49.32	$73.41	$147.97
2023	$14.91	$50.47	$74.56	$151.41
2024	$14.91	$51.62	$75.71	$154.86
2025	$16.06	$52.77	$78.00	$158.30
2026	$16.06	$53.91	$79.15	$161.74
2027	$17.21	$55.06	$80.30	$164.03
2028	$17.21	$56.21	$81.44	$167.47
2029	$17.21	$56.21	$82.59	$170.92
2030	$18.35	$57.35	$83.74	$174.36
2031	$18.35	$58.50	$84.88	$177.80
2032	$19.50	$59.65	$86.03	$181.24
2033	$19.50	$60.80	$87.18	$184.68
2034	$20.65	$61.94	$88.33	$188.12
2035	$20.65	$63.09	$89.47	$192.71
2036	$21.79	$64.24	$90.62	$196.15

[50] 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.

4.2.4 Total GHG emissions reductions

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 20: 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

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 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 rule, at a 2.5-percent discount rate (see Appendix B for rationale) for reductions in GHG emissions, is estimated to be approximately $10 billion in present value dollars. For context within other possible estimates of the SCC, total present values at alternative discount rates and for catastrophic impacts are shown below. Per Interagency Working Group guidance, SCC values are discounted at the same rate for which they were calculated, to maintain internal consistency with the models. Present values calculated for discount rates other than 2.5 percent are not directly comparable to present value costs in this document, which were also discounted at 2.5 percent.

Table 21: Total 2015$ Present Value SCC Benefits, For 2.5 Percent and Alternative Discount Rates

SCC Discount Rate	Present Value SCC Benefit
5%	$2,094,498,887
3%	$6,160,908,302
2.50%	**$9,594,778,504**
95th percentile, 3%	$18,625,266,684

This value excludes many types of climate change impact that are difficult to comprehensively identify and quantify. As identified by Peter Howard and the Cost of Carbon Project[51], these include:

- Health
  - Respiratory illness
  - Lyme disease
  - Death, injuries, and illnesses from omitted natural disaster and migration
  - Water, food, sanitation, shelter
- Agriculture
  - Weeds, pests, pathogens
  - Food price spikes
  - Heat and precipitation extremes
- Oceans
  - Acidification, temperature, and extreme weather impacts on fisheries, extinction, reefs
  - Storm surge interaction with sea level rise
- Forests
  - Pest infestations
  - Pathogens
  - Species invasion and migration
  - Flooding and soil erosion
  - Wildfire:
    - Burned acreage
    - Public health
    - Property losses
    - Fire management costs

[51] Howard, P (2014). Omitted Damages: What's missing from the Social Cost of Carbon. Cost of Carbon Project. A joint project of the Environmental Defense Fund, the Institute for Policy Integrity, and the Natural Resources Defense Council.

- Ecosystems
    - Biodiversity
    - Habitat
    - Species extinction
    - Outdoor recreation and tourism
    - Ecosystem services
    - Rising value of ecosystems due to increased scarcity
    - Accelerated decline due to mass migration
- Productivity and economic growth
    - Labor productivity and supply, public health
    - Infrastructure impacts from sever events
    - Diversion of resources to climate adaptation
- Water
    - Availability and competing needs
    - Flooding
- Transportation
    - Changes to land and ocean transportation
- Energy
    - Energy supply disruptions
- Catastrophic impacts and tipping points:
    - Rapid sea level rise
    - Methane releases from permafrost
    - Damages at very high temperatures
    - Unknown catastrophic events
- Inter- and intra-regional conflict:
    - National security
    - Increased violent conflicts

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.

4.2.7 Costs of climate change in Washington

While we cannot provide a specific estimate relating the rule to climate change impacts in Washington (see discussion of the use of global SCC, section 4.2.2), based on comments received during this rulemaking, we are including in this document descriptions and valuations of total costs of climate change in Washington. These costs are intended to illustrate the breadth and sizes of the state's vulnerability to climate change in qualitative and quantified terms.

In 2010, Ecology commissioned (jointly, with the Washington Department of Community, Trade, and Economic Development) a study assessing climate change risks in Washington.[52] The study found the following costly impacts of climate change.

Forests

- Federal and state costs of fighting wildfires may exceed $75 million per year by the 2020s (a 2-degree F warming), 50 percent higher than current expenditures.
- Compared to an "average year" during the 20th century, an average year in the 2020s is projected to feature a 50 percent increase in the number of acres burned, and an average year in the 2040s is projected to feature a 100 percent increase in the number of acres burned.
- The full range of economic impacts of wildfire, including lost timber value, lost recreational expenditures, and health and environmental costs related to air pollution and other forest changes, could be many times larger than the preparedness and control costs described above.
- Urban forests may also face growing wildfire risks as temperatures rise.
- Economic impacts unrelated to wildfires – e.g., from pests or changes in tree growth rates attributable to climate change – are unknown and may be either positive or negative.
- Timber harvests on public lands account for 16 percent of the state's total harvest of approximately 3.6 billion board-feet. Most wood products come from private commercial timberlands.
- Tourism and recreation revenues may be reduced in some localities due to forest closures and smoke intrusion associated with larger, more frequent wildfires.

[52] WA Department of Ecology (2010). Impacts of Climate Change on Washington's Economy: A Preliminary Assessment of Risks and Opportunities. Ecology publication no. 07-01-010. Commissioned jointly with WA Community, Trade, and Economic Development. Produced by the Washington Economic Steering Committee and the Climate Leadership Initiative, Institute for a Sustainable Environment, University of Oregon.

Electricity

- The Northwest Power and Conservation Council estimates annual net impacts on power sales to range from a gain of $777 million to a loss of $233 million by 2020, and from a gain of $169 million to a loss of $730 million by 2040 compared to current sales, although the report acknowledges that gains are likely overestimated and losses under estimated because estimates of growth in air conditioning are not yet incorporated into the Council's demand projections.
- Hydropower revenues may be affected as stream flow regimes change in response to rising temperatures.
- Taking all factors into account, simulations of the power market by University of Washington researchers suggest a revenue impact of 5 percent or less, which at today's rates would total at most $165 million annually.

Agriculture

- Two key counties may experience a decline in dairy revenues by as much as $6 million by the 2040s due to the effect of higher-than-optimal temperatures on dairy cows.
- Water allocation restrictions or higher costs for water affecting farmers in the Yakima Basin may become more probable as the likelihood of drought years increases.
- Agricultural output in the Yakima Basin is highly sensitive to water availability, and to climate change impacts that increase the probability of water shortages. Expected annual crop losses with water shortage rise from an historic average of $13 million to $79 million by mid-century, or from 1.4 percent to 8.8 percent of the $901 million agricultural output during good years.

Human health

- Although it is not certain that West Nile Virus will spread in Washington as it has in other states, medical and non-medical direct costs in Colorado (estimated at $121.5 million over a five-year period) and medical, non-medial, and public health costs in Louisiana (estimated at $20.1 million for a single year) illustrate the magnitude of potential costs.
- Efforts to reduce global warming emissions may pay a "double dividend" by reducing the impact of asthma, a disease already estimated to cost Washington State over $400 million each year.

Shorelines

- Sea level rise impacts in Washington will vary throughout the state. A region particularly vulnerable to early impacts is the South Puget Sound between Tacoma and Olympia.
- A two-foot rise in sea levels would inundate 56 square miles and affect at least 44,429 people, a portion of the state's population larger than the current population of Olympia.
- Engineering re-design of Seattle's Alaskan Way seawall to account for new sea level rise projections might add 5 to 10 percent to total project costs, or $25 to $50 million.
- Low-lying agricultural areas protected from tidewater by dikes and tidegates (e.g., Willapa Bay, Skagit River Delta) will be among the first areas in the state affected.
- Impacts on the outer coast are likely to include accelerated erosion and increased vulnerability to storm surges and high tides.

Snow sports

- Snow sports areas accounting for over 40 percent of average visits to Washington ski areas during the past ten years are based at low elevations at which climate change impacts on snow cover are likely.
- The frequency of warm winters would increase to more than 50 percent at some ski areas, given winter temperature change projected for the 2020s and 2040s.
- Population projections for Puget Sound cities suggest potential for growth in demand for winter recreation opportunities that could offset the economic impact of deteriorating snow conditions.

Fisheries

- For example, Anderson et al. (1993) combined existence values (from contingent valuation studies) with commercial, recreational, and capital values to determine that climate change of 2 to 4 degrees F would reduce the value of Yakima River spring Chinook salmon by $.38 million, from $7 million to $3.2 million. If the state undertook various "enhancements" to improve the fishery, thereby raising the base value of Yakima River spring chinook to $30.6 million, climate change would reduce that value by $19.5 million.

  In another study, Goodstein and Matson (forthcoming) estimate existence value for wild fish in the Pacific Northwest. Based on their results, a reductions of wild salmon populations by one-third would correspond to a loss of between $222 million and $2.2 billion for Washington State; a reduction by two-thirds would correspond to a loss of between $445 million and $4.5 billion.

Water supply

- Water conservation expenditures to offset the decline in firm yield of Seattle's water supply due to climate change impacts could exceed $8 million per year by the 2020s and $16 million per year by the 2040s.
- Consumers could face water price increases in some basins that supply municipal water.

Flooding

- Washington State may experience increased winter flooding and resulting economic costs due to climate change, but the probability of increased flooding is unknown. Hamlet and Lettenmaier (2006) argue that 20th century temperature change "have resulted in substantial changes in flood risks" over much of the western United States. Temperature-induced changes in flood risk vary by geography, however, increasing in some areas and decreasing in others.

  Flood damage in Washington costs an average of $40 million a year. Major storms can generate significant impacts. For example, the City of Seattle attributes costs of $20 million to landslides caused by major storms during the winter of 1996-97. Although we could not assess the frequency or impact of more severe storms, policymakers should prepare for the possibility that the economic costs of flooding will increase as temperatures warm and climate change proceeds.
- Cumulative economic effects larger than the sum of individual sector or regional effects may occur due to interactions between industries and economic sectors.

  Further study in late 2010 also estimated decreases in snowpack by an average of 28 to 30 percent across the state by the 2020s would yield a net cost of $7.1 billion in lost natural water storage.[53] The same study estimated increased costs of forestry losses to increased beetle infestations resulting from climate change, of $31 million in 2020.

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.

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[53] Adams, S, R Hamilton, S Vynne and B Doppelt (2010). Additional analysis of the Potential Economic Costs to the State of Washington of a Business-as-Usual Approach to Climate Change: Lost Snowpack Water Storage and Bark Beetle Impacts. A report from the Program on Climate Economic, Climate Leadership Initiative, Institute for a Sustainable Environment, University of Oregon. December 30, 2010.

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,[54] 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 22: 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

[54] 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.
- US 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.

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 rule.[55] 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 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[56]:** 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 five 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 on-site emissions reductions that covered parties use to comply with their GHG reduction pathways.

[55] US Environmental Protection Agency (2015). EJSCREEN. www.epa.gov/ejscreen. Accessed November 9, 2015.
[56] Households with all adults speaking a language other than English, and with reduced or limited proficiency in English language.

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.

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 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 rules, but in the case of this rulemaking, multiple comments have already been provided about the indirect impacts of the 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 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 offset GHG 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 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.[57]

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.

[57] 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.

4.6 Benefits of reporting fee reallocation

As part of the rulemaking, Ecology is adopting 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 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 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 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 new 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
- Adopted estimated fee: $0 per year

Table 23: 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

Note that some covered parties are both transportation fuel suppliers and petroleum product producers or importers, and will experience a combination of increased and decreased fees. Fee increases are discussed in section 3.5 of this document.

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 adopted 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 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 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 rule. This means benefits would be higher than those estimated for this analysis. It also means that the costs of the rule would also be correspondingly higher than those estimated in this analysis.

For EITE covered parties, the 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 rule

The 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 $10 billion (at a 2.5-percent discount rate; the full range is $2 – 18.6 billion, depending on discount rate and focus on severe impacts). This quantified value excludes impacts to elements of:
    - Health
    - Agriculture
    - Oceans
    - Forests
    - Ecosystems
    - Productivity
    - Water availability
    - Flooding
    - Transportation
    - Energy supply
    - Catastrophic and tipping point impacts
    - Inter- and intra-regional conflict
    - Avoided emissions of associated pollutants, with avoided damages per MT (see table below):

Table 24: 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

- 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. Note that some covered parties are both transportation fuel suppliers and petroleum product producers or importers, and will experience a combination of increased and decreased fees. Fee increases are discussed in section 3.5 of this document.

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Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Summary of the costs and benefits of the rule

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

Costs

Average costs of permanent reductions

Table 25: 20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction

20-Year Present Value Costs of 1 2/3 Percent Annual Emissions Reduction			
ON SITE (including purchases from other covered parties)		**MARKET**	
Low	$2,701,481,367	Low	$1,524,969,786
High	$6,753,703,419	High	$1,626,288,909
PROJECT		**RECs**	
Low	$732,801,746	Low	$401,543,314
High	$1,282,403,055	High	$1,337,692,682

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types.

Average cost of reductions going toward the reserve

Table 26: 20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction

20-Year Present Value Costs of 1/30 Percent Reserve Emissions Reduction			
ON SITE (including purchases from other covered parties)		**MARKET**	
Low	$60,422,166	Low	$34,107,945
High	$151,055,415	High	$36,374,080
PROJECT		**RECs**	
Low	$16,390,070	Low	$8,981,042
High	$28,682,622	High	$29,919,247

Note: See Section 3.2.3.3 for ranges of costs for specific covered party types and options for compliance.

Additional costs

- 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.
- Ecology will also incur the costs of implementing the rule. Implementation of the Clean Air Rule will involve a combination of additional full-time employees and work by existing employees. Ecology currently estimates additional costs of approximately $1.3 million in the current biennium, with $4.5 million in ensuing biennia.

Benefits

The 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 $10 billion (at a 2.5-percent discount rate; the full range is $2 – 18.6 billion, depending on discount rate and focus on severe impacts). This quantified value excludes impacts to elements of:
    - Health
    - Agriculture
    - Oceans
    - Forests
    - Ecosystems
    - Productivity
    - Water availability
    - Flooding
    - Transportation
    - Energy supply
    - Catastrophic and tipping point impacts
    - Inter- and intra-regional conflict
    - Avoided emissions of associated pollutants, with avoided damages per MT (see table below):

Table 27: 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

- 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. Note that some covered parties are both transportation fuel suppliers and petroleum product producers or importers, and will experience a combination of increased and decreased fees. Fee increases are discussed in section 3.5 of this document.

5.2 Conclusion

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

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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 [sic] 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 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 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 rule were the least burdensome.

6.2 Goals and objectives of the authorizing statutes

Ecology has developed the 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 goals and objectives:

- 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.

Chapter 70.235 RCW includes the following goals and objectives:

- 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.

6.3 Alternatives considered and why they were not included

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

- **Broader applicability (e.g., to include all petroleum 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 from these sources 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 reductions be on site**
  - Allowing compliance only through on-site emissions reductions would be more burdensome, and would limit the ability to comply with the rule. Increased burden would come not only from the higher relative cost of emissions reductions on-site as compared to, e.g., purchases from approved markets, but due to the lack of facilities at which to reduce emissions resulting from in-state combustion of natural gas and petroleum fuels (which could only make "on-site" reductions by reducing volume). Emission reduction projects and programs, as well as access to markets, give covered parties choices to make reductions at the lowest cost.
- **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.
  - Existing systems are allowance-based and Ecology opted against an allowance-based system due to the inability to auction or otherwise set a price signal for allowances.
  - Existing market programs differ fundamentally in their definitions, requirements, restrictions, and standards, as compared to the Washington GHG reporting program and the 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 (such as shifting from producing fuels in the state to increasing fuel imports) 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 rule.
    - Reducing the scope of the rule would limit the ability to meet the goals and objectives of the authorizing statutes.
- **A different threshold for coverage**
    - Based on known emissions below the 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**
    - Ecology evaluated the proportion of the state's GHG emissions generated by the entities covered by this program. It then evaluated the reductions that are necessary to help the state reach its statutory limits and assigned those entities a share of those reductions in proportion to their contribution to our total emissions. The average annual reduction rate is a fair allocation of the responsibility for meeting its statutory limits.
- **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 rule is intended to, at a minimum, achieve the statutory reductions in Chapter 70.235 RCW for the proportion of statewide GHG emissions covered by the rule, which would not be possible with a lower rate.
- **Allowing sequestration as a form of emissions reduction**
    - Ecology strongly supports addressing climate change through all the means available to Washingtonians to combat climate change. That includes sequestration activities. However, by definition, sequestration into trees and soils, or into geological formations, is not an emission reduction. It is the temporary removal of carbon dioxide from the atmosphere. This program is focused on real, permanent emission reductions and, as such, does not include sequestration activities in the menu of options available to demonstrate that real, permanent emission reductions have been achieved.

      Note that emission reduction projects in the agricultural space are included in the rule, such as those from methane management and from certain soil fertilizer management practices that reduce nitrous oxide emissions. In general, Ecology has taken a broad a viewpoint on emission reductions so as to include these types of activities. But, as noted, sequestration activities are not emission reductions.

- **Including more provisions preventing "double counting"**

  Double-counting occurs in any greenhouse gas reduction system based on a cap in which emissions reduction projects or programs occur in capped sectors. In the case of the CAR, virtually the entire state's economy (all emitting sectors except agriculture) has been capped. Ecology has no plausible choice other than to allow the option of pursuing emissions reduction projects and programs given that the majority of emission reductions needed in the program come from entities with indirect emissions that are not able to reduce their own emissions. Given this dilemma, Ecology was faced with two options:

  1. Allow emissions reduction projects and programs in covered sectors, including Washington's most important contributor to the state's GHG emissions: the transportation sector. This sector is typically responsible for about 45 percent of GHG emissions.
  2. Prohibit emissions reduction projects and programs from occurring in the transportation sector, as well as severely constricting emissions reduction options in all sectors except agriculture. This would require most, if not nearly all, emissions reductions to occur out of state (which is not currently allowed under the CAR).

  There are specific provisions in the rule that can mitigate or eliminate double-counting. In cases where ERUs may be generated in the industrial or waste sectors by projects that produce direct emissions at or on the emitting facility and that are reflected in the GHG reporting program, there is a specific provision that allows only one ERU to be generated and credited for that project. Note that this is a specific case where even though the two ERUs are conceptually created simultaneously, the fact that they are created simultaneously at the same physical location, allows the GHG reporting framework in place to capture that moment, and correct accordingly. Ecology is confident that in the industrial and waste sectors there is a mechanism in place in the fuel to address this issue.

  Ecology notes that double counting will occur in the electricity sector, particularly in energy-efficiency projects utilized by utilities providing the power that is offset by those projects. When the federal Clean Power Plan goes into effect (though it is not part of our baseline for this analysis; see section 2.2) the vast majority of the power sector would transition to being regulated by the CPP program, alleviating double-counting for the electricity sector.

  The reserve mechanism also includes a provision for retiring ERUs to mitigate double counting, contingent on the supply of ERUs available. This is a mitigation measure for Ecology to utilize as necessary.

6.4 Conclusion

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

Appendix A: Indirect Costs

A.1 REMI Analysis

Under contract with the Washington State Office of Financial Management, Regional Economic Models, Inc. estimated impacts to the Washington State economy, personal income, and employment, resulting from the direct costs estimated in this analysis.[58] Because this analysis estimated a range of direct costs for each type of compliance method, the REMI analysis estimated ranges of indirect impacts for each method as well, and did so for two scenarios:

- 50 percent of energy costs are passed on to energy consumers.
- 100 percent of energy costs are passed on to energy consumers.

The markets for energy and fuels are likely to be inelastic (see section A.2.2, below), and are therefore more likely to pass costs on to their customers. The scenario passing on 100 percent of costs is an upper bound, while the 50 percent pass-through scenario is intended to represent a lower bound for inelastic markets.

A.1.1 Estimated impacts assuming 50 percent of energy costs are passed on

The REMI results for 50-percent energy cost pass-through are presented in the tables below, and overall ranges (across all compliance methods) can be summarized as:

- Reductions in state gross domestic product of:
    - $2.6 million to $48.8 million in 2020 (0.001 to 0.01 percent of baseline) through
    - $30.5 million to $560 million in 2035 (0.005 to 0.084 percent of baseline).

- Reductions in real personal income, per capita, of:
    - $0.25 to $4.67 in 2020 through
    - $0.58 to $10.66 in 2035.

- Job losses of:
    - 30 to 430 jobs in 2020 (0.001 to 0.1 percent of baseline) through
    - 200 to 3,270 jobs in 2035 (0.004 to 0.071 percent of baseline).

[58] Regional Economic Models, Inc. (2016). Macroeconomic Impacts of the Clean Air Rule (Chapter 173-442) Costs on the Washington State Economy. Prepared for the Washington State Office of Financial Management.

Table 28: Impact to Gross Domestic (State) Product, 50 Percent Energy Cost Pass-Through

Gross Domestic Product (Millions of Inflation-Adjusted 2015 Dollars)	2017	2020	2025	2030	2035
On Site Low	$0.321	-$19.542	-$86.169	-$157.793	-$225.297
On Site High	$0.802	-$48.773	-$214.679	-$392.676	-$560.017
Project Low	$0.087	-$5.305	-$23.414	-$42.852	-$61.226
Project High	$0.152	-$9.282	-$40.955	-$74.996	-$107.128
Market Low	$0.181	-$11.037	-$48.691	-$89.169	-$127.362
Market High	$0.193	-$11.770	-$51.922	-$95.087	-$135.810
Project (REC) Low	$0.043	-$2.643	-$11.666	-$21.324	-$30.475
Project (REC) High	$0.159	-$9.682	-$42.718	-$78.228	-$111.741

Table 29: Percentage Impact to Baseline GDP, 50 Percent Energy Cost Pass-Through

Gross Domestic Product (% Change from Baseline Forecast)	2017	2020	2025	2030	2035
Compliance 1 & 2 Low	0.000%	-0.004%	-0.016%	-0.026%	-0.034%
Compliance 1 & 2 High	0.000%	-0.010%	-0.040%	-0.066%	-0.084%
Compliance 3 Low	0.000%	-0.001%	-0.004%	-0.007%	-0.009%
Compliance 3 High	0.000%	-0.002%	-0.008%	-0.013%	-0.016%
Compliance 4 Low	0.000%	-0.002%	-0.009%	-0.015%	-0.019%
Compliance 4 High	0.000%	-0.002%	-0.010%	-0.016%	-0.020%
Compliance 5 Low	0.000%	-0.001%	-0.002%	-0.004%	-0.005%
Compliance 5 High	0.000%	-0.002%	-0.008%	-0.013%	-0.017%

Table 30: Impact to Real Disposable Personal Income, Per Capita, 50 Percent Energy Cost Pass-Through

Real Disposable Personal Income per capita (Inflation Adjusted 2015 Dollars)	2017	2020	2025	2030	2035
On Site Low	$0.021	-$1.872	-$4.715	-$5.171	-$4.289
On Site High	$0.052	-$4.673	-$11.743	-$12.868	-$10.655
Project Low	$0.006	-$0.508	-$1.281	-$1.400	-$1.163
Project High	$0.010	-$0.889	-$2.241	-$2.455	-$2.038
Market Low	$0.012	-$1.057	-$2.664	-$2.920	-$2.423
Market High	$0.013	-$1.128	-$2.841	-$3.114	-$2.585
Project (REC) Low	$0.003	-$0.253	-$0.638	-$0.694	-$0.576
Project (REC) High	$0.010	-$0.928	-$2.338	-$2.561	-$2.126

Table 31: Impact to Employment, 50 Percent Energy Cost Pass-Through

Employment (Jobs)	2017	2020	2025	2030	2035
On Site Low	<10	-170	-640	-1020	-1320
On Site High	<10	-430	-1600	-2530	-3270
Project Low	<10	-50	-170	-280	-360
Project High	<10	-80	-310	-480	-630
Market Low	<10	-100	-360	-570	-740
Market High	<10	-100	-390	-610	-790
Project (REC) Low	<10	-30	-100	-150	-200
Project (REC) High	<10	-80	-320	-500	-650

Table 32: Percentage Impact to Baseline Employment, 50 Percent Energy Cost Pass-Through

Employment (% Change from Baseline Forecast)	2017	2020	2025	2030	2035
On Site Low	0.000%	-0.004%	-0.015%	-0.023%	-0.029%
On Site High	0.000%	-0.010%	-0.037%	-0.058%	-0.071%
Project Low	0.000%	-0.001%	-0.004%	-0.006%	-0.008%
Project High	0.000%	-0.002%	-0.007%	-0.011%	-0.014%
Market Low	0.000%	-0.002%	-0.008%	-0.013%	-0.016%
Market High	0.000%	-0.002%	-0.009%	-0.014%	-0.017%
Project (REC) Low	0.000%	-0.001%	-0.002%	-0.003%	-0.004%
Project (REC) High	0.000%	-0.002%	-0.007%	-0.011%	-0.014%

A.1.2 Estimated impacts assuming 100 percent of energy costs are passed on

The REMI results for 100-percent energy cost pass-through are presented in the tables below, and overall ranges (across all compliance methods) can be summarized as:

- Reductions in state gross domestic product of:
  - $4.8 million to $79.9 million in 2020 (0.001 to 0.017 percent of baseline) through
  - $47.1 million to $775.7 million in 2035 (0.007 to 0.117 percent of baseline).
- Reductions in real personal income, per capita, of:
  - $0.46 to $7.74 in 2020 through
  - $0.85 to $13.98 in 2035.
- Job losses of:
  - 180 to 730 jobs in 2020 (0.001 to 0.017 percent of baseline) through
  - 280 to 4580 jobs in 2035 (0.006 to 0.1 percent of baseline).

Table 33: Impact to Gross Domestic (State) Product, 100 Percent Energy Cost Pass-Through

Gross Domestic Product (Millions of Inflation-Adjusted 2015 Dollars)	2017	2020	2025	2030	2035
On Site Low	$0.514	-$32.090	-$127.234	-$224.742	-$314.472
On Site High	$1.286	-$79.929	-$315.573	-$555.663	-$775.672
Project Low	$0.139	-$8.721	-$34.649	-$61.301	-$85.879
Project High	$0.244	-$15.253	-$60.569	-$107.110	-$150.004
Market Low	$0.290	-$18.134	-$71.991	-$127.283	-$178.229
Market High	$0.309	-$19.338	-$76.759	-$135.701	-$190.005
Project (REC) Low	$0.076	-$4.780	-$18.999	-$33.621	-$47.111
Project (REC) High	$0.254	-$15.910	-$63.173	-$111.710	-$156.441

Table 34: Percentage Impact to Baseline GDP, 100 Percent Energy Cost Pass-Through

Gross Domestic Product (% Change from Baseline Forecast)	2017	2020	2025	2030	2035
On Site Low	0.000%	-0.007%	-0.024%	-0.038%	-0.047%
On Site High	0.000%	-0.017%	-0.059%	-0.093%	-0.117%
Project Low	0.000%	-0.002%	-0.006%	-0.010%	-0.013%
Project High	0.000%	-0.003%	-0.011%	-0.018%	-0.023%
Market Low	0.000%	-0.004%	-0.013%	-0.021%	-0.027%
Market High	0.000%	-0.004%	-0.014%	-0.023%	-0.029%
Project (REC) Low	0.000%	-0.001%	-0.004%	-0.006%	-0.007%
Project (REC) High	0.000%	-0.003%	-0.012%	-0.019%	-0.024%

Table 35: Impact to Real Disposable Personal Income, Per Capita, 100 Percent Energy Cost Pass-Through

Real Disposable Personal Income per capita (Inflation Adjusted 2015 Dollars)	2017	2020	2025	2030	2035
On Site Low	$0.029	-$3.109	-$6.914	-$7.185	-$5.686
On Site High	$0.071	-$7.743	-$17.138	-$17.737	-$13.975
Project Low	$0.008	-$0.845	-$1.883	-$1.961	-$1.555
Project High	$0.014	-$1.478	-$3.292	-$3.426	-$2.716
Market Low	$0.016	-$1.757	-$3.912	-$4.071	-$3.226
Market High	$0.017	-$1.873	-$4.171	-$4.340	-$3.439
Project (REC) Low	$0.004	-$0.463	-$1.033	-$1.076	-$0.854
Project (REC) High	$0.014	-$1.541	-$3.433	-$3.573	-$2.832

Table 36: Impact to Employment, 100 Percent Energy Cost Pass-Through

Employment (Jobs)	2017	2020	2025	2030	2035
On Site Low	<10	-290	-980	-1480	-1860
On Site High	10	-730	-2440	-3670	-4580
Project Low	<10	-80	-270	-400	-510
Project High	<10	-140	-470	-710	-880
Market Low	<10	-170	-560	-840	-1050
Market High	<10	-180	-590	-900	-1120
Project (REC) Low	<10	-40	-150	-220	-280
Project (REC) High	<10	-150	-490	-740	-920

Table 37: Percentage Impact to Baseline Employment, 100 Percent Energy Cost Pass-Through

Employment (% Change from Baseline Forecast)	2017	2020	2025	2030	2035
On Site Low	0.000%	-0.007%	-0.023%	-0.034%	-0.041%
On Site High	0.000%	-0.017%	-0.056%	-0.083%	-0.100%
Project Low	0.000%	-0.002%	-0.006%	-0.009%	-0.011%
Project High	0.000%	-0.003%	-0.011%	-0.016%	-0.019%
Market Low	0.000%	-0.004%	-0.013%	-0.019%	-0.023%
Market High	0.000%	-0.004%	-0.014%	-0.020%	-0.024%
Project (REC) Low	0.000%	-0.001%	-0.003%	-0.005%	-0.006%
Project (REC) High	0.000%	-0.003%	-0.011%	-0.017%	-0.020%

A.1.3 Estimated impacts to energy expenditures and prices

The REMI analysis also addressed the impacts of 100-percent energy cost pass-through, for 2020 and 2035. The ranges of results (across all compliance methods) are summarized below.

Year 2020

For Households

Increases in average annual household expenditures of:

- $1.15 to $16.15 on electricity.
- Up to $2.55 on natural gas.

For Industry

- 0.1 percent to 1.4 percent increase in natural gas expenditures at industrial facilities.

For Transportation

- Up to a $0.01 increase in gasoline and diesel prices.

Year 2035

For Households

Increases in average annual household expenditures of:

- $5.77 to $106.15 on electricity.
- $0.96 to $17.86 on natural gas.

For Industry

- 0.5 percent to 10.2 percent increase in natural gas expenditures at industrial facilities.

For Transportation

- $0.01 to a $0.09 increase in gasoline and diesel prices.

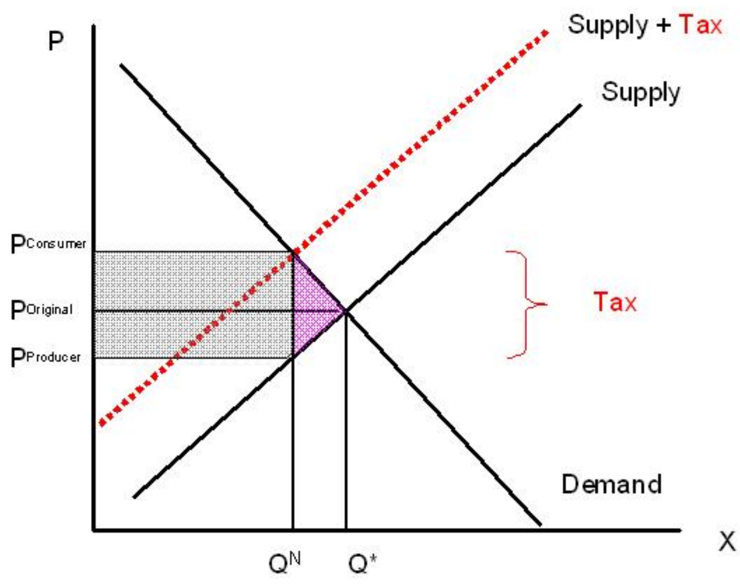
A.2 Pass-through cost technical discussion

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.2.1 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.[59] This is true for any increase in the per-unit costs or production.

Figure 1: Pass-through



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

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.

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.2.2 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.2.2.1 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.2.2.2 Food production

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

A.2.2.3 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.2.2.4 Manufacturing

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

A.2.2.5 Metals

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

A.2.2.6 Minerals

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

A.2.2.7 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.2.2.8 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.2.2.9 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.2.2.10 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.2.2.11 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.2.2.12 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.

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.[60]

> "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.

[60] 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.

Table 38: 2010 Published SCC (2007$)

Discount Rate Year	5% Avg	3% Avg	2.5% Avg	3% 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

Table 39: 2013 Published SCC (2007$)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 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."

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Appendix C: Addressing Real Price Growth

Ecology performed the primary analysis of costs of the adopted rule assuming no real (inflation-adjusted) price growth. This is because Ecology does not necessarily expect real prices of emission reduction units (ERUs) to rise significantly over the course of the program's first 20 years. This assumption is due to the breadth of compliance options available to covered parities under the rule, as well as the likely incentivizing of entrants generating project-based or excess emissions reductions. Moreover, developments in technology may work to reduce the costs of GHG emissions reductions over time.

Based on comments received during this rulemaking, we have added this appendix to the analysis, estimating the emissions reduction costs of the rule under a scenario that assumes three elements that would increase costs at one or more periods of time:

- Higher project costs (including RECs) in the first two compliance periods[61]
- 1.5-percent annual growth in real prices of market emissions reductions[62]
- Higher growth rates for emissions from natural gas utilities[63]

Resulting estimates of 20-year present-value costs of emissions reductions are summarized below. These higher cost estimates did not affect Ecology's conclusion that the benefits of the rule likely outweigh its costs.

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[61] WA Department of Ecology (2016). Concise Explanatory Statement, Chapter 173-442 WAC Clean Air Rule, Chapter 173-441 WAC Reporting of Emissions of Greenhouse Gases: Summary of rulemaking and response to comments. Ecology publication no. 16-02-014. Ecology received comments regarding the development rate of emissions reduction projects.

[62] Ibid. Ecology received comments regarding growth in real prices of market-based emissions reductions, as well as renewable energy credits.

Note that we chose an alternative to the comments' suggested 5% annual growth rate (per nominal growth rates set for floor prices in some markets), since the rule does not limit compliance using market emissions reduction sources to those with price floors or predetermined price floor growth rates, such as that used to proxy market prices in this analysis. The European market has no set growth in its market price floor, while the RGGI price floor grows in line with the Consumer Price Index (0-percent real growth). Ecology instead used average daily and annual prices from the California offset futures market since 2014 (when the market price settled after initial program development and uncertainty), finding equivalent annual real growth of between 1 and 2 percent of initial price (assuming 2-percent inflation).

[63] Ecology received comments regarding higher natural gas demand growth than used in our primary analysis. We performed this additional analysis assuming natural gas utilities would experience emissions growth in line with their forecast demand growth as reported in their available Integrated Resource Plans:

- Puget Sound Energy (2015). 2015 Integrated Resource Plan. Filed November 30, 2015.
- NW Natural (2014). 2014 Integrated Resource Plan LC-60 and UG-131473.
- Cascade Natural Gas Corporation (2011). 2011 Integrated Resource Plan. December 15, 2011.
- Avista (2014). 2014 Natural Gas Integrated Resource Plan. August 31, 2014.

Table 40: 20-year Present Value Costs of Permanent Emissions Reductions, Real Price Growth And High Initial Project Prices

20-year Present Value Cost of Permanent Emissions Reductions			
ON SITE LOW-PRICE		**MARKET LOW**	
EITEs	$169,936,888	EITEs	$115,266,360
Direct Emitters	$432,919,113	Direct Emitters	$289,991,404
Power Producers	$189,542,030	Power Producers	$127,062,897
NG LDCs	$754,677,481	NG LDCs	$504,294,880
Petroleum Products	$1,356,241,826	Petroleum Products	$911,945,715
ALL PARTIES	**$2,903,317,338**	ALL PARTIES	**$1,948,561,255**
ON SITE HIGH-PRICE		**MARKET HIGH**	
EITEs	$424,842,220	EITEs	$122,924,667
Direct Emitters	$1,082,297,781	Direct Emitters	$309,258,458
Power Producers	$473,855,076	Power Producers	$135,504,967
NG LDCs	$1,886,693,703	NG LDCs	$537,800,275
Petroleum Products	$3,390,604,564	Petroleum Products	$972,535,466
ALL PARTIES	**$7,258,293,345**	ALL PARTIES	**$2,078,023,832**
PROJECT LOW		**PROGRAM (REC) LOW**	
EITEs	$46,096,949	EITEs	$28,651,280
Direct Emitters	$117,433,304	Direct Emitters	$82,121,721
Power Producers	$51,415,025	Power Producers	$35,587,241
NG LDCs	$204,713,230	NG LDCs	$145,998,776
Petroleum Products	$367,893,108	Petroleum Products	$247,631,629
ALL PARTIES	**$787,551,615**	ALL PARTIES	**$539,990,647**
PROJECT HIGH		**PROGRAM (REC) HIGH**	
EITEs	$80,669,660	EITEs	$95,448,254
Direct Emitters	$205,508,281	Direct Emitters	$273,578,518
Power Producers	$89,976,293	Power Producers	$118,554,561
NG LDCs	$358,248,152	NG LDCs	$486,377,155
Petroleum Products	$643,812,940	Petroleum Products	$824,954,635
ALL PARTIES	**$1,378,215,326**	ALL PARTIES	**$1,798,913,122**

Table 41:20-year Present Value Costs of Emissions Reductions Toward Reserve, Real Price Growth And High Initial Project Prices

20-year Present Value Cost of Emissions Reductions Toward Reserve			
ON SITE LOW-PRICE		**MARKET LOW**	
EITEs	$2,741,082	EITEs	$1,863,730
Direct Emitters	$7,378,897	Direct Emitters	$4,945,339
Power Producers	$4,501,930	Power Producers	$3,015,367
NG LDCs	$7,351,115	NG LDCs	$4,923,735
Petroleum Products	$38,449,141	Petroleum Products	$25,795,264
ALL PARTIES	**$60,422,166**	ALL PARTIES	**$40,543,434**
ON SITE HIGH-PRICE		**MARKET HIGH**	
EITEs	$6,852,706	EITEs	$1,987,556
Direct Emitters	$18,447,243	Direct Emitters	$5,273,908
Power Producers	$11,254,825	Power Producers	$3,215,708
NG LDCs	$18,377,787	NG LDCs	$5,250,868
Petroleum Products	$96,122,854	Petroleum Products	$27,509,103
ALL PARTIES	**$151,055,415**	ALL PARTIES	**$43,237,143**
PROJECT LOW		**PROGRAM (REC) LOW**	
EITEs	$822,774	EITEs	$450,844
Direct Emitters	$2,540,823	Direct Emitters	$1,392,260
Power Producers	$1,555,108	Power Producers	$852,131
NG LDCs	$2,539,306	NG LDCs	$1,391,429
Petroleum Products	$13,088,440	Petroleum Products	$7,171,893
ALL PARTIES	**$20,546,452**	ALL PARTIES	**$11,258,557**
PROJECT HIGH		**PROGRAM (REC) HIGH**	
EITEs	$1,439,855	EITEs	$1,501,933
Direct Emitters	$4,446,441	Direct Emitters	$4,638,145
Power Producers	$2,721,439	Power Producers	$2,838,772
NG LDCs	$4,443,786	NG LDCs	$4,635,376
Petroleum Products	$22,904,770	Petroleum Products	$23,892,288
ALL PARTIES	**$35,956,291**	ALL PARTIES	**$37,506,513**

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Appendix D: ERU Availability

Ecology believes that there are sufficient opportunities available to meet program needs in the short term through projects and programs located in the state. Moreover, Ecology believes that the emission reduction market will grow over time, expanding opportunities for covered parties to obtain emission reductions. Ecology used professional judgement, state agency expertise, and widely available data sources to provide context for the range of ERU-generation opportunities available to covered parties. Examples of data sources includes information from the Energy Information Administration, Washington Department of Agriculture, WSU Energy Extension, Climate Action Reserve, American Carbon Registry, and the State of California.

As an illustration of some of the possible sources for ERUs, both immediately and into the future, consider the following examples:

Projects Already Registered on the Climate Action Reserve
A number of emission reduction projects already exist in Washington that are providing emission reductions to both voluntary and compliance carbon markets. The following projects are currently listed on the Climate Action Reserve and, as such, would be able to provide emission reductions that could be used to generate ERUs, either now or in the future as any existing commitments may be modified.

Table 42: Projects Already Registered on the Climate Action Reserve

Project Name	Project Type	Total Number of Offset Credits Registered
Rainier Biogas, LLC	Livestock Gas Capture/Combustion	3101
Farm Power Rexville Regional Digester	Livestock Gas Capture/Combustion	71610
Farm Power Lynden Anaerobic Digester	Livestock Gas Capture/Combustion	30426
Sudbury Road Landfill Gas Destruction Project	Landfill Gas Capture/Combustion	32087
George DeRuyter & Sons Dairy	Livestock Gas Capture/Combustion	131618
Vander Haak Dairy	Livestock Gas Capture/Combustion	3639
Lenz Composting	Organic Waste Composting	28522
Farm Power Lynden Anaerobic Digester	Livestock - ARB Compliance	22901
Edaleen Cow Power, LLC	Livestock Gas Capture/Combustion	17053
Washington Beef LLC Greenhouse Gas and Solids Reduction Project	Organic Waste Digestion	58293
Cedar Grove Composting	Organic Waste Composting	128445
Cedar Grove - Maple Valley OWC Composting Project	Organic Waste Composting	250643

Dairy Digesters
Ecology asked the Department of Commerce for some estimates on the potential for dairy digesters to produce emission reductions. These are illustrative, given certain assumptions, and are cumulative. Note that these should be additional to the projects already registered in, for example, the Climate Action Reserve as listed above. The results are below (with assumptions in the footnotes).

Table 43: Dairy Digesters

Dairy Digesters	2020	2030
New digesters with no existing commitment for emissions reductions	400,000 $MTCO2_e$[64]	1,000,000 $MTCO2_e$[65]

Renewable Energy
Close to 10 million MWh of renewable energy project production may be available in Washington at this time for CAR compliance (see below). A large portion of this will likely be used for Washington Energy Independence Act compliance. However, a significant portion will likely be free for use in the CAR in the short term, and may be free in the longer term as well depending on how utilities choose to structure their REC portfolios in terms of out-of-state RECS being used for the EIA and in-state RECs being used for CAR compliance. Even assuming that large quantities of this renewable energy is used for EIA compliance, this still frees up potentially millions of ERUs for use in the CAR.

Table 44: Renewable Energy

Facility	Fuel	MWH
Qualco - Qualco	Biogas	6,222
Port Townsend Paper	Biomass	32,055
Weyerhaeuser Longview WA	Biomass	225,043
Longview Fibre	Biomass	275,734
WestRock (WA)	Biomass	338,203
Cosmo Specialty Fibers Plant	Biomass	103,555
Cedar Hills	LFG	22,682
LRI LFGTE Facility	LFG	36,677
Roosevelt Biogas 1	LFG	151,659

[64] From WA Department of Agriculture Dairy Nutrient Management Program, *Washington Dairies and Digesters* and the WA Department of Commerce Energy Office, Senior Energy Policy Specialist Peter Moulton, *Roadmap for Biogas Development in Washington State*. Washington has eight operating on-farm digesters, and up to 10 in development that could yield credits over the next five years. The Yakima Basin project, with 7-8 digesters and pipeline injection in Outlook-Granger and Sunnyside, would manage manure from ~40,000 cows (roughly half the cows in the Yakima Basin). Two smaller projects, accounting for another 2,000 cows, are in development in Whatcom and Snohomish counties. Current literature estimates 4-5 $MTCO2_e$ per cow per year, with biogas yields doubling if the manure is co-digested with agricultural and food processing wastes. The estimate for 2020 is based on 40,000 cows at 10 $MTCO2_e$ per cow per year.
[65] Craig Frear, formerly with WSU and now with Regenis, estimated the number of dairy cows statewide that could be economically included in digester projects to be ~100,000. The estimate for 2030 is based on 100,000 cows at 10 $MMTCO2_e$ per cow per year.

Facility	Fuel	MWH
West Point Treatment Plant	OBG	16,881
Kettle Falls Generating Station	WDS	320,249
Darrington	WDS	18,992
SDS Lumber Gorge Energy Division	WDS	5,820
Sierra Pacific Aberdeen	WDS	122,131
Sierra Pacific Burlington Facility	WDS	159,064
NPI USA Cogeneration Plant	WDS	7,573
Big Horn Wind II	Wind	103,866
Big Horn Wind Project	Wind	431,826
Coastal Energy Project	Wind	16,270
FPL Energy Vansycle LLC (WA)	Wind	343,021
Goodnoe Hills	Wind	186,746
Harvest Wind Project	Wind	236,025
Hopkins Ridge Wind	Wind	362,253
Juniper Canyon I Wind Project	Wind	307,443
Linden Wind Energy Project	Wind	132,595
Lower Snake River Wind Energy Project	Wind	732,789
Marengo Wind Plant	Wind	436,657
Nine Canyon	Wind	211,208
Palouse	Wind	293,563
Sagebrush Power Partners	Wind	253,803
Swauk Wind LLC	Wind	11,215
Tucannon River Wind Farm	Wind	758,197
Tuolumne Wind Project	Wind	333,606
Vantage Wind Energy LLC	Wind	237,043
White Creek Wind Farm	Wind	483,372
Windy Flats Wind Project	Wind	621,861
Wild Horse	Wind	609,963
Snohomish PUD Solar Express	Solar	1,411
Boulder Community Solar	Solar	511
Mason County PUD 3-Johns Pr Bldg D Solar Project	Solar	182
Little Falls #4	Hydro	4,862
Long Lake #3	Hydro	14,197
Rocky Reach Hydroelectric Facility	Hydro	47,756
Priest Rapids Fish Bypass	Hydro	401,349
Wanapum Fish Bypass	Hydro	5,571
Lower Baker Incr. Hydro Project	Hydro	103,365
Snoqualmie Falls Incr. Hydro Project	Hydro	18,904
Woods Creek Hydroelectric Project	Hydro	1,053
Mossyrock Incremental Hydro	Hydro	46,758

Facility	Fuel	MWH
Cushman No 2 Incremental Hydro	Hydro	18,000
Lagrande No. 6 Incremental Hydro	Hydro	3,300

The above are intended to be illustrative of the kind of potential supply of ERUs that exists now, and that can be expected to be maintained into the near future. Ecology is aware that supply and availability of ERU generation opportunities is vitally important to this program. Therefore, while Ecology does believe that there are sufficient ERU opportunities available to meet program needs in the short term (as illustrated above with some examples) Ecology will be constantly evaluating those conditions and any conditions affecting ERU supply can be re-examined in the future if necessary.

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