



Final Regulatory Analyses:

Including the:

- Final Cost-Benefit Analysis
- Least-Burdensome Alternative Analysis
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

Chapter 173-443 WAC, Hydrofluorocarbons (HFCs)

Chapter 173-455 WAC, Air Quality Fee Rule

(title change: Chapter 173-443 WAC,
Hydrofluorocarbons (HFCs) and Other
Fluorinated Greenhouse Gases)

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For the

Climate Pollution Reduction Program
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Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	P.O. Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
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Preliminary Regulatory Analyses

Including the:

Preliminary Cost-Benefit Analysis

Least-Burdensome Alternative Analysis

Administrative Procedure Act Determinations

Regulatory Fairness Act Compliance

Chapter 173-443 WAC, Hydrofluorocarbons (HFCs)

Chapter 173-455 WAC, Air Quality Fee Rule

(title change: Chapter 173-443 WAC, Hydrofluorocarbons (HFCs) and Other Fluorinated Greenhouse Gases)

Climate Pollution Reduction Program
Washington State Department of Ecology

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Table of Contents

Table of Contents	5
Tables	7
Abbreviations	8
Executive Summary	9
Chapter 1: Background and Introduction	15
1.1 Introduction	15
1.1.1 Background	15
1.1.2 HFC reduction in context	16
1.2 Summary of the rule amendments	18
1.3 Reasons for the amendments	19
1.4 Document organization	19
Chapter 2: Baseline and Rule Amendments	21
2.1 Introduction	21
2.2 Baseline	21
2.3 Rule amendments	22
2.3.1 Amendments to manufacturer requirements	23
2.3.2 Amendments to requirements for facilities	32
2.3.3 Amendments to requirements for wholesalers, distributors, and reclaimers	43
2.3.4 Amendments to requirements for service technicians	43
2.3.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law	44
2.3.6 Making corresponding changes to the Air Quality Fee Rule	44
Chapter 3: Likely Costs of the Rule Amendments	46
3.1 Introduction	46
3.1.1 Data variability	46
3.2 Cost analysis	46
3.2.1 Amendments to manufacturer requirements	48
3.2.2 Amendments to requirements for facilities	55
3.2.3 Amendments to requirements for wholesalers, distributors, and reclaimers	63
3.2.4 Amendments to requirements for service technicians	64
3.2.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law	64
3.2.6 Making corresponding changes to the Air Quality Fee Rule	64
Chapter 4: Likely Benefits of the Rule Amendments	65
4.1 Introduction	65
4.1.1 Data variability	65
4.2 Benefits analysis	65
4.2.1 Amendments to manufacturer requirements	67
4.2.2 Amendments to requirements for facilities	89
4.2.3 Amendments to requirements for wholesalers, distributors, and reclaimers	92

4.2.4 Amendments to requirements for service technicians	92
4.2.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law	92
4.2.6 Making corresponding changes to the Air Quality Fee Rule	93
Chapter 5: Cost-Benefit Comparison and Conclusions.....	94
5.1 Summary of costs and benefits of the rule amendments.....	94
5.2 Conclusion.....	95
Chapter 6: Least-Burdensome Alternative Analysis	96
6.1 Introduction	96
6.2 Goals and objectives of the authorizing statute	96
6.3 Alternatives considered and why they were excluded	97
6.3.1 Not require automatic leak detection with a 10-ppm detection level.	97
6.3.2 Allow for later GWP threshold effective dates for some types of equipment.....	97
6.3.3 Raise the leak rate threshold under the RMP for grocery retailers.	98
6.3.4 Require an earlier GWP threshold effective date for room air conditioners and residential dehumidifiers	98
6.4 Conclusion.....	98
Chapter 7: Regulatory Fairness Act Compliance	100
7.1 Introduction	100
7.2 Analysis of relative compliance cost burden	100
7.3 Loss of sales or revenue.....	104
7.4 Action taken to reduce small business impacts.....	105
7.5 Small business and government involvement	106
7.6 North American Industry Classification System (NAICS) codes of impacted industries	107
7.7 Impact on jobs	109
References.....	111
Appendix A: Administrative Procedure Act (RCW 34.05.328) Determinations	115
Appendix B: Subcategories of Present Value Costs and Benefits.....	117

Tables

Table 1. 20-year Present Value (PV) costs and benefits.	11
Table 2. Incremental costs of switching to refrigerant with GWP<150.	50
Table 3. Change in refrigerant costs per system, of switching to refrigerant with GWP<150.	51
Table 4. Change in electricity costs per system, of switching to refrigerant with GWP<150.	51
Table 5. Facilities by type of system, Dun & Bradstreet.	51
Table 6. Facilities by type of system, Data Axle.	52
Table 7. Costs passed on to purchaser of Air Conditioning equipment.	53
Table 8. Facilities by size and type subject to fees, Dun & Bradstreet.	56
Table 9. Phase-down schedule of share of baseline facilities using refrigerant with a GWP greater than 150.	56
Table 10. Facilities by size and type subject to fees, Data Axle.	57
Table 11. Estimated compliance costs of leak monitoring and inspection requirements, Dun & Bradstreet facility counts.	59
Table 12. Estimated compliance costs of leak monitoring and inspection requirements, Data Axle facility counts.	60
Table 13. Percent PV saved by difference in expenditure timing.	61
Table 14. Percent PV saved by difference in expenditure timing.	62
Table 15: Social Cost of Carbon (2023\$).	70
Table 16. Facilities by type of system, Dun & Bradstreet.	85
Table 17. Leak rates by category and size.	85
Table 18. Facilities by type of system, Data Axle.	86
Table 19. Annual and end-of-life leak rates.	87
Table 20. 20-year PV costs and benefits.	94
Table 21: First Year Compliance Costs per Employee for Small Businesses, Dun & Bradstreet.	100
Table 22. First Year Compliance Costs per Employee for Large Businesses, Dun & Bradstreet.	101
Table 23: First Year Compliance Costs per Employee for Small Businesses, Data Axle.	102
Table 24. First Year Compliance Costs per Employee for Large Businesses, Data Axle.	103
Table 23. Low-Cost modeled impacts to output accounting for social cost of carbon (millions of \$).	105
Table 24. High-Cost modeled impacts to output accounting for social cost of carbon (millions of \$).	105
Table 25. Industries and their associated NAICS codes that are impacted by the rule.	108
Table 26: Low-cost impacts on jobs (Data Axle).	109
Table 27. High-cost impacts on jobs (Data Axle).	110
Table 28. Low-cost impacts on jobs (Dun & Bradstreet).	110
Table 29. High-cost impacts on jobs (Dun & Bradstreet).	110
Table 30. 20-year PV costs and benefits, low estimate, Dun & Bradstreet facility counts.	117
Table 31. 20-year PV costs and benefits, high estimate, Dun & Bradstreet facility counts.	118
Table 32. 20-year PV costs and benefits, low estimate, Data Axle facility counts.	119
Table 33. 20-year PV costs and benefits, high estimate, Data Axle facility counts.	120

Abbreviations

AIM Act	American Innovation and Manufacturing Act
ALD	Automatic Leak Detection
APA	Administrative Procedure Act
CBA	Cost-Benefit Analysis
CFCs	Chlorofluorocarbon
CFR	Code of Federal Regulations
CO ₂ e	Carbon dioxide equivalent
EPA	United States Environmental Protection Agency
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
LBA	Least-Burdensome Alternative Analysis
PV	Present Value (discounted stream of costs or benefits over time)
RCW	Revised Code of Washington
RFA	Regulatory Fairness Act
RMP	Refrigerant Management Program
SCC	Social Cost of Carbon
SNAP	Significant New Alternatives Policy
WAC	Washington Administrative Code

Executive Summary

This report presents the determinations made by the Washington State Department of Ecology as required under Chapters 34.05 RCW and 19.85 RCW, for the adopted amendments to the Hydrofluorocarbons (HFCs) rule, Chapter 173-443 WAC and the Air Quality Fee Rule, Chapter 173-455 WAC. This includes the:

- Final Cost-Benefit Analysis (CBA)
- Least-Burdensome Alternative Analysis (LBA)
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

The Washington Administrative Procedure Act (APA; RCW 34.05.328(1)(d)) 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 – 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.

The APA also requires Ecology to make several other determinations (RCW 34.05.328(1)(a) – (c) and (f) – (h)) about the rule, including authorization, need, context, and coordination. Appendix A of this document provides the documentation for these determinations.

The Washington Regulatory Fairness Act (RFA; Chapter 19.85 RCW) requires Ecology to evaluate the relative impact of rules that impose costs on businesses in an industry. It compares the relative compliance costs for small businesses to those of the largest businesses affected. Chapter 7 of this document documents that analysis, when applicable.

Summary of the amendments

The amendments make the following changes to Chapter 173-443 WAC, the Hydrofluorocarbons (HFCs) rule:

- For manufacturers:
 - Adding centrifugal chillers used for heating or for heating and cooling, and ice machines, to existing prohibitions on the use of certain refrigerants
 - Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs. (pounds).
 - Setting maximum GWP thresholds for certain refrigerants used in new air conditioning equipment.

- Setting maximum GWP thresholds for certain refrigerants in small containers of refrigerant and nonessential consumer products.
- Establishing exemptions for certain products using refrigerants that would otherwise be prohibited.
- Amending and adding labeling requirements.
- Adding recordkeeping requirements.
- Establishing a variance process and criteria.
- For facilities with refrigeration or air conditioning systems:
 - Establishing refrigerant management program (RMP) registration requirements
 - Setting implementation fees and annual fees.
 - Requiring leak inspection and monitoring.
 - Setting leak rate thresholds and establishing notification requirements.
 - Establishing requirements for leak repair, timing, and verification.
 - Establishing requirements for retrofit and retirement plans.
 - Establishing an exemption process and criteria.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For refrigerant wholesalers, distributors, and reclaimers:
 - Establishing registration requirements.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For service technicians:
 - Establishing required service practices.
- Making additional updates to Chapter 173-443 WAC without material impact, including expanding the rule title.

The amendments also make changes to Chapter 173-455 WAC, the Air Quality Fee Rule.

Reasons for the rule amendments

In 2021, the Legislature passed Engrossed Second Substitute House Bill 1050, which included amendments to the Hydrofluorocarbons — Emissions Reduction law, Chapter 70A.60 RCW. The 2021 law directed Ecology to:

- Enforce a maximum GWP threshold for substances used in ice rinks.
- Establish a refrigerant management program (RMP) to address refrigerant emissions from large stationary refrigeration and air conditioning equipment.

The law also authorized Ecology to set a maximum GWP threshold for substances used in:

- New stationary refrigeration equipment.
- New stationary air conditioning equipment containing more than 50 lbs. of refrigerant.

Costs and benefits of the rule

In Chapters 3 and 4, we identified the following costs and benefits likely to result from the rule amendments. As discussed in those chapters, we considered two distinct datasets in identifying the potential numbers of affected facilities (see, e.g., Section 3.1.1 for discussion).

Table 1. 20-year Present Value (PV) costs and benefits.

Facility Count Dataset	PV Cost Range	PV Benefits Range
Dun & Bradstreet	\$39 million – \$364 million	\$157 million – \$700 million
Data Axle	\$403 million – \$624 million	\$222 million – \$750 million

The underlying PV costs and benefits of separate sections of the rule are listed in tables in Appendix B.

We note that as the number of potentially covered facilities increases, the Present Value (PV) cost and benefit ranges increasingly overlap. This is due to large increases in quantifiable costs associated with activities such as leak detection and monitoring, registration, and reporting, for which there are no fully quantifiable benefits for comparison. The following benefits are uncertain or variable in their magnitude and scope, and so are discussed qualitatively and including illustrative dollar values in Chapter 4:

- Qualitative and unquantified benefits of reduced GHG emissions, including reduced impacts related to:
 - Environmental justice.
 - Health.
 - Agriculture.
 - Oceans.
 - Forests.
 - Wildfire.
 - Ecosystems.
 - Productivity and economic growth.
 - Water.
 - Transportation.
 - Energy.
 - Catastrophic impacts and tipping points.
 - Inter- and intra-regional conflict.
- Exemptions: Mitigation of compliance costs.
- Recordkeeping requirements: Additional and clear information about product contents and compliance along supply chains.

- Variances: Mitigation of the extent to which GWP thresholds may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities.
- RMP registration: Comprehensive data tracking of facilities, wholesalers, distributors, and reclaimers. This would support program tracking, future regulatory decisions, and effective and confident reduction in the use of refrigerants with GWP greater than 150 in Washington.
- Ecology management of the RMP: Value added services including timely service to covered entities and opportunities for efficiencies and technical support.
- Earlier detection and repair of leaks: Depending on the speed at which leaks are identified and addressed under the baseline, potential for millions of dollars in avoided GHG emissions impacts, and potential for billions of dollars in avoided additional refrigerant purchases. These benefits decrease in proportion to how quickly leaks would be addressed under the baseline.

Under the APA, quantitative and qualitative costs and benefits must be considered when making a determination about the rule.

Determination

We conclude, based on a reasonable understanding of the quantified and qualitative costs and benefits likely to arise from the rule amendments, as compared to the baseline, that the benefits of the rule amendments are greater than the costs.

Least-burdensome alternative

We considered the following alternative rule content, and did not include it in the rule amendments, because it would have imposed additional compliance burden, would not have met the goals and objectives of the law, or both.

- Not require automatic leak detection with a 10-ppm detection level.
- Allow for later GWP threshold effective dates for some types of equipment.
- Raise the leak rate threshold under the RMP for grocery retailers.
- Require an earlier GWP threshold effective date for room air conditioners and residential dehumidifiers.

After considering alternatives to the rule's contents, within the context of the goals and objectives of the authorizing statute, we determined that the rule represents the least-burdensome alternative of possible rule contents meeting the goals and objectives.

Regulatory Fairness Act Compliance

The intent of the RFA is to identify whether the rule would have disproportionate impacts on small businesses. By using conservative assumptions throughout our cost analysis (see Chapter 3), we reduce the likelihood that disproportionate impacts would not be identified or apparent. We compared the compliance costs per employee at small businesses and the largest ten percent of businesses likely impacted by the rule amendments. We conclude that the rule

amendments are likely to have disproportionate impacts on small businesses, and therefore Ecology must include elements in the rule amendments to mitigate this disproportion, as far as is legal and feasible.

Mitigation includes:

- Businesses that have refrigeration equipment with a refrigerant charge capacity of less than 50 lbs. are not required to comply with the requirements of the rule.²
- Exemptions from requirements of the rule may be granted if an exemption will not increase the overall risk to human health and the environment and the facility is a retail food facility or a small business, compliance with the requirements would result in extreme financial hardship, and the applicant has made a good faith effort to mitigate any potential noncompliance.

Modifying regulatory requirements, changing reporting requirements, reducing the frequency of inspections, or delaying compliance timetables would not meet statutory objectives or are not feasible and within the scope of this rulemaking.

The results of the economic model show a peak job loss of 2,557 to 3,218 jobs one year after implementation of the rule. In both the low-cost and high-cost scenarios of rule compliance, job loss decreases continually after 2025. The highest impacted industries in the state will be the construction industry and retail trade, as these industries are highly sensitive to the general level of economic activity in the state.

² The economic model assumes that smaller systems are correlated with smaller businesses and therefore eliminating fees for small RMP systems would predominantly include more small businesses.

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Chapter 1: Background and Introduction

1.1 Introduction

This report presents the determinations made by the Washington State Department of Ecology as required under Chapters 34.05 RCW and 19.85 RCW, for the adopted amendments to the Hydrofluorocarbons (HFCs) rule, Chapter 173-443 WAC and the Air Quality Fee Rule, Chapter 173-455 WAC. This includes the:

- Final Cost-Benefit Analysis (CBA)
- Least-Burdensome Alternative Analysis (LBA)
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

The Washington Administrative Procedure Act (APA; RCW 34.05.328(1)(d)) 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 – 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.

The APA also requires Ecology to make several other determinations (RCW 34.05.328(1)(a) – (c) and (f) – (h)) about the rule, including authorization, need, context, and coordination. Appendix A of this document provides the documentation for these determinations.

The Washington Regulatory Fairness Act (RFA; Chapter 19.85 RCW) requires Ecology to evaluate the relative impact of rules that impose costs on businesses in an industry. It compares the relative compliance costs for small businesses to those of the largest businesses affected. Chapter 7 of this document documents that analysis, when applicable.

1.1.1 Background

HFCs are chemicals made up of hydrogen, fluorine, and carbon. They are commonly used in air conditioning and refrigeration, in producing insulating foams, and as propellants. These greenhouse gases are thousands of times more powerful than carbon dioxide.

HFCs were designed to be less harmful to the earth's protective ozone layer. But now, HFCs are quickly building up in the atmosphere. If their use isn't stopped, HFC emissions will increase to

7–19% of global greenhouse gas emissions by 2050.³ In Washington, HFCs account for about 4% of overall greenhouse gas emissions.

In 2021, the Legislature passed Engrossed Second Substitute House Bill 1050 (Chapter 315, Laws of 2021), which included amendments to the Hydrofluorocarbons — Emissions Reduction law, Chapter 70A.60 RCW. The law necessitates amendments to the rule, to meet specific direction as well as authorizations related to setting maximum global warming potential (GWP) levels and the establishment of a refrigerant management program.

Starting July 25, 2021, the law also banned the sale and purchase of small cans of certain refrigerants, as well as certain non-essential consumer products (like air horns and noisemakers).

1.1.2 HFC reduction in context

In Washington, the phasing out of HFCs began Jan 1, 2020, a result of the Legislature passing Engrossed Second Substitute House Bill 1112 in 2019 (Chapter 284, Laws of 2019), which was codified as Chapter 70A.60 RCW.

In 2019 – 2020, Ecology adopted five emergency rules while developing a permanent rule to implement the law. These rules required initial reporting due by December 31, 2019. In 2020, Ecology adopted a new rule, Chapter 173-443 WAC, Hydrofluorocarbons (HFCs). The purpose of the rule was to establish requirements to move away from HFCs. The rule requires manufacturers, importers, and distributors to:

- Notify Ecology about their products and equipment and contain HFCs. The timing of this notification requirement depends on the product category, phasing in the requirement between 2020 and 2024.
- Label the product or equipment that contains HFCs.⁴

At the federal level, under the American Innovation and Manufacturing Act of 2020⁵ (AIM Act), the Environmental Protection Agency (EPA) is implementing the phase down of HFCs by 85 percent by 2036, through a phasedown of production and consumption of listed HFCs in a stepwise manner.⁶ The program establishes an allowance trading system and an allowance allocation for each entity required to comply, including entities that use HFCs to manufacture products, such as refrigeration and air conditioning systems, foams, aerosols and fire suppression systems, and entities that use HFCs in one of the following six specific applications listed in the AIM Act: a propellant in metered dose inhalers; defense sprays; structural composite preformed polyurethane foam for marine and trailer use; etching of semiconductor material or wafers and cleaning within the semiconductor manufacturing sector; mission critical

³ WA Department of Ecology, 2023. Hydrofluorocarbon transition. <https://ecology.wa.gov/Air-Climate/Reducing-Greenhouse-Gas-Emissions/Hydrofluorocarbons>

⁴ <https://ecology.wa.gov/Regulations-Permits/Laws-rules-rulemaking/Closed-rulemaking/WAC173-443>

⁵ 42 U.S.C. § 7675

⁶ [40 CFR Part 84](#), effective November 4, 2021.

military end uses; and onboard aerospace fire suppression. These entities are issued a certain number of allowances, based on “exchange values” of HFCs defined in the AIM Act, that can be traded or sold if not used for compliance. These entities have an incentive to reduce their use of HFCs with higher emissions, to reduce their obligation and the number of allowances they need to use for compliance. In 2022, the EPA issued the first allocation of allowances under the program, for emissions year 2023.

The AIM Act also authorized EPA to implement a “technology transitions” program by adopting rules to restrict or phase-out the use of HFCs in certain sectors and subsectors.⁷ In response to several petitions to conduct rulemaking pursuant to this subsection of the AIM Act,⁸ EPA published a rule for public comment in December 2022.⁹ First, the rule sets GWP thresholds on all HFCs used in the following industrial sectors: aerosols, foam blowing, refrigeration, air conditioning, and heat pumps. Second, the rule sets restrictions on the use of specific HFCs in particular sectors and subsectors. The rule also includes new labeling, reporting, and recordkeeping requirements for purposes of verifying compliance. EPA adopted their final version of this rule in October 2023.

HFCs are also the subject of regulations in other states. Since the 2006 passage of California’s Global Warming Solutions Act, the California Air Resources Board (CARB) has regulated emissions of GHGs from various sources, including refrigerants. Further legislation provided new targets for HFCs of a 40 percent reduction below 1990 levels.¹⁰ CARB has implemented HFC reduction programs, including:¹¹

- Regulation of the sale, use, and disposal of small containers of automotive refrigerant with Global Warming Potential (GWP) greater than 150.
- California Significant New Alternatives Policy (SNAP) program rules that limit GWP in refrigerants in new refrigeration and air conditioning equipment, and require retail food companies with existing systems containing more than 50 lbs. of refrigerant to achieve company-wide HFC and other GHG emissions reductions.
- A Refrigerant Management Program (RMP) that requires facilities with refrigeration systems containing more than 50 lbs. of refrigerant with GWP greater than 150 to conduct and report periodic leak inspections, promptly repair leaks, and keep service records on site.¹²

⁷ 42 U.S.C. § 7675(i).

⁸ 86 Fed. Reg. 57141, *Notice of Determination to Grant or Partially Grant Certain Petitions Submitted Under Subsection (i) of the American Innovation and Manufacturing Act of 2020* (Oct. 14, 2021).

⁹ 87 Fed. Reg. 76738, *Phasedown of Hydrofluorocarbons: Restrictions on Certain Uses of Hydrofluorocarbons Under Subsection (i) of the American Innovation and Manufacturing Act* (Dec. 15, 2022).

¹⁰ California Senate Bill 1383, 2016.

¹¹ <https://ww2.arb.ca.gov/our-work/programs/stationary-hydrofluorocarbon-reduction-measures>

¹² Note that the CARB RMP applies to refrigeration systems containing more than 50 lbs. (not inclusive), while the EPA RMP and Ecology’s RMP apply to those with at least 50 lbs. (inclusive), and Ecology’s RMP applies to refrigeration *and* air conditioning systems.

Internationally, the Montreal Protocol, a treaty first agreed upon by the international community in 1987, was designed to protect the ozone layer by phasing out production of substances responsible for ozone depletion, including chlorofluorocarbon refrigerants.¹³ Since then, the treaty has gone through nine significant revisions. The 2016 Kigali amendment¹⁴ to the Montreal Protocol added hydrochlorofluorocarbons (HCFCs) to an international list of controlled substances, stipulating the international community's commitment to reduce the use of HFCs by more than 85 percent by 2045. In addition to the passing of the AIM Act in 2020, the US Senate ratified the Kigali Amendment in 2022. As of May 15, 2023, 147 states and the European Union (EU) had ratified or accepted the amendment.¹⁵

We observe that over time the regulatory approach has shifted from limiting, phasing out, or prohibiting specific HFCs, to focusing on a categorical phasedown of their use.

1.2 Summary of the rule amendments

The amendments make the following changes to Chapter 173-443 WAC, the Hydrofluorocarbons (HFCs) rule:

- For manufacturers:
 - Adding centrifugal chillers used for heating or for heating and cooling, and ice machines, to existing prohibitions on the use of certain refrigerants
 - Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs. (pounds).
 - Setting maximum GWP thresholds for certain refrigerants used in new air conditioning equipment.
 - Setting maximum GWP thresholds for certain refrigerants in small containers of refrigerant and nonessential consumer products.
 - Establishing exemptions for certain products using refrigerants that would otherwise be prohibited.
 - Amending and adding labeling requirements.
 - Adding recordkeeping requirements.
 - Establishing a variance process and criteria.
- For facilities with refrigeration or air conditioning systems:
 - Establishing refrigerant management program (RMP) registration requirements

¹³ UNEP. 2020. Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, 14th edition. United Nations Environment Programme. Nairobi, Kenya.

¹⁴ *ibid*

¹⁵ https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-2-f&chapter=27

- Setting implementation fees and annual fees.
- Requiring leak inspection and monitoring.
- Setting leak rate thresholds and establishing notification requirements.
- Establishing requirements for leak repair, timing, and verification.
- Establishing requirements for retrofit and retirement plans.
- Establishing an exemption process and criteria.
- Establishing reporting requirements.
- Establishing recordkeeping requirements.
- For refrigerant wholesalers, distributors, and reclaimers:
 - Establishing registration requirements.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For service technicians:
 - Establishing required service practices.
- Making additional updates to Chapter 173-443 WAC without material impact, including expanding the rule title.

The amendments also make changes to Chapter 173-455 WAC, the Air Quality Fee Rule.

1.3 Reasons for the amendments

In 2021, the Legislature passed Engrossed Second Substitute House Bill 1050, which included amendments to the Hydrofluorocarbons — Emissions Reduction law, Chapter 70A.60 RCW. The 2021 law directed Ecology to:

- Enforce a maximum GWP threshold for substances used in ice rinks.
- Establish a refrigerant management program (RMP) to address refrigerant emissions from large stationary refrigeration and air conditioning equipment.

The law also authorized Ecology to set a maximum GWP threshold for substances used in:

- New stationary refrigeration equipment.
- New stationary air conditioning equipment containing more than 50 lbs. of refrigerant.

1.4 Document organization

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

- **Baseline and the rule amendments (Chapter 2):** Description and comparison of the baseline (what would occur in the absence of the rule amendments) and the rule requirements.
- **Likely costs of the rule amendments (Chapter 3):** Analysis of the types and sizes of costs we expect impacted entities to incur as a result of the rule amendments.
- **Likely benefits of the rule amendments (Chapter 4):** Analysis of the types and sizes of benefits we expect to result from the rule amendments.
- **Cost-benefit comparison and conclusions (Chapter 5):** Discussion of the complete implications of the CBA.
- **Least-Burdensome Alternative Analysis (Chapter 6):** Analysis of considered alternatives to the contents of the rule amendments.
- **Regulatory Fairness Act Compliance (Chapter 7):** When applicable. Comparison of compliance costs for small and large businesses; mitigation; impact on jobs.
- **APA Determinations (Appendix A):** RCW 34.05.328 determinations not discussed in chapters 5 and 6.

Chapter 2: Baseline and Rule Amendments

2.1 Introduction

We analyzed the impacts of the rule amendments relative to the existing rule, within the context of all existing requirements (federal and state laws and rules). This context for comparison is called the baseline, and reflects the most likely regulatory circumstances that entities would face if the rule was not adopted. It is discussed in Section 2.2, below.

2.2 Baseline

The baseline for our analyses generally consists of existing rules and laws, and their requirements. This is what allows us to make a consistent comparison between the state of the world with and without the rule amendments.

For this rulemaking, the baseline includes:

- The existing rule: Chapter 173-443 WAC, Hydrofluorocarbons (HFCs).
- The authorizing statute: Chapter 70A.60 RCW, Hydrofluorocarbons – Emissions Reduction (ES2HB 1112 passed in 2019; ES2HB 1050 passed in 2021).
- The United States Clean Air Act, 42 USC 7401 et seq.
- The American Innovation and Manufacturing (AIM) Act of 2020, 42 USC 7675.
- EPA Significant New Alternatives Policy (SNAP) Program, 40 CFR Part 82, Subpart G.
- EPA HFC Allowance Allocation and Reporting Program, 40 CFR Part 84, Subpart A.
- The EPA Technology Transitions rule: 88 FR 73098, Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under Subsection (i) the American Innovation and Manufacturing Act of 2020.¹⁶
- The Kigali Amendment (2016) to the Montreal Protocol on Substances that Deplete the Ozone Layer.

While they are not elements of baseline regulations in Washington State or at the federal level, we note the following are regulations that may apply to some of the entities impacted by the rule amendments, if they sell products across multiple markets. Entities affected by similar regulations across multiple jurisdictions in which they do business may be able to take advantage of economies of scale, for example mitigating cost increases by streamlining production attributes for products sold across entire regions.

¹⁶ In June 2023, the US Court of Appeals for the District of Columbia Circuit affirmed the EPA's authorization to regulate HFCs as proposed in the Technology Transitions rule. The court did, however, vacate the EPA's proposed restrictions on refillable containers and container tracking requirements. *Heating, Air Conditioning, & Refrigeration Distributors International, et al., v. Environmental Protection Agency and Michael S Regan, 2023. USCA Case #21-1251, Document #2003935. Argued November 18, 2022. Decided June 20, 2023.*

- California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4, Sub article 5. Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Stationary Air-conditioning, and Other End-Uses.
- California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4, Sub article 5.1 Management of High Global Warming Potential Refrigerants for Stationary Sources.

2.3 Rule amendments

The rule amendments make the following changes to Chapter 173-443 WAC, the Hydrofluorocarbons (HFCs) rule:

- For manufacturers:
 - Adding centrifugal chillers used for heating or for heating and cooling, and ice machines, to existing prohibitions on the use of certain refrigerants
 - Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs. (pounds).
 - Setting maximum GWP thresholds for certain refrigerants used in new air conditioning equipment.
 - Setting maximum GWP thresholds for certain refrigerants in small containers of refrigerant and nonessential consumer products.
 - Establishing exemptions for certain products using refrigerants that would otherwise be prohibited.
 - Amending and adding labeling requirements.
 - Adding recordkeeping requirements.
 - Establishing a variance process and criteria.
- For facilities with refrigeration or air conditioning systems:
 - Establishing refrigerant management program (RMP) registration requirements
 - Setting implementation fees and annual fees.
 - Requiring leak inspection and monitoring.
 - Setting leak rate thresholds and establishing notification requirements.
 - Establishing requirements for leak repair, timing, and verification.
 - Establishing requirements for retrofit and retirement plans.
 - Establishing an exemption process and criteria.
 - Establishing reporting requirements.

- Establishing recordkeeping requirements.
- For refrigerant wholesalers, distributors, and reclaimers:
 - Establishing registration requirements.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For service technicians:
 - Establishing required service practices.
- Making additional updates to Chapter 173-443 WAC without material impact, including expanding the rule title.

The amendments also make changes to Chapter 173-455 WAC, the Air Quality Fee Rule.

2.3.1 Amendments to manufacturer requirements

Baselines, amendments, and expected impacts described in this section reflect the assumption that compliance behavior would be undertaken by manufacturers. We acknowledge that other participants along supply chains may incur some of the costs discussed in this section if manufacturers decide to pass on their compliance costs to their customers in the form of higher prices, but in the interest of avoiding double-counting of costs or benefits, we made the simplifying assumption that costs would be borne by manufacturers where this information was unavailable or unknown.

2.3.1.1 Adding centrifugal chillers and ice machines to existing prohibitions

Baseline

Under the baseline, Chapter 173-443 WAC lists specific prohibited substances and the prohibition effective dates for various end-uses of new products and equipment. This list includes, but is not limited to the following products and equipment:

- Air conditioning:
 - Centrifugal chillers (cooling only), effective 2024.
 - Positive displacement chillers (cooling only), effective 2024.
- Refrigeration:
 - Remote condensing units, effective 2020.
 - Stand alone units, effective 2020.

The baseline EPA Technology Transitions rule includes a list of prohibited substances in various end-uses, including automated commercial ice machines, effective 2027 for self-contained and remote automatic commercial ice machines. The Technology Transitions rule also includes a 2026 prohibition on self-contained units using refrigerant with GWP greater than 150.

Adopted

The rule amendments add the following chillers to baseline prohibitions starting in 2025:

- Centrifugal chillers (heating; heating and cooling), effective 2025.
- Positive displacement chillers (heating; heating and cooling), effective 2025.

The rule also lists automatic commercial ice machines with expanded lists of prohibited refrigerants, rather than applying a maximum GWP threshold. The list included in our rule matches the list for ice machines with more than 500 grams of refrigerant in the federal Technology Transitions rule, for:

- Refrigeration:
 - Automatic commercial ice machines (remote condensing units), effective 2025.
 - Automatic commercial ice machines (stand alone units), effective 2025.

Expected impact

Ecology's rule amendments are likely to result in costs associated with manufacturers of centrifugal and positive displacement chillers used for heating or heating and cooling, switching to unlisted replacement refrigerants.

This results in corresponding benefits of reduced GHG emissions from these types of chillers. Refrigerant leakage will occur when using centrifugal and positive displacement chillers.

2.3.1.2 Setting maximum GWP thresholds for new refrigeration equipment

Baseline

Ecology's baseline HFC rule does not contain GWP thresholds. The 2021 law established specific GWP thresholds and effective dates for new equipment used in ice rinks. In particular, the 2021 law set the following GWP thresholds for new equipment manufactured after December 31, 2023:

- 150 GWP threshold for new equipment installed in new ice rinks; and
- 750 GWP threshold for new equipment installed in existing ice rinks.

The EPA Technology Transitions rule establishes GWP thresholds and prohibitions for a set of end uses of new refrigeration equipment. In particular, the EPA Technology Transition rule sets the following GWP thresholds:

- 300 GWP threshold for new refrigeration equipment with less than 200 lbs. charge capacity, effective in 2026;
- 150 GWP threshold for new refrigeration equipment with more than 200 lbs. charge capacity, effective in 2026; and
- 700 GWP threshold for chillers used for industrial process refrigeration, effective in 2026 or 2028, depending on exiting fluid temperature.

Adopted

The rule amendments add GWP thresholds for substances consistent with the EPA Technology Transitions rule, except:

- Our rule sets a 150 GWP threshold¹⁷ for all new refrigeration equipment with charge capacities exceeding 50 lbs.¹⁸.
- Our rule sets a 750 GWP threshold for chillers used for industrial process refrigeration.

Our rule also incorporates the GWP thresholds and effective dates for ice rinks from the state law.

We initially proposed that the rule treat retrofitted equipment as new, including retrofits in the definition of new equipment. The adopted amendments instead remove retrofitted equipment from the definition of new equipment, and set later effective dates of 2029 for retrofits.

We also proposed that the rule allow sale of equipment manufactured before the effective date of restrictions. The adopted rule amendments instead allow refrigeration equipment manufactured before January 1, 2024 to be sold, leased, rented, installed, or otherwise introduced into Washington commerce until January 1, 2026.

Expected impact

The rule amendments are likely to result in costs beginning in 2025, associated with restrictions on new refrigeration equipment that are more stringent than the EPA Technology Transitions rule. In particular, for new refrigeration equipment with charge capacities exceeding 50 lbs. but less than 200 lbs., our rule establishes a GWP threshold of 150, which is more stringent than the EPA Technology Transitions rule's GWP threshold of 300.¹⁹

This increased stringency will result in an inability to sell new refrigeration equipment for use in specific sectors in Washington, if they use substances with a GWP greater than 150 and have a charge capacity between 50 lbs. and 200 lbs.

Our rule amendments are likely to result in benefits beginning in 2025, of lower GHG emissions resulting from the leakage from, and eventual disposal of, new refrigeration equipment with GWP exceeding our thresholds when the rule is more stringent than the baseline, as listed above.

The ability to sell refrigeration equipment manufactured before January 1, 2024 will continue to mitigate these costs, though in the case of later effective dates it will do so to a smaller degree than the proposed rule would have. Limiting sales of this equipment to before 2026 will also reduce the degree to which this allowance mitigates compliance costs. The adopted sell

¹⁷ Thresholds are not inclusive of the threshold value. For example, refrigerants with a GWP of exactly 150 would not exceed the 150 threshold.

¹⁸ RCW 70A.60.010(3)(a) does not authorize Ecology to set a GWP threshold for refrigeration equipment with a charge capacity of 50 lbs. or less. However, once the EPA's TT rule is adopted, the 300 GWP threshold will apply to that subset of small refrigeration equipment that doesn't have a WA-specific GWP threshold.

¹⁹ This is consistent with California regulations.

through provisions will, however, reduce potential program leakage over time, by eliminating the possibility that older equipment not meeting restrictions will continue to circulate, leak, and emit GHGs well into the future. Simultaneously, they reduce incentives to build up additional stock before the effective dates of the restrictions, which would exacerbate potential future emissions risk.

Delaying effective dates for retrofits will also mitigate compliance costs associated with meeting the new restrictions. It provides more time for necessary planning at facilities with existing equipment.

2.3.1.3 Setting maximum GWP thresholds for new air conditioning equipment

Baseline

RCW 70A.60.020, which was added by the 2021 law, authorizes but does not require Ecology to set a 750 GWP threshold for substances used in new stationary air conditioning (excluding chillers) and sets the earliest dates such prohibitions could begin. In particular, the 2021 law established the following as the earliest possible effective dates for the specified types of air conditioning equipment:

- Dehumidifiers and room air conditioners: January 1, 2023
- Systems with variable refrigerant flow or volume: January 1, 2026
- All other types of stationary air conditioning equipment:
 - January 1, 2025, if the Washington State Building Code Council (WSBCC) adopted four specified safety standards by January 1, 2023; or
 - 24 months after the WSBCC's adoption of the specified safety standards, if adopted after January 1, 2023.

The WSBCC did not adopt all four safety standards specified in RCW 70A.60.020(2)(b)(i) by January 1, 2023. They are expected to adopt all the relevant standards in late 2023.

The EPA Technology Transitions rule sets a GWP limit of 700 for:

- Air conditioning except variable refrigerant flow systems, beginning in 2025.
- Variable refrigerant flow systems, beginning in 2026.

Adopted

The rule sets a 750 GWP threshold²⁰ for substances used in new air conditioning equipment as follows:

- Room air conditioners and residential dehumidifiers, effective 2024. This is one year later than the earliest possible effective date for this type of equipment.

²⁰ Thresholds are not inclusive of the threshold value. For example, refrigerants with a GWP of exactly 750 would not exceed the 750 threshold.

- Variable refrigerant flow or volume systems, effective 2026. This is the earliest possible effective date for this type of equipment.
- Other types of air conditioning equipment used in residential and nonresidential applications, effective on the earlier of:
 - 24 months after the four specified safety standards are adopted by the WSBC, or
 - January 1, 2026, if standards are not adopted. This is based on our understanding that the state building code council will adopt the four specified safety standards in late 2023.

We initially proposed that the rule treat retrofitted equipment as new, including retrofits in the definition of new equipment. The adopted amendments instead remove retrofitted equipment from the definition of new equipment, and set later effective dates of 2029 for retrofits.

We also proposed that the rule allow sale of equipment manufactured before the effective date of restrictions. The adopted rule amendments instead allow air conditioning equipment manufactured before January 1, 2024 to be sold, leased, rented, installed, or otherwise introduced into Washington commerce until January 1, 2026.

Expected impact

The rule amendments are likely to result in costs associated with the new restrictions on substances used in new stationary room air conditioners and residential dehumidifiers, for the year 2024. Beginning in 2025, the more stringent baseline EPA restrictions will drive compliance.

These costs are associated with inability to sell new air conditioning equipment in Washington in 2024, if such equipment was manufactured after the applicable effective date and uses substances with GWP greater than 750.

The rule amendments are likely to result in benefits beginning in 2024, of lower GHG emissions resulting from the decreased use and eventual disposal of air conditioning equipment with GWP exceeding our threshold.

The ability to sell air conditioning equipment manufactured before January 1, 2024 will continue to mitigate these costs, though in the case of later effective dates it will do so to a smaller degree than the proposed rule would have. Limiting sales of this equipment to before 2026 will also reduce the degree to which this allowance mitigates compliance costs. The adopted sell through provisions will, however, reduce potential program leakage over time, by eliminating the possibility that older equipment not meeting restrictions will continue to circulate, leak, and emit GHGs well into the future. Simultaneously, they reduce incentives to build up additional stock before the effective dates of the restrictions, which would exacerbate potential future emissions risk.

Delaying effective dates for retrofits will also mitigate compliance costs associated with meeting the new restrictions. It provides more time for necessary planning at facilities with existing equipment.

2.3.1.4 Setting maximum GWP thresholds for small containers and nonessential consumer products

Baseline

RCW 70A.60.080, which was amended by the 2021 law, prohibits the use of substances with greater than 150 GWP in small containers of refrigerant and nonessential consumer products. These statutory prohibitions went into effect on July 25, 2021.

Adopted

The rule amendments incorporate the new statutory prohibitions without change.

Expected impact

We do not expect this amendment to result in costs or benefits as compared to the baseline.

2.3.1.5 Establishing exemptions

Baseline

The 2021 law established acceptable uses (exemptions) for specified substances for certain end use categories.

For refrigeration equipment, the 2021 law also exempts:

- Equipment with 50 lbs. or less of refrigerant.
- Replacement of components in existing facilities as part of normal maintenance.
- Facilities with new equipment with a building permit issued before the effective date of the amended rule.

Under the 2021 law, stationary air conditioning equipment is also exempt for facilities with new equipment with a building permit issued before the effective date.

Adopted

The rule amendments establish new exemptions consistent with additional prohibitions being adopted (see previous sections). These exemptions include certain applications of centrifugal chillers and positive displacement chillers:

- Using HFC-134a for some military marine vessels.
- Using HFC-134a and R-404A for some human-related spacecraft and support equipment).

They also include exemptions for mission-critical military end-uses.

Our rule also incorporates the other statutory exemptions described above.

Expected impact

These rule amendments are not likely to result in costs. Instead, they are likely to result in mitigation of what compliance costs would otherwise be if the additional exemptions were not adopted.

2.3.1.6 Amending and adding labeling requirements

Baseline

Under the 2019 and 2021 laws, manufacturers of products and equipment using substances that are listed under the existing rule (see previous sections in 2.3.1) must meet labeling requirements, unless their products are exempt.

RCW 70A.60.060(4)(c), added by the 2021 law, requires Ecology to allow for alternative disclosure methods if Ecology determines that compliance with the applicable labeling requirement is not feasible for a particular product or equipment.

RCW 70A.60.020(5), added by the 2021 law, authorized Ecology to establish labeling requirements for new stationary air conditioning and refrigeration equipment that is subject to our GWP thresholds.

Adopted

The amendments implement the statutory directive to allow for alternative disclosure methods by specifying the required contents and process for requesting approval to use alternative disclosure methods.

The rule amendments also establish new, separate labelling and disclosure requirements, consistent with the EPA rule, for the following equipment subject to our GWP thresholds:

- New refrigeration equipment.
- New air conditioning equipment.

These new labelling requirements will require an on-product label with the following information, including existing labels that meet these content requirements:

- Name or designation of the substance in the equipment.
- GWP of the substance.
- Date of manufacture or import.
- Refrigerant charge.

Expected impact

Given the simultaneous removal and addition of alternative compliance options for labeling under these rule amendments, we do not expect them to result in significant costs or benefits as compared to the baseline, beyond the benefit of providing clarity.

2.3.1.7 Adding recordkeeping requirements

Baseline

RCW 70A.60.060 requires Ecology to establish reporting and recordkeeping requirements. The existing rule includes reporting and recordkeeping requirements for manufacturers of products containing substances that are restricted under the baseline.

The EPA Technology Transition rule includes reporting requirements and 3-year recordkeeping requirements for covered products.

Adopted

The rule amendments specify that existing reporting requirements apply to products and equipment using substances that are restricted under with amended requirements:

- Air conditioning:
 - Centrifugal chillers (heating; heating and cooling), effective 2025.
 - Positive displacement chillers (heating; heating and cooling), effective 2025.
- Refrigeration:
 - Automatic commercial ice machines (remote condensing units), effective 2025.
 - Automatic commercial ice machines (stand alone units), effective 2025.

The rule amendments also establish new, separate recordkeeping requirements, consistent with the EPA rule, for new stationary air conditioning and refrigeration equipment that are subject to our GWP thresholds. Records include:

- Sector or subsector.
- Refrigerant type.
- Date of manufacture or import.
- Name of the company to which the product was sold.
- Bill of lading.
- Invoice.

The rule requires an additional 2 years of records retention: 5-year retention of records compared to the 3 years required in the EPA rule.

Expected impact

These rule amendments are likely to result in minimal costs of retaining records for an additional two years, which is minimal in light of the option of maintaining records in an electronic format.

These amendments are likely to result in benefits associated with additional and clear information about product contents and compliance along the supply chain.

During the public comment period for this rulemaking, we received comments expressing concern that labeling, tracking, and reporting refrigerant type would impose high compliance burden and disrupt existing processes in the distribution chain. Our analysis, however, accounts for the baseline federal requirements, under the AIM Act and EPA Technology Transitions rule, which already require these compliance activities. We do not, therefore, expect our rule amendments to result in additional cost beyond these baseline requirements.

2.3.1.8 Establishing a variance process and criteria

Baseline

RCW 70A.60.020(5)(c), added by the 2021 law, gives Ecology the authority to grant variances from GWP thresholds and associated requirements for new stationary air conditioning and refrigeration equipment.

Adopted

The rule amendments establish three types of variances, with associated eligibility criteria, for which manufacturers can apply by demonstrating that issuance of the requested variance would not increase overall risk to human health or the environment. A manufacturer applying for such a variance must demonstrate one the following circumstances applies:

- **Impossibility:** Compliant substances are not available.
- **Force majeure:** Compliance is not possible due to a force majeure event.
- **Economic hardship:** A retail food facility or small business would be forced to close or suffer a substantial loss of revenue if required to comply.

Applicants also need to demonstrate they made a good faith effort to anticipate, address, and mitigate potential noncompliance.

The rule establishes the application process for a variance, including:

- Required application contents.
- Application submittal process.
- Approval and disapproval process and criteria.

Expected impact

These amendments are not likely to result in costs as compared to the baseline. They are, however, likely to result in benefits by mitigating the extent to which GWP thresholds may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities, which could also impact consumers.

2.3.2 Amendments to requirements for facilities

2.3.2.1 Establishing refrigerant management program (RMP) registration requirements

Baseline

RCW 70A.60.030, added by the 2021 law, directs Ecology to adopt rules to implement a refrigerant management program (RMP) applicable to stationary refrigeration and air conditioning systems using refrigerants with a GWP greater than 150 and with a volume of 50 or more lbs., and installation and servicing of these systems.

RCW 70A.60.030(3) establishes annual registration requirements that apply to the owner or operator of a stationary refrigeration or air conditioning system with a charge capacity of 50 lbs. or more.

Under RCW 70A.60.030(7), Ecology must adopt rules requiring the following entities to provide an annual report to Ecology:

- Facilities with refrigeration or air conditioning system with a full charge of at least 50 lbs. of refrigerant with a GWP greater than 150.
- Any person who wholesales, distributes, or reclaims any amount of refrigerant with a GWP greater than 150.

Under RCW 70A.60.030(8), Ecology is also authorized to adopt rules establishing service practices for stationary appliances, which may include reporting requirements for technicians.

The statute also allows Ecology to phase in RMP requirements over time based on the relative full charge of refrigeration or air conditioning systems.

Adopted

The rule amendments incorporate the annual RMP registration requirement from the 2021 law. The rule also establishes reporting requirements applicable to:

- Facilities with refrigeration or air conditioning system with a full charge of at least 50 lbs. of refrigerant with a GWP greater than 150.
- Any person who wholesales, distributes, or reclaims any amount for refrigerant with a GWP greater than 150.
- Any person who installs, repairs, maintains, services, or disposes of refrigeration or air conditioning equipment.

The rule phases in the requirement to register and provide information to Ecology based on:

- Full charge of refrigerant with a GWP greater than 150.
- Initial operating date of the refrigeration or air conditioning system.

Registration entails providing detailed information to Ecology about:

- The facility, ownership, operation, and industry.

- Refrigeration or air conditioning system attributes and manufacturer information.

Wholesalers, distributors, and reclaimers of any amount of refrigerant with a GWP greater than 150 are also required to register with Ecology and provide detailed information about the facility with which they interact (including facility information, ownership, operation, and industry).

Expected impact

These rule amendments are likely to result in costs associated with registration and reporting. They are also likely to result in benefits of comprehensive tracking of information and data from facilities, wholesalers, distributors, reclaimers, and service personnel that use or deal with refrigerants. This will provide better information to Ecology and support program tracking, future regulatory decisions, and the effective and confident reduction in the use of refrigerants with a GWP greater than 150 in Washington.

2.3.2.2 Setting implementation fees and annual fees

Baseline

RCW 70A.60.030(9), added by the 2021 law, gives Ecology authority to charge fees to cover the costs of implementing the RMP. Fees must be based on the direct and indirect costs of administering and enforcing the RMP.

The statute also allows Ecology to phase in RMP requirements over time based on the relative full charge of refrigeration or air conditioning systems.

Adopted

The rule amendments set an initial implementation fee of \$150 for facilities with refrigeration or air conditioning systems with a full charge of at least 1,500 lbs. of refrigerant with a GWP greater than 150.

The rule amendments also set an annual implementation fee for facilities with refrigeration or air conditioning systems with full charge of at least 200 lbs. of refrigerant with a GWP greater than 150 as follows:

- Beginning in 2024: \$370 for facilities whose equipment has a full charge of at least 1,500 lbs.
- Beginning in 2026: \$170 for facilities whose equipment has a full charge of between 200 and 1,499 lbs.

Ongoing fees (beginning in 2025 and 2027, respectively) will be established using a process consistent with the updating process for other air quality-related fees. This is specified in a new section of the Air Quality fee rule, in WAC 173-455-160 (see discussion in Section 2.3.7).

Expected impact

These rule amendments will result in costs of paying the applicable fees, beginning in 2024. They will also result in benefits of a fully funded RMP and the services it provides.

2.3.2.3 Requiring leak inspection and monitoring

Baseline

RCW 70A.60.030, added by the 2021 law, directs Ecology to establish requirements for leak detection and monitoring as part of the RMP. At a minimum, RCW 70A.60.030(6) requires the owner or operator of a registered stationary air conditioning or refrigeration system to inspect for leaks each time significant amounts of refrigerant are added to the system.

RCW 70A.60.030(5) authorizes Ecology to scale the requirements for periodic leak-detection inspections based on the relative full charge of the refrigeration or air conditioning systems. RCW 70A.60.030(5) also authorizes Ecology to exempt systems that use low-GWP substances or that have automatic leak-detection systems from the requirements for periodic inspections.

Adopted

The rule amendments set leak inspection requirements for facilities with year-round refrigeration and air conditioning systems²¹ with a full charge capacity of at least 1,500 lbs., beginning in 2024. These include:

- Monthly leak inspections unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.
- Within 24 hours of an alert from an automatic leak detection system.

The rule amendments also set requirements for automatic leak detection for year-round refrigeration systems with a full charge capacity of at least 1,500 lbs., beginning in 2025, if:

- A refrigerant circuit is located entirely within an enclosed structure.
- The compressor, evaporator, condenser, or other component of the system is located in an enclosed structure.

The above requirements for automatic leak detection do not apply if the system will be replaced or retrofitted to use refrigerant with GWP less than 150 before 2027.

Automatic leak detection systems can be direct systems that detect the presence of refrigerant in the air, or they can be indirect systems that interpret measurements to indicate a refrigerant leak.

Direct automatic leak detection systems must be calibrated to:

- Detect concentrations of 10 ppm (parts per million).
- Alert the operator when concentration of 100 ppm is reached.

²¹ The owner or operator of a facility that has a refrigeration or air conditioning system that is not intended to operate year-round must conduct a leak inspection of the full system within 30 days after starting each operation of the system, and once every three months thereafter until the system is shut down.

Indirect automatic leak detection systems must be calibrated to alert the owner or operator when measurements indicate a loss of 50 pounds of refrigerant or 10 percent of the system's full charge, whichever is less.

The rule amendments also require both types of automatic leak detection systems to be annually audited and calibrated using manufacturer recommended procedures.

For facilities with refrigeration or air conditioning systems with full charge between over 200 and 1,500 lbs., beginning in 2026 the rule amendments require:

- Quarterly leak inspection unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.

For facilities with refrigeration or air conditioning systems with full charge between 50 and 200 lbs., beginning in 2024 the rule amendments require:

- Annual leak inspection unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.

Expected impact

These rule amendments are likely to result in costs associated with performing leak inspections. They are also likely to result in benefits of earlier identification of leaks.

We note that in addition to being a regulatory requirement under the 2021 law, increased leak inspections are incentivized by the cost of refrigerants. Leaks result in a need to replace refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly.

2.3.2.4 Setting leak rate thresholds and establishing notification requirements

Baseline

The EPA has existing leak-related requirements and leak rate thresholds for any person maintaining, servicing, or repairing appliances containing class I, class II, or non-exempt substitute refrigerants²², for the following uses, under Section 608 of the Clean Air Act:²³

- Industrial process refrigeration.

²² Certain classes of ozone-depleting substances.

²³ 40 CFR Part 82, Subpart F. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-82/subpart-F>

- Commercial refrigeration.
- Comfort cooling.
- Other covered appliances.

RCW 70A.60.030(7)(f), added by the 2021 law, requires Ecology to establish leak rate thresholds that achieve greater emissions reductions than the federal rules adopted by EPA.

Adopted

The rule amendments set thresholds for leak rates and associated notification requirements. These include, for facilities with refrigeration or air conditioning systems with full charge of at least 50 lbs.:

- Calculation of leak rates during each leak inspection and each time refrigerant is added, using a 12-month rolling average.
- Notification to Ecology of any exceedance of the following leak rate thresholds:
 - 16 percent for commercial or retail refrigeration.
 - 24 percent for industrial process refrigeration.
 - 8 percent for air conditioning.
- Deadlines for reporting verification test results after leak repair.

Expected impact

These rule amendments are likely to result in costs associated with:

- Efforts to calculate leak rates during each inspection or addition of refrigerant.
- Notification to Ecology when leak rate thresholds are exceeded.
- Reporting of verification tests after repairs.

These rule amendments are likely to result in benefits of:

- Consistent and comprehensive leak rate calculation and notification.
- Consistent follow up when leaks resulting in leak rates that exceed thresholds are repaired.

We note that there are facilities and systems for which baseline requirements and the amended rule requirements could overlap. Since we cannot confidently identify the scope of these special circumstances in which more-limited or less-stringent baseline EPA requirements for ozone depleting substances would mitigate costs incurred under our rule amendments, we chose to conservatively overestimate costs by considering full costs of compliance with the rule amendments.

2.3.2.5 Establishing requirements for leak repair, timing, and verification

Baseline

The EPA has existing leak-related requirements and leak rate thresholds for any person maintaining, servicing, or repairing appliances containing class I, class II, or non-exempt substitute refrigerants, for the following uses, under Section 608 of the Clean Air Act:²⁴

- Industrial process refrigeration.
- Commercial refrigeration.
- Comfort cooling.
- Other covered appliances.

EPA requirements include timing requirements for corrective action if the applicable EPA leak rate thresholds (“triggers”) are exceeded. These include:

- Repairing leaks within 30 days, or 120 days for industrial process shutdown.
- Conducting initial and follow-up verification tests at the conclusion of any repair efforts.
- Retrofit or retirement plans for appliances instead of repairing the leaks; if the owner or operator fails to take action to identify or repair the leaks; or if an appliance continues to leak after having conducted repairs and verification testing.

RCW 70A.60.030(7)(a), added by the 2021 law, requires Ecology to adopt rules that require leaking systems to be repaired within a specified amount of time.

Adopted

The rule amendments establish timing and other requirements for leak repair, beginning in 2024, including:

- Repairs must be performed by a certified technician.
- Repairs must be completed within 14 days unless a 45-day or 120-day allowance is merited.
- A 45-day allowance for repairs may be merited if:
 - A certified technician is not available.
 - Necessary parts are not available.
 - The repair requires an industrial process shutdown that would temporarily stop manufacturing.
- A 120-day allowance for repairs may be merited if:
 - The facility is a mandatory reporter of greenhouse gas (GHG) emissions under the state’s Greenhouse Gas Reporting Rule (Chapter 173-441 WAC).

²⁴ 40 CFR Part 82, Subpart F. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-82/subpart-F>

- The system is an industrial process refrigeration system.
- The repair requires an industrial process shutdown that would temporarily stop manufacturing.

The amendments require verification tests upon completion of leak repairs, as well as follow-up verification tests within 14 days of reaching normal operating conditions for a system that requires evacuation to conduct a repair.

Expected impact

The rule amendments will result in repairs being required earlier than under the EPA requirements. To the extent that these rule amendments result in earlier repair of leaks, they will result in benefits of reduced GHG emissions.

We note that in addition to being a regulatory requirement, rapid leak repair is incentivized by the cost of refrigerants. Leaks result in a need to replace refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly. There may be multiple reasons and internal business decisions for a facility to delay repairs, and in these cases the amendments require documentation (an additional cost) that will benefit both Ecology's RMP and potentially the business by necessitating careful consideration and focus on leak repair decisions.

2.3.2.6 Establishing requirements for retrofit and retirement plans

Baseline

The EPA has existing leak-related requirements and leak rate thresholds for any person maintaining, servicing, or repairing appliances containing class I, class II, or non-exempt substitute refrigerants, for the following uses, under Section 608 of the Clean Air Act:²⁵

- Industrial process refrigeration.
- Commercial refrigeration.
- Comfort cooling.
- Other covered appliances.

These leak-related EPA requirements include development of a retrofit or retirement plan within 30 days of detecting a leak in excess of leak thresholds:

- A copy of the plan must be kept on site.
- Plans must be implemented and completed within one year from the date of the plan.
- Additional time is allowed under certain conditions for industrial process refrigeration and federally owned appliances.

²⁵ 40 CFR Part 82, Subpart F. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-82/subpart-F>

- Retrofit and repair requirements may not apply to appliances with full charge of at least 50 lbs. if second repair efforts are successful, or if leak rates fall below thresholds within 180 days.

RCW 70A.60.030(7)(b), added by the 2021 law, requires Ecology to adopt rules requiring leaking systems that are not capable of being repaired to be retrofitted, replaced, or retired.

Adopted

The rule amendments require facilities with refrigeration or air conditioning systems with a full charge of at least 50 lbs. of refrigerant with a GWP greater than 150, with leaks that are not capable of being repaired within the applicable timeframes and are not exempt, to prepare and implement a retrofit or retirement plan meeting the following requirements:

- Retrofit or retirement schedules must be at most 6 months.
- A copy of the plan must be kept on site.
- The plan must describe the retrofit or new system.
- Plans must be submitted to Ecology if leak rate thresholds are exceeded, within 90 days of the end of the leak repair timeframe.

Expected impact

These rule amendments are likely to result in earlier retrofit or retirement than under the baseline, and will result in costs of developing and submitting plans.

Earlier retrofit or retirement could have associated costs of earlier expenditures, as well as benefits of earlier retrofit or retirement eliminating leaks that were otherwise unable to be repaired in a timely fashion.

We note that in addition to being a regulatory requirement, retrofitting or retiring leaking equipment than cannot be repaired is incentivized by the cost of refrigerants. Leaks result in a need to replace refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly.

2.3.2.7 Establishing exemption criteria and process for leak repair, retrofit, and replacement.

Baseline

RCW 70A.60.030(8)(b), added by the 2021 law, authorizes Ecology to establish a process for wholesalers, distributors, reclaimers, and equipment operators to apply for an exemption from rule requirements related to leak repair and retrofit or replacement. The statute authorizes Ecology to grant such exemptions on the basis of economic hardship, natural disaster, or based on a calculation of the impact on lifecycle GHG emissions.

Adopted

The rule amendments add three types of exemptions, with associated eligibility criteria, for which facilities can apply by demonstrating that approval of the requested exemption would

not increase overall risk to human health or the environment. An entity applying for such an exemption will also need to demonstrate one of the following circumstances applies:

- Impossibility: Needed repair components are not available.
- Force majeure: Compliance is not possible due to a force majeure event.
- Economic hardship: A retail food facility or small business would close or suffer a substantial loss of revenue.

Applicants will also need to demonstrate they made a good faith effort to anticipate, address, and mitigate potential noncompliance.

The rule establishes the application process for an exemption, including:

- Required application contents.
- Application submittal process.
- Approval and disapproval process and criteria.

Expected impact

These amendments are not likely to result in costs as compared to the baseline. They are, however, likely to result in benefits by mitigating the extent to which the leak repair, retrofit, and retirement requirements may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities, which could also impact consumers.

2.3.2.8 Establishing reporting requirements

Baseline

RCW 70A.60.030(7), added by the 2021 law, directs Ecology to establish annual reporting requirements for facilities, including information about:

- System service and leak repair.
- Purchase and use of refrigerants.

The statute also directs Ecology to require refrigerant wholesalers, distributors, and reclaimers to report annually.

Under RCW 70A.60.030(8), Ecology is also authorized to adopt rules establishing service practices for stationary appliances, which may include reporting requirements for technicians.

Adopted

The rule amendments specify the timing and required contents of annual reports. Timing requirements include reporting by March of the calendar year following the first year in which the system begins operating:

- Facilities with systems with full charge of at least 1,500 lbs.: First reports due in 2025 at the earliest.

- Facilities with systems with full charge of less than 1,500 lbs.: First reports due in 2027 at the earliest.
- Reports are due annually thereafter.

Annual facility reports must include:

- System information.
- Service and leak repair information.
- Refrigerant purchases and use information.

The rule amendments also require refrigerant wholesalers, distributors, and reclaimers to report annually for the previous calendar year, beginning in 2025 for 2024. Information in the report includes:

- For wholesalers and distributors:
 - Statewide aggregated data.
 - Contact information.
 - Refrigerant distribution information.
- For reclaimers:
 - Statewide aggregated data.
 - Contact information.
 - Refrigerant reclamation information.

Expected impact

These rule amendments will result in costs to facilities and wholesalers, distributors, and reclaimers, beginning in:

- 2025 for wholesalers, distributors, and reclaimers.
- 2025 for facilities with systems with full charge greater than 1,500 lbs.
- 2027 for facilities with systems with full charge of 200 lbs. to 1,500 lbs.

The above costs are associated with developing and submitting annual reports.

The rule amendments will result in benefits associated with comprehensive and consistent information for Ecology to track progress in achieving the goals of the law in Chapter 70A.60 RCW, as well as in ongoing regulatory planning.

2.3.2.9 Establishing recordkeeping requirements

Baseline

The EPA has existing requirements for class I, class II, or non-exempt substitute refrigerants, for the following uses at facilities:²⁶

- Industrial process refrigeration.
- Commercial refrigeration.
- Comfort cooling.
- Other covered appliances.

EPA requirements include recordkeeping requirements for three years.

RCW 70A.60.030(7)(e), added by the 2021 law, directs Ecology to adopt recordkeeping requirements for facility operators as well as refrigerant wholesalers, distributors, and reclaimers.

Adopted

The rule amendments require recordkeeping beginning in 2024. Facilities with refrigeration or air conditioning systems with full charge of at least 50 lbs. of refrigerant with a GWP greater than 150 are required to maintain the following records on site for at least 5 years:

- Registration information.
- Leak-related documentation.
- System service and repair documentation.
- Retrofit or retirement plans.
- Reports.
- Applications for exemptions or variance.
- Replacement plans.
- Invoices of refrigerant purchases.
- Records of shipments of refrigerants for reclamation or destruction.
- Records of all data, measurements, calculations, and assumptions to determine full charge.

The rule amendments also require refrigerant wholesalers, distributors, and reclaimers to maintain the following records on site for at least 5 years, beginning in 2024:

- Annual reports.
- Invoices of refrigerants received or distributed.

²⁶ 40 CFR Part 82, Subpart F. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-82/subpart-F>

- Documentation that purchasers employ at least one certified technician.

Expected impact

These rule amendments are likely to result in costs of an additional two years of records retention compared to the baseline, which is minimal in light of the option of maintaining records in an electronic format.

These amendments are likely to result in benefits associated with comprehensive and consistent information for Ecology to track progress in achieving the goals of the law in Chapter 70A.60 RCW, including inspection of records and follow up.

2.3.3 Amendments to requirements for wholesalers, distributors, and reclaimers

The rule amendments establish requirements for refrigerant wholesalers, distributors, and reclaimers, as follows. As the requirements for wholesalers, distributors, and wholesalers align with a subset of requirements for facilities, the baseline and rule amendments for these requirements are discussed in the corresponding sections listed below.

- Establishing registration requirements (see Section 2.3.2.1).
- Establishing reporting requirements (see Section 2.3.2.8).
- Establishing recordkeeping requirements (see Section 2.3.2.9).

2.3.4 Amendments to requirements for service technicians

2.3.4.1 Establishing required service practices

Baseline

RCW 70A.60.030(8)(a), added by the 2021 law, authorizes Ecology to adopt rules establishing required service practices for stationary appliances. The rules may include requirements for service technician certification and prohibitions on practices that are likely to result in releases to the environment.

Service practices are required by the EPA under their Phaseout of Ozone-Depleting Substances (ODS) program, for class I and class II controlled substances.

Adopted

The rule amendments require the same service practices for HFCs as are required under the baseline for other refrigerants that are also ODS. The rule amendments also require that additional refrigerant charge may not be added to equipment known to have a leak unless the charge is needed to maintain operations while preparing for or conducting repairs.

Expected impact

We do not expect these amendments to result in significant costs or benefits as compared to the baseline. This includes the additional requirement regarding adding charge to leaky

systems, as this requirement is consistent with other service requirements in combination with the requirements and exemption options for leak repairs.

2.3.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law

Baseline

The 2021 law added new definitions, terminology, and specifications to Chapter 70A.60 RCW. The existing rule does not reflect these aspects of the 2021 law.

Adopted

The rule amendments update the existing rule to align with the 2021 law. They also add definitions that do not, in and of themselves, have impact on the substantive requirements of the rule. Their minimal impacts, if any, are addressed in the context of the new requirements discussed in previous sections.

The rule amendments also change the title of the rule to “Hydrofluorocarbons (HFCs) and Other Fluorinated Gases” to reflect the broader scope of rule amendments.

As compared to the rule language we initially proposed during this rulemaking, the final adopted rule includes additional clarifications with no material impact, in response to comments and questions received during the public comment period. It also separates, but does not change the meaning of new equipment and retrofit equipment.

Expected impact

We do not expect these amendments to have material impacts on costs or benefits as compared to the baseline.

2.3.6 Making corresponding changes to the Air Quality Fee Rule

Baseline

Chapter 173-455 WAC is the primary location of fees associated with Ecology Air Quality programs, including how they are updated over time.

Adopted

The rule amendments add a new section to Chapter 173-455 WAC to establish the RMP implementation fees authorized by the 2021 law. This amendment facilitates annual updating of the RMP implementation fees consistent with updating other Air Quality fees. Before updating any RMP implementation fees, Ecology must:

- Prepare a draft workload analysis and budget that reflects the anticipated cost of administering and enforcing the refrigerant management program over the coming year compared to the total fees collected under this section during the previous year.
- Post the draft workload analysis, budget, and proposed fee change on Ecology’s website by August 1st of the year before the calendar year in which the change will take effect.

- Provide a 30-day public comment period on the draft workload analysis, budget, and proposed fee change.
- Post the final workload analysis, budget, and new annual implementation fee by December 1st of the year before the new fee takes effect.

Expected impact

We expect this rule amendment to result in an increase of implementation fees charged over time as needed to reflect the actual costs of the workload associated with administering and enforcing the RMP.

Chapter 3: Likely Costs of the Rule Amendments

3.1 Introduction

We analyzed the likely costs associated with the rule amendments, as compared to the baseline. The rule amendments and the baseline are discussed in detail in Chapter 2 of this document.

3.1.1 Data variability

In developing the cost estimates for this analysis, we examined results using two distinct datasets identifying potentially impacted facilities in Washington:

- Dun & Bradstreet (<https://www.dandb.com/>)
- Data Axle (<https://www.data-axle.com/>)

We noted these datasets were variably comparable in identifying facilities in Washington, and in facility details provided (such as square footage):

- In the aggregate, the datasets were comparable for refrigeration, though Data Axle data indicated a larger proportion of large covered facilities than Dun & Bradstreet.
- The datasets differed significantly in identification and details of businesses with likely air conditioning. Data Axle potentially covered entity numbers were an order of magnitude larger than those identified by Dun & Bradstreet.

There are multiple likely explanations for these differences, including:

- Different size categorization and industry categorization practices across business data aggregators. This could include groupings of square footage categories, or choice of NAICS listing for businesses operating in multiple industries.
- Different timing for underlying data gathering. Particularly with regard to air conditioning, a changing climate and experience of high-heat events may impact the degree to which air conditioning is reflected in data gathered at different times.
- An update to the North American Industry Classification System (NAICS) codes and industry categorizations during the data-gathering phase of this rulemaking.
- The COVID-19 pandemic. Business closures (temporary, permanent, or unclear due to difficulty receiving a response) may have also affected data gathering and data quality.

To reflect these types of uncertainty in the facility data underlying our estimates of costs and benefits, we performed our analyses using both datasets.

3.2 Cost analysis

The amendments make the following changes to Chapter 173-443 WAC, the Hydrofluorocarbons (HFCs) rule:

- For manufacturers:
 - Adding centrifugal chillers used for heating or for heating and cooling to existing prohibitions on the use of certain refrigerants
 - Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs. (pounds).
 - Setting maximum GWP thresholds for certain refrigerants used in new air conditioning equipment.
 - Setting maximum GWP thresholds for certain refrigerants in small containers of refrigerant and nonessential consumer products.
 - Establishing exemptions for certain products using refrigerants that would otherwise be prohibited.
 - Amending and adding labeling requirements.
 - Adding recordkeeping requirements.
 - Establishing a variance process and criteria.
- For facilities with refrigeration or air conditioning systems:
 - Establishing refrigerant management program (RMP) registration requirements
 - Setting implementation fees and annual fees.
 - Requiring leak inspection and monitoring.
 - Setting leak rate thresholds and establishing notification requirements.
 - Establishing requirements for leak repair, timing, and verification.
 - Establishing requirements for retrofit and retirement plans.
 - Establishing an exemption process and criteria.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For refrigerant wholesalers, distributors, and reclaimers:
 - Establishing registration requirements.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For service technicians:
 - Establishing required service practices.
- Making additional updates to Chapter 173-443 WAC without material impact, including expanding the rule title.

The amendments also make changes to Chapter 173-455 WAC, the Air Quality Fee Rule.

3.2.1 Amendments to manufacturer requirements

3.2.1.1 Adding centrifugal chillers and commercial ice machines to existing prohibitions

We used data from the Building Services Research & Information Association (BSRIA)²⁷ to estimate the number of chillers in Washington in 2025, excluding those that are cooling-only air conditioning. The data identified real and estimated numbers of the following types of chillers in the United States capable of heating or heating and cooling, in 2019 - 2021:

- Reciprocating
- Screw
- Scroll
- Centrifugal

We note that all identified centrifugal chillers were cooling only (air conditioning) for all years; none were identified as capable of heating or heating and cooling. We scaled these national counts on a GDP basis to Washington State.²⁸

The BSRIA data also identified the types of refrigerants used by different types of chillers. In 2020, all screw chillers used R134A and scroll chillers used R404A. The forecast percentages (by volume of sales) shifted away from these refrigerants to some degree, and toward R1233zd, R1234ze, and R513A.²⁹ Using BSRIA's growth rate of 2 percent per year, we estimated between 10 and 13 new chillers in 2025 that would be affected by the rule amendments.

In 2020, the California Air Resources Board (CARB) stated that chiller manufacturers indicated that switching to low-GWP refrigerant would cost between twice and five times the baseline \$3 per pound (lb.) price.³⁰ This resulted in an estimated price of between \$6 and \$15 per lb.. Using this range of per-lb. price increases, and a weighted low-end average of 149 lbs. per chiller across all identified potential manufacturers,³¹ we estimated total annual costs between about \$5,000 and \$22,000 across all affected chillers.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost

²⁷ BSRIA, 2020. Central Plant Air Conditioning – Chillers, In-depth Analysis 2020. USA. Report 101437/2. October 2020.

²⁸ US Bureau of Economic Analysis, 2023. GDP by State. <https://www.bea.gov/data/gdp/gdp-state>.

²⁹ BSRIA, 2020. Central Plant Air Conditioning – Chillers, In-depth Analysis 2020. USA. Report 101437/2. October 2020.

³⁰ California Air Resources Board, 2020. Public hearing to consider the proposed amendments to the prohibitions on use of certainty hydrofluorocarbons in stationary refrigeration, chillers, aerosols-propellants, and foam end-uses regulation. Staff Report: Initial Statement of Reasons. October 20,2020.

³¹ Dun & Brandstreet, 2023. Market Insight. Database tool.

of having funds later versus now.³² Based on the annual costs above, we estimated the 20-year PV costs of this rule amendment as between about \$80,000 and \$385,000.

We also estimated the costs of the rule amendment requirement for ice machines to switch to lower-GWP refrigerants one year earlier. We again used BSRIA data³³ on the:

- Volume of evaporator units annually installed in the United States (over 9 thousand).
- Percent using a prohibited refrigerant (12 percent).
- Percent of units used for making ice (3 percent).

We then scaled this number of units to Washington State using relative GDP values.³⁴ This resulted in less than one unit potentially being impacted in Washington in 2025. Based on the difference in the cost of high versus low-GWP refrigerant discussed earlier in this section³⁵, we estimated that this expenditure could cost up to \$1,500 in the first year. Spending these funds one year earlier (the amended rule's 2025 restriction compared to the baseline 2026) would result in approximately \$35 in present value costs.³⁶ This is the opportunity cost and inflation loss associated with spending \$1,500 one year earlier.

3.2.1.2 Setting maximum GWP thresholds for new refrigeration equipment

The rule amendments are likely to result in costs beginning in 2025, associated with restrictions on new refrigeration equipment that are more stringent than the EPA Transitions rule. In particular, for new refrigeration equipment with charge capacities exceeding 50 lbs. but less than 200 lbs., our rule establishes a GWP threshold of 150, which is more stringent than the EPA Technology Transitions rule's GWP threshold of 300.

This increased stringency will result in an inability to sell new refrigeration equipment for use in the following sectors in Washington, if they use substances with a GWP greater than 150 and with between 50 lbs. and 200 lbs. charge capacity.

³² Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

³³ BSRIA, 2019. Industrial Refrigeration. Report US1705/1 Edition 2. September 2019.

³⁴ US Bureau of Economic Analysis, 2023. GDP by State. <https://www.bea.gov/data/gdp/gdp-state>.

³⁵ California Air Resources Board, 2020. Public hearing to consider the proposed amendments to the prohibitions on use of certainty hydrofluorocarbons in stationary refrigeration, chillers, aerosols-propellants, and foam end-uses regulation. Staff Report: Initial Statement of Reasons. October 20,2020.

³⁶ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

We estimated these costs using data from the California Air Resources Board (CARB), which implemented similar rules in 2020, on the incremental installation costs of equipment using substances with less than 150 GWP.³⁷ The table below summarizes this input data.

Table 2. Incremental costs of switching to refrigerant with GWP<150.

End-Use Sector	System Size	Equipment	Installation	Equipment increase	Installation increase
retail food refrigeration	large	20%	10%	\$191,600	\$43,100
retail food refrigeration	med	20%	10%	\$43,800	\$9,850
retail food refrigeration	small	20%	10%	\$15,300	\$3,440
other commercial refrigeration	large	20%	10%	\$134,000	\$14,400
other commercial refrigeration	med	20%	10%	\$30,600	\$3,280
other commercial refrigeration	small	20%	10%	\$10,720	\$1,150
industrial process cooling	large	20%	20%	\$182,400	\$82,200
industrial process cooling	med	20%	20%	\$58,600	\$26,400
industrial process cooling	small	20%	20%	\$19,800	\$8,920
cold storage	large	20%	20%	\$226,000	\$101,400
cold storage	med	20%	20%	\$49,000	\$22,000
cold storage	small	20%	20%	\$21,600	\$9,680

We also incorporated CARB data on the incremental refrigerant and electricity costs per system associated with this more stringent GWP threshold.³⁸

³⁷ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

³⁸ Ibid.

Table 3. Change in refrigerant costs per system, of switching to refrigerant with GWP<150.

Category	Low	High
retail food refrigeration (large, medium, and small)	-\$56	-\$2,800
Industrial Process Refrigeration (IPR) (large, medium, and small)	-\$33	-\$2,500
Cold storage (large, medium, and small)	-\$15	-\$3,800

Table 4. Change in electricity costs per system, of switching to refrigerant with GWP<150.

Category	Reduction
IPR (large only)	-\$3,500
Cold storage (large, medium, and small)	-\$3,500

We identified the following numbers of end-use facilities that would be impacted by the rule amendments, as they would have a charge capacity between 50 and 200 lbs..

Table 5. Facilities by type of system, Dun & Bradstreet.

Category	Count
Retail refrigeration	5,687
Cold storage warehouse	1,317
IPR (except chillers)	484

Based on the ranges in the above tables, combined with counts of likely affected facilities by type of system, with differences from the baseline as discussed above, we estimated a range of annual costs from small systems in:

- Retail refrigeration.
- Cold storage.
- Industrial process refrigeration (IPR)

We conservatively assumed all identified facilities would immediately invest in new equipment, meaning that all capital expenditures would occur in 2025, with subsequent years resulting in a cost-savings on refrigerant and electricity. In reality, these expenditures could occur later, or could be financed differently over time, reducing the first-year and present value of these costs.

In our Preliminary Regulatory Analyses, we compared the proposed rule amendments to a baseline that included the proposed EPA Technology Transitions rule. The proposed Technology Transitions rule included a 2025 effective date for GWP thresholds on refrigeration equipment. During the public comment period for this rulemaking, the EPA adopted the final Technology Transitions rule, with effective dates of 2026 or 2028 (depending on system attributes). Because we made conservative assumptions in our cost estimation in the Preliminary Regulatory Analyses (that capital expenditures would occur in 2025, and be the result of Ecology’s rule amendments rather than the later baseline restrictions), we have not adjusted our cost estimates for this Final Regulatory Analyses document.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost

of having funds later versus now.³⁹ The range of total PV costs across all identified facilities impacted was estimated to be between -\$25.8 million (a net cost-savings due to 20 years of savings on refrigerant and electricity) and \$292.5 million (a net cost due to higher up-front costs outweighing the stream of subsequent savings).⁴⁰

We also estimated these costs using facility counts from Data Axle, below.

Table 6. Facilities by type of system, Data Axle.

Category	Count
Retail refrigeration	1,270
Cold storage warehouse	2,152
IPR (except chillers)	459

This alternative set of assumed impacted facilities resulted in a range of 20-year PV costs between \$-62.8 million and \$123.6 million.

The rule requirements we initially proposed during this rulemaking included retrofitted equipment in the definition of new equipment. The adopted rule amendments instead separate retrofits and assign them a later effective date of January 1, 2029. This will mitigate compliance costs resulting from the adopted GWP thresholds. Due to data limitations, however, we could not identify which facilities would purchase new equipment versus retrofit existing equipment. We have therefore retained the cost estimates above from the Preliminary Regulatory Analyses for this rulemaking, and acknowledge they are likely overestimates as they do not capture cost-mitigation associated with later effective dates for retrofitted equipment.

The adopted amendments also mitigate compliance costs by allowing sale of equipment manufactured before January 1, 2024. The January 1, 2026 end date of this provision limits the extent of this cost mitigation, balancing it with risk of program leakage over time (see Section 4.2.1.2). We similarly could not identify the degree to which existing stock would be built up, sold, or priced or marketed differently than under the baseline, and so have retained our initial cost estimates to avoid overestimating this mitigation and underestimating costs.

³⁹ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

⁴⁰ Note that installation costs of low-GWP systems may decrease over time, as markets and availability increase. This is consistent with stakeholder feedback Ecology received during the development of the rule amendments.

3.2.1.3 Setting maximum GWP thresholds for new air conditioning equipment

The rule amendments are likely to result in costs associated with the new restrictions on substances used in new stationary room air conditioners and residential dehumidifiers, for the year 2024. Beginning in 2025, the more stringent baseline EPA restrictions will drive compliance.

These costs are associated with inability to sell new air conditioning equipment in Washington in 2024, if such equipment was manufactured after the applicable effective date and uses substances with GWP greater than 750.

To estimate costs, we used CARB data, from a similar rulemaking, on the numbers of the following types of new stationary air conditioning units in California by year.⁴¹ We then scaled this data to Washington State using the relative share of homes with air conditioning in each state (53% in Washington versus 72% in California)⁴² and relative numbers of households (2.9 million in Washington versus 13.2 million in California).⁴³ We note that climate change may result in increased rates of air conditioning adoption over time in areas of Washington that do not currently have high air conditioning rates.

We estimated costs using the conservative assumption that manufacturers and other entities along the supply chain would change the products they manufacture specifically to meet Washington state requirements. Other compliance options include changing where different products are marketed, and reducing costs by using lessons learned from compliance with other jurisdictions with large markets like California. Manufacturers could also decide, based on internal business decisions, to market uniform products across their sales areas.

Manufacturers for California indicated that costs passed on to purchasers would be reflected by the table below, from which we applied the costs associated with small self-contained air conditioning.⁴⁴

Table 7. Costs passed on to purchaser of Air Conditioning equipment.

small self-contained AC	Residential	Non-residential (average)
\$25	\$32	\$141

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost

⁴¹ BSRIA, 2020. Central Plant Air Conditioning – Chillers, In-depth Analysis 2020. USA. Report 101437/2. October 2020.

⁴² Energy Institute at HAAS, 2022. How Many US Households Don't Have Air Conditioning? Energy Institute Blog. Posted August 15, 2022 by Lucas Davis.

⁴³ US Census Bureau, 2022. QuickFacts database. <https://www.census.gov/quickfacts/fact/table/US/HCN010217>.

⁴⁴ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19, 2020.

of having funds later versus now.⁴⁵ Combining the above assumptions resulted in year 2024 costs of approximately \$11 million. The 20-year PV of these costs is also \$11 million.

The rule requirements we initially proposed during this rulemaking included retrofitted equipment in the definition of new equipment. The adopted rule amendments instead separate retrofits and assign them a later effective date of January 1, 2029. This will mitigate compliance costs resulting from the adopted GWP thresholds. Due to data limitations, however, we could not identify which facilities would purchase new equipment versus retrofit existing equipment. We have therefore retained the cost estimates above from the Preliminary Regulatory Analyses for this rulemaking, and acknowledge they are likely overestimates as they do not capture cost-mitigation associated with later effective dates for retrofitted equipment.

The adopted amendments also mitigate compliance costs by allowing sale of equipment manufactured before January 1, 2024. The January 1, 2026 end date of this provision limits the extent of this cost mitigation, balancing it with risk of program leakage over time (see Section 4.2.1.3). We similarly could not identify the degree to which existing stock would be built up, sold, or priced or marketed differently than under the baseline, and so have retained our initial cost estimates to avoid overestimating this mitigation and underestimating costs.

3.2.1.4 Setting maximum GWP thresholds for small containers and nonessential consumer products

We do not expect this amendment to result in any costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

3.2.1.5 Establishing exemptions

These rule amendments are not likely to result in costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments. Instead, they are likely to result in mitigation of what compliance costs would otherwise be if the additional exemptions were not adopted.

3.2.1.6 Amending and adding labeling requirements

Given the simultaneous removal and addition of alternative compliance options for labeling under these rule amendments, we do not expect them to result in significant costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

During the public comment period for this rulemaking, we received comments expressing concern that labeling, tracking, and reporting refrigerant type would impose high compliance burden and disrupt existing processes in the distribution chain. Our analysis, however, accounts for the baseline federal requirements, under the AIM Act and EPA Technology Transitions rule,

⁴⁵ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

which already require these compliance activities. We do not, therefore, expect our rule amendments to result in additional cost beyond these baseline requirements.

3.2.1.7 Adding recordkeeping requirements

The rule amendments are likely to result in costs of retaining records for an additional two years, which is minimal in light of the option of maintaining records in an electronic format.

3.2.1.8 Establishing a variance process and criteria

These amendments are not likely to result in costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

3.2.2 Amendments to requirements for facilities

3.2.2.1 Establishing refrigerant management program (RMP) registration requirements

These rule amendments are likely to result in costs associated with registration.

We estimated costs using a total count of 16,709 potentially affected facilities using Dun & Bradstreet data,⁴⁶ assuming one hour was required to complete and submit registration. At a median hourly wage of \$23.04, for “Office and administrative support occupations”,⁴⁷ this amendment would result in a one-time cost of \$384,974. As this cost would be incurred in 2024, the PV cost is \$381,578. Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁴⁸

Using Data Axle data, these 20-year PV costs rise in proportion to the number of registering facilities. With over 76,000 facilities, the 20-year PV costs are approximately \$1.7 million.

3.2.2.2 Setting implementation fees and annual fees

These rule amendments will result in costs of paying the applicable fees, beginning in 2024.

We estimated these costs based on the facility counts in the table below.⁴⁹

⁴⁶ Dun & Bradstreet, 2023. Market Insight database. We note that there are currently about 15 entities that operate in wholesaling, distribution, or reclamation of refrigerants in Washington.

⁴⁷ US Bureau of Labor Statistics, 2022. May 2022 State Occupational Employment and Wage Estimates. Washington State. https://www.bls.gov/oes/current/oes_wa.htm.

⁴⁸ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

⁴⁹ Dun & Bradstreet, 2023. Market Insight database.

Table 8. Facilities by size and type subject to fees, Dun & Bradstreet.

Category	Facilities
Large Refrigeration Equipment	519
Medium Refrigeration Equipment	1881
Large air conditioning Equipment	116
Medium air conditioning Equipment	1025

We estimated total fees collected for 20 years of implementation, beginning in 2024. We also assumed that medium and large facilities would gradually phase down their use of refrigerants with a GWP greater than 150 (a goal of the rule and statute), using a schedule consistent with assumptions made by CARB⁵⁰ according to the following schedule. We conservatively assumed the phase-down would occur in a stepwise manner, after the last year of each timeframe.

Table 9. Phase-down schedule of share of baseline facilities using refrigerant with a GWP greater than 150.

Years	Percent Covered
2024 – 2028	60%
2029 – 2033	30%
2034 – 2035	20%
2036 and thereafter	15%

Total fees would begin at about \$330,000 in 2024, falling to \$137,000 by 2043. Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁵¹ The total PV over 20 years for this cost would be \$7.4 million.

Using the Data Axle facility counts below, the larger number of fee payers would result in total fees beginning at about \$3.9 million in the first year, rising to \$8.6 million when medium facilities are covered, and then falling in line with the phase-down schedule to about \$1.4 million by 2043. This would result in approximately \$78.6 million in 20-year PV costs.

⁵⁰ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19, 2020.

⁵¹ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

Table 10. Facilities by size and type subject to fees, Data Axle

Category	Facilities
Large Refrigeration Equipment	1,904
Medium Refrigeration Equipment	2,363
Large air conditioning Equipment	5,594
Medium air conditioning Equipment	25,350

We note that there is a significant difference in fees used to fund the RMP, depending on the underlying facility dataset. If facility counts are low, the service demands for the program would also be lower, resulting in a lower funding need. Similarly, if facility counts are high, service demands would also be higher, resulting in the larger funding need.

3.2.2.3 Requiring leak inspection and monitoring

The rule amendments set leak inspection requirements for facilities with year-round refrigeration and air conditioning systems using refrigerants with a GWP greater than 150 with a full charge capacity of at least 50 lbs., beginning in 2024.

For facilities using 1,500 lbs. or more of refrigerant with a GWP greater than 150, the amendment requirements include:

- Monthly leak inspections unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.
- Within 24 hours of an alert from an automatic leak detection system.

The rule amendments also set requirements for automatic leak detection for refrigeration systems with a full charge capacity of at least 1,500 lbs., beginning in 2025, if:

- A refrigerant circuit is located entirely within an enclosed structure.
- The compressor, evaporator, condenser, or other component of the system is located in an enclosed structure.

The above requirements for automatic leak detection do not apply if the system will be replaced or retrofitted to use low-GWP refrigerant before 2027.

Automatic leak detection systems can be direct systems that detect the presence of refrigerant in the air, or they can be indirect systems that interpret measurements to indicate a refrigerant leak.

Direct automatic leak detection systems must be calibrated to:

- Detect concentrations of 10 ppm (parts per million).
- Alert the operator when concentration of 100 ppm is reached.

Indirect automatic leak detection systems must be calibrated to alert the owner or operator when measurements indicate a loss of 50 pounds of refrigerant or 10 percent of the system’s full charge, whichever is less.

The rule amendments also require both types of automatic leak detection systems to be annually audited and calibrated using manufacturer recommended procedures.

For facilities with refrigeration or air conditioning systems with a full charge of 200 lbs. or more but less than 1,500 lbs., beginning in 2026 the rule amendments require:

- Quarterly leak inspection unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.

For facilities with refrigeration or air conditioning systems with full charge between 50 and 200 lbs., beginning in 2024 the rule amendments require:

- Annual leak inspection unless automatic leak detection is installed.
- Leak inspections at the time of verification test or follow-up verification test.
- Leak inspections when at least 5 lbs. of refrigerant, or one percent of full charge (whichever is greater) is added.
- Leak inspections when oil residue indicates a refrigerant leak.

Since the amendments place different requirements on facilities based on the amount of refrigerant they use, we estimated costs on a per facility basis based on those requirements⁵². We then multiplied by the number of affected facilities in Washington.

The labor needed to conduct the inspections produces most of the cost associated with the amendments. We used time and cost estimates from the California Air Resources Board’s original analysis of their rule: “For all labor estimates an hourly labor rate of \$75 is used. This is a fully loaded (including overhead, benefits, etc.) average labor rate representing input from ICF International, stakeholders, the air quality control districts, and the ARB.”⁵³ Using the Bureau of Labor statistics Consumer Price Index calculator, we updated the value to \$103.50 as of May 2023. The results are summarized in the following table.

⁵² California Air Resources Board, 2009. Appendix C, Economic Impact Estimates – High-Global Warming Potential Stationary Source Refrigerant Management Program. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2009/gwprmp09/refappc.pdf>, plus ECI price estimate and stakeholder outreach.

⁵³ California Air Resources Board, 2009. Appendix C, Economic Impact Estimates – High-Global Warming Potential Stationary Source Refrigerant Management Program.

Table 11. Estimated compliance costs of leak monitoring and inspection requirements, Dun & Bradstreet facility counts.

System Size	Inspection Frequency /Labor time	Annual labor cost per facility	Estimated Number of Facilities	20 year PV Cost
Small AC and Refrigeration (50-200 lbs.)	Annual / 1 hour	\$103.5	12,850	\$7.6 million
Medium AC and Refrigeration (200-1,500 lbs.)	Quarterly / 4 hours	\$1,656	2,350	\$18.5 million
Large AC (>1,500 lbs.)	Monthly / 6 hours	\$7,452	116	\$4.9 million
Large Refrigeration (>1,500 lbs.)	Automatic Leak Detection System	\$2,401	379	\$8.8 million - \$15.7 million

Facilities with refrigeration systems using 1,500 pounds or more of refrigerant with a GWP greater than 150 are required to install automatic leak detection (ALD) systems by Jan. 1, 2025. We estimate the initial expense to purchase and install an ALD system ranges from \$11,200 to \$29,200, based on both CARB’s estimate and Ecology’s research. We conservatively assumed the covered facilities will incur this expense in the first year. The annual maintenance and operating expenses then add to the present value each year after.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁵⁴ We estimate the present value cost of the leak inspection requirements over 20 years to be between \$39.8 million and \$46.6 million.

Importantly, we assumed the number of facilities subject to the amendments would decrease in proportion to federal restrictions on the production and purchase of a set of widely used HFCs. The EPA’s authority to implement these restrictions resulted from the AIM Act of 2020. These restrictions are incentivizing the development of lower GWP refrigerants, and these factors are expected to produce a downward trend in use of HFCs with a GWP greater than 150.⁵⁵ This assumption reduces the number of facilities incurring costs from these amendments to 17 percent of those presently impacted by 2036. This assumption reduced the estimated costs by approximately two thirds.

Using Data Axle facility counts, these costs rise significantly, to between \$270.7 million and \$305.0 million in 20-year PV costs. The table below breaks down these costs by sub-category.

⁵⁴ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

⁵⁵ [Final Rule - Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the AIM Act | US EPA](#)

Table 12. Estimated compliance costs of leak monitoring and inspection requirements, Data Axle facility counts.

System Size	Inspection Frequency /Labor time	Annual labor cost per facility	Estimated Number of Facilities	20 year PV Cost
Small AC and Refrigeration (50-200 lbs.)	Annual / 1 hour	\$103.5	41,012	\$24.1 million
Medium AC and Refrigeration (200-1,500 lbs.)	Quarterly / 4 hours	\$1,656	27,713	\$202.1 million
Large AC (>1,500 lbs.)	Monthly / 6 hours	\$7,452	5,594	\$237.1 million
Large Refrigeration (>1,500 lbs.)	Automatic Leak Detection System	\$2,401	1,904	\$44,4 million - \$78,7 million

3.2.2.4 Setting leak rate thresholds and establishing notification requirements

These rule amendments are likely to result in costs associated with:

- Efforts to calculate leak rates during each inspection or addition of refrigerant.
- Notification to Ecology when leak rate thresholds are exceeded.
- Reporting of verification tests after repairs.

We estimated costs using a total count of 26,676 potentially affected facilities performing additional calculations annually, and up to 1,973 facilities needing to notify Ecology of exceedances.⁵⁶ We assumed a half-hour was required to complete additional calculations, and one hour was needed to complete a notification. At median hourly wages of \$103.50 for inspection technicians (including loading of overhead, travel, and associated costs of an external inspector)⁵⁷ and 23.04 for “Office and administrative support occupations”,⁵⁸ this amendment would result in annual costs of \$439,987.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁵⁹ The 20-year PV of this cost is \$4.2 million.

⁵⁶ Dun & Bradstreet, 2023. Market Insight database.

⁵⁷ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

⁵⁸ US Bureau of Labor Statistics, 2022. May 2022 State Occupational Employment and Wage Estimates. Washington State. https://www.bls.gov/oes/current/oes_wa.htm.

⁵⁹ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

Using higher Data Axle facility counts, this 20-year PV cost rises to \$16.7 million.

3.2.2.5 Establishing requirements for leak repair, timing, and verification

The rule amendments result in repairs being required earlier than under EPA requirements.

We could not confidently forecast how the rule amendments will affect the timing of actual leak repairs, as they may already occur earlier than the baseline EPA requirements. We can, however, consider the relative present value of costs incurred at different times, including the difference between the baseline EPA and our leak repair timeframes.

Internally to the facility in question, internal rates of return on invested capital may be higher than the social rate of time preference used in PV calculations, but for consistent analysis, all calculations must use the same discount rate. The table below summarizes the PV percentage savings on each dollar spent, depending on how much later it is spent. It illustrates the small difference in the present value of expenditures at different times when expenditures occur short timeframes earlier – such as one year earlier. The rule amendments shift leak repair expenditures by between approximately two weeks and 3.5 months, indicating the percentage present value cost increases would be a fraction of a percent of each dollar spent.

Table 13. Percent PV saved by difference in expenditure timing.

<u>Year</u>	<u>% of each \$ saved</u>
1	0.9%
2	1.8%
3	2.6%
4	3.5%
5	4.3%
6	5.2%
7	6.0%
8	6.8%
9	7.7%
10	8.5%

We note that in addition to being a regulatory requirement, rapid leak repair is incentivized by the cost of refrigerants. Leaks result in a need to replace refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly. There may be multiple reasons and internal business decisions for a facility to delay repairs, and in these cases the amendments require documentation (an additional cost) that will benefit both Ecology’s RMP and potentially the business by necessitating careful consideration and focus on leak repair decisions.

3.2.2.6 Establishing requirements for retrofit and retirement plans

These rule amendments are likely to result in earlier retrofit or retirement than under the baseline, and result in costs of developing and submitting plans.

Earlier retrofit or retirement could have associated costs of earlier expenditures. We could not confidently forecast how these rule amendments would affect the timing of this work and its

completion. We can, however, consider the relative present value of costs incurred at different times.

The table below summarizes the PV percentage savings on each dollar spent, depending on how much later it is spent. It illustrates the small difference in the present value of expenditures at different times when expenditures occur short timeframes earlier – such as one year earlier. The rule amendments shift system retrofit and retirement expenditures by between approximately two weeks and 3.5 months, indicating the percentage present value cost increases would be a fraction of a percent of each dollar spent.

Table 14. Percent PV saved by difference in expenditure timing.

Year	% of each \$ saved
1	0.9%
2	1.8%
3	2.6%
4	3.5%
5	4.3%
6	5.2%
7	6.0%
8	6.8%
9	7.7%
10	8.5%

3.2.2.7 Establishing an exemption process and criteria

These amendments are not likely to result in costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

3.2.2.8 Establishing reporting requirements

These rule amendments likely result in costs to facilities, wholesalers, distributors, and reclaimers, beginning in:

- 2025 for wholesalers, distributors, and reclaimers.
- 2025 for facilities with systems with full charge greater than 1,500 lbs.
- 2027 for facilities with systems with full charge between 50 and 1,500 lbs.

The above costs are associated with developing and submitting annual reports.

We estimated costs using a total count of: ⁶⁰

- 635 large facilities.
- 15 Washington wholesalers, distributors, and reclaimers.
- 2,906 medium facilities.

⁶⁰ Dun & Bradstreet, 2023. Market Insight database.

We assumed 16 hours for a large facility, wholesaler, distributor, or reclaimer to complete an annual report, and 8 hours for medium facilities. At a median hourly wage of \$39.25 for “Business and financial occupations”⁶¹ this rule results in annual costs beginning at about \$408,000 in 2025. Assuming the same phasedown schedule across our analysis (see Table 7), annual costs fall to \$220,000 by 2043.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁶² The 20-year PV of this cost is \$8.5 million.

Using the higher Data Axle facility counts below, these PV costs rise to \$87.2 million across:

- 7,497 large facilities.
- 15 Washington wholesalers, distributors, and reclaimers.
- 27,713 medium facilities.

3.2.2.9 Establishing recordkeeping requirements

These rule amendments result in costs of an additional two years of records retention compared to the baseline, which is minimal in light of the option of maintaining records in an electronic format.

3.2.3 Amendments to requirements for wholesalers, distributors, and reclaimers

The rule amendments establish requirements for refrigerant wholesalers, distributors, and reclaimers, as follows. As the requirements for wholesalers, distributors, and wholesalers align with a subset of requirements for facilities, the costs associated with these requirements are discussed in the corresponding sections listed below.

- Establishing registration requirements (see Section 3.2.2.1).
- Establishing reporting requirements (see Section 3.2.2.8).
- Establishing recordkeeping requirements (see Section 3.2.2.9).

⁶¹ US Bureau of Labor Statistics, 2022. May 2022 State Occupational Employment and Wage Estimates. Washington State. https://www.bls.gov/oes/current/oes_wa.htm.

⁶² Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

3.2.4 Amendments to requirements for service technicians

3.2.4.1 Establishing required service practices

We do not expect these amendments to result in significant costs as compared to the baseline. This includes the additional requirement regarding adding charge to leaky systems, as this requirement is consistent with other required service practices in combination with the amended rule requirements and exemption options for leak repairs.

3.2.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law

We do not expect these amendments to have material impacts on costs as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

3.2.6 Making corresponding changes to the Air Quality Fee Rule

We expect this rule amendment to result in an increase of implementation fees charged over time as needed to reflect the actual costs of the workload associated with administering and enforcing the RMP. This impact is reflected to the extent currently possible, above, in Section 3.2.2.2.

Chapter 4: Likely Benefits of the Rule Amendments

4.1 Introduction

We analyzed the likely benefits associated with the rule amendments, as compared to the baseline. The rule amendments and the baseline are discussed in detail in Chapter 2 of this document.

4.1.1 Data variability

In developing the benefits estimates for this analysis, we examined results using two distinct datasets identifying potentially impacted facilities in Washington:

- Dun & Bradstreet (<https://www.dandb.com/>)
- Data Axle (<https://www.data-axle.com/>)

We noted these datasets were variably comparable in identifying facilities in Washington, and in facility details provided (such as square footage):

- In the aggregate, the datasets were comparable for refrigeration, though Data Axle data indicated a larger proportion of large covered facilities than Dun & Bradstreet.
- The datasets differed significantly in identification and details of businesses with likely air conditioning. Data Axle potentially covered entity numbers were an order of magnitude larger than those identified by Dun & Bradstreet.

There are multiple likely explanations for these differences, including:

- Different size categorization and industry categorization practices across business data aggregators. This could include groupings of square footage categories, or choice of NAICS listing for businesses operating in multiple industries.
- Different timing for underlying data gathering. Particularly with regard to air conditioning, a changing climate and experience of high-heat events may impact the degree to which air conditioning is reflected in data gathered at different times.
- An update to the North American Industry Classification System (NAICS) codes and industry categorizations during the data-gathering phase of this rulemaking.
- The COVID-19 pandemic. Business closures (temporary, permanent, or unclear due to difficulty receiving a response) may have also affected data gathering and data quality.

To reflect these types of uncertainty in the facility data underlying our estimates of costs and benefits, we performed our analyses using both datasets.

4.2 Benefits analysis

The amendments make the following changes to Chapter 173-443 WAC, the Hydrofluorocarbons (HFCs) rule:

- For manufacturers:
 - Adding centrifugal chillers used for heating or for heating and cooling to existing prohibitions on the use of certain refrigerants
 - Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs. (pounds).
 - Setting maximum GWP thresholds for certain refrigerants used in new air conditioning equipment.
 - Setting maximum GWP thresholds for certain refrigerants in small containers of refrigerant and nonessential consumer products.
 - Establishing exemptions for certain products using refrigerants that would otherwise be prohibited.
 - Amending and adding labeling requirements.
 - Adding recordkeeping requirements.
 - Establishing a variance process and criteria.
- For facilities with refrigeration or air conditioning systems:
 - Establishing refrigerant management program (RMP) registration requirements
 - Setting implementation fees and annual fees.
 - Requiring leak inspection and monitoring.
 - Setting leak rate thresholds and establishing notification requirements.
 - Establishing requirements for leak repair, timing, and verification.
 - Establishing requirements for retrofit and retirement plans.
 - Establishing an exemption process and criteria.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For refrigerant wholesalers, distributors, and reclaimers:
 - Establishing registration requirements.
 - Establishing reporting requirements.
 - Establishing recordkeeping requirements.
- For service technicians:
 - Establishing required service practices.
- Making additional updates to Chapter 173-443 WAC without material impact, including expanding the rule title.

The amendments also make changes to Chapter 173-455 WAC, the Air Quality Fee Rule.

4.2.1 Amendments to manufacturer requirements

4.2.1.1 Adding centrifugal chillers and ice machines to existing prohibitions

These rule amendments are likely to result in benefits of avoided leakage of GHGs associated with reduced use of refrigerants with a GWP greater than 150 in chillers. This would only be benefits associated with incremental leakage from positive displacement and centrifugal chillers capable of heating or heating and cooling.

We used data from the Building Services Research & Information Association (BSRIA)⁶³ to estimate the number of chillers in Washington in 2025, excluding those that are cooling-only. The data identified real and estimated numbers of the following types of chillers in the United States capable of heating or heating and cooling, in 2019 - 2021:

- Reciprocating
- Screw
- Scroll
- Centrifugal

We note that all identified centrifugal chillers were cooling only for all years; none were identified as capable of heating or heating and cooling. We scaled these national counts on a GDP basis to Washington State.⁶⁴

The BSRIA data also identified the types of refrigerants used by different types of chillers. In 2020, all screw chillers used R134A and scroll chillers used R410A. The forecast percentages (by volume of sales) shifted away from these refrigerants to some degree, and toward R1233zd, R1234ze, and R513A.⁶⁵ Using BSRIA's growth rate of 2 percent per year, we estimated between 10 and 13 new chillers in 2025 that would be affected by the rule amendments.

Using a weighted low-end average of 149 lbs. per chiller across all identified potential manufacturers,⁶⁶ and range of GWP differences between replacement refrigerant (assumed to continue the trend toward R513A) and baseline refrigerants (1,430 lbs. carbon-dioxide equivalent (CO₂e) for R134A; 2,087.5 lbs. CO₂e for R410A), we estimated avoided GHG emissions of between 595 MT CO₂e and 1,306 MT CO₂e in 2025, with 2 percent annual growth afterward.

⁶³ BSRIA USA. 2020. Central Plant Air Conditioning - Chillers, In-depth Analysis 2020, Report 101437/2. USA: BSRIA USA.

⁶⁴ US Census Bureau, 2022. QuickFacts database. <https://www.census.gov/quickfacts/fact/table/US/HCN010217>.

⁶⁵ BSRIA USA. 2020. Central Plant Air Conditioning - Chillers, In-depth Analysis 2020, Report 101437/2. USA: BSRIA USA.

⁶⁶ Dun & Bradstreet, 2023. Market Insight database.

The Social Cost of Carbon (SCC)

To estimate the costs of emitting (or benefits of avoiding) a metric ton of GHG emissions, Ecology uses the Social Cost of Carbon (SCC) developed by the federal Interagency Working Group.⁶⁷ The SCC is an estimate of the global costs resulting from climate change associated with one additional metric ton of GHG emissions.

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.

We (as well as the federal Interagency Working Group (IWG) that developed the SCC cited in this analysis) acknowledge the limitations of any quantitative estimate of the SCC. 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 the following section, are necessary to consider when interpreting and applying the SCC estimates.”⁶⁸

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

⁶⁷ Interagency Working Group on Social Cost of Carbon, 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide. Interim Estimates under Executive Order 13990. February 2021.

⁶⁸ 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>

climate and non-climate goods at higher temperature increases, both of which have implications for the discount rate used.”⁶⁹

We note that these issues, among others, exist for all SCC estimates, 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 it is tied to not only the certainty of the 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 – carry greater uncertainty. We chose to use the SCC developed by the federal Interagency Working Group on Social Cost of Carbon 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 we wanted to use the estimate that uses the inputs most closely resembling those typically made in Ecology analyses in discounting social values.⁷⁰

In 2021, the federal government issued new interim values for the Social Cost of Carbon (SCC).⁷¹ These included median values estimated using three discount rates, as well as a set of values reflecting highly damaging scenarios. Ecology uses a discount rate based on the long-run average risk-free rate of return, approximated using the historic average return rate on US Treasury Department I Bonds. The current historic average rate is 0.89 percent.⁷² When using SCC values, Ecology uses estimates for the 2.5 percent discount rate, as this is the closest discount rate for which SCC values were available.

⁶⁹ 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.

⁷⁰ We note that the federal SCC was called into question by a federal district court in 2022 (*Louisiana v. Biden*, Federal District Court for the District of Louisiana, Case No. 2:21-CV-01074. Memorandum Decision, 2/11/2022). This decision was subsequently stayed by the 5th Circuit Court. The three-judge panel stated, “We conclude the standing inquiry shows the Government Defendants’ likelihood of success on the merits in this appeal, and the other factors, including the public interest, favor granting a stay of the injunction.” (*Louisiana v. Biden*, United States Court of Appeals for the Fifth Circuit, Case No. 22-30087. Document: 00516220740. Filed: 03/01/2022).

⁷¹ Interagency Working Group on Social Cost of Greenhouse Gases, 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. United States Government. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

⁷² US Treasury Department, 2023. I bonds interest rates. <https://www.treasurydirect.gov/savings-bonds/i-bonds/i-bonds-interest-rates/>.

Table 15: Social Cost of Carbon (2023\$).

Year	Median SCC 2.5% Discount Rate
2021	91.40367
2022	92.93947
2023	94.47527
2024	96.01107
2025	97.54687
2026	99.08267
2027	100.6185
2028	102.1543
2029	103.6901
2030	105.2259
2031	106.8287
2032	108.4315
2033	110.0344
2034	111.6384
2035	113.2412
2036	114.844
2037	116.4469
2038	118.0509
2039	119.6537
2040	121.2565
2041	122.8276
2042	124.3987
2043	125.9686

Global emissions context

Comments received on past rulemaking analyses involving the SCC expressed concern that global emissions contribution was not an appropriate measure of the benefits of a rule. We believe, 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 directly and indirectly through:

- International markets.
- Multinational businesses and supply chains.
- Trade.

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.⁷³ This approach is consistent with our analytic practices and the requirements of the APA 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 it 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 IWG addresses global SCC twofold in its interim 2021 Technical Support Document:⁷⁴

“First, the IWG found previously and is restating here that a global perspective is essential for SC-GHG estimates because climate impacts occurring outside U.S. borders can directly and indirectly affect the welfare of U.S. citizens and residents. Thus, U.S. interests are affected by the climate impacts that occur outside U.S. borders. Examples of affected interests include: direct effects on U.S. citizens and assets located abroad, international trade, tourism, and spillover pathways such as economic and political destabilization and global migration. In addition, assessing the benefits of U.S. GHG mitigation activities requires consideration of how those actions may affect mitigation activities by other countries, as those international mitigation actions will provide a benefit to U.S. citizens and residents by mitigating climate impacts that affect U.S. citizens and residents.

Second, the IWG found previously and is restating here that the use of the social rate of return on capital to discount the future benefits of reducing GHG emissions inappropriately underestimates the impacts of climate change for the purposes of estimating the SC-GHG (see Section 3.1 [of the TSD]). Consistent with the findings of the National Academies (2017) and the economic literature, the IWG continues to conclude that the consumption rate of interest is the theoretically appropriate discount rate in an intergenerational context (IWG 2010, 2013, 2016). The IWG recommends that discount rate uncertainty and relevant aspects of intergenerational ethical considerations be accounted for in selecting future discount rates.”

⁷³ 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. This means if costs estimated in Chapter 3 are incurred by a facility owned by a firm headquartered outside of Washington, those costs are included in the Cost-Benefit Analysis.

⁷⁴ Interagency Working Group on Social Cost of Greenhouse Gases, 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. United States Government. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

- The IWG previously addressed global SCC (as well as OMB guidance), and stated in its 2015 revised Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis:⁷⁵

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

- 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:⁷⁶

“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.]”

- The 2010 TSD addresses scaling of global benefits of reducing global GHG emissions, and states, “It is recognized that [scaling to domestic (US) SCC is] approximate, provisional,

⁷⁵ 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.

⁷⁶ 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.

and highly speculative. There is no logical 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 comments in support of global SCC:⁷⁷

“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.”

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

⁷⁷ Interagency Working Group on Social Cost of Carbon, 2015. Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis. July 2015. United States Government.

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, the IWG also responded to concerns regarding domestic damages:⁷⁸

"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

⁷⁸ Interagency Working Group on Social Cost of Carbon, 2015. Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis. July 2015. United States Government.

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 8th, 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:⁷⁹

⁷⁹ 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.”

- On July 15, 2020, the US District Court in the Northern District of California ruled to reinstate a 2016 US Bureau of Land Management Waste Prevention Rule that had been rolled back in 2018 based on an “interim domestic social cost of methane” that resulted in significantly lower estimates of benefits than had been found during the 2016 rulemaking. The Court found the 2018 rescission to be arbitrary and capricious, stating:⁸⁰

“The analysis ignores impacts on 8 million United States citizens living abroad, including thousands of United States military personnel; billions of dollars of physical assets owned by United States companies abroad; United States companies impacted by their trading partners and suppliers abroad; and global migration and geopolitical security.”

The discussion above concerning the application of the global SCC to valuation of domestic US GHG emissions reduction benefits applies equally to the application of the global SCC to the benefits of GHG emissions reductions in Washington. Washington’s economy is tied to the world economy through trade, international supply chains, and local employment by international firms.

- Washington exported an estimated \$69.9 billion in goods and \$28.8 billion in services in 2018.⁸¹
- International trade, including exports and imports, supported 940,800 Washington jobs in 2018.⁸²

⁸⁰ State of California and Sierra Club, et al. v. David Bernhardt, et al., Case No. 4:18-cv-05712-YGR, Consolidated case, Re: Dkt. Nos. 108, 109, 123, 125, 126, 127. US District Court, Northern District of California. Decided July 15, 2020.

⁸¹ Delaney, P, 2020. How Washington’s Economy Benefits from Trade and Investment. Business Roundtable. https://s3.amazonaws.com/brt.org/BRT_General_Trade_WA_2020.pdf

⁸² *Ibid.*

- 140,600 people in Washington are directly employed by US affiliates of foreign multinational companies.⁸³

As with the US economy as a whole, Washington is impacted directly and indirectly by economic disruptions outside the state.^{84, 85}

In 2017, authors at Carbon Brief addressed criticisms of the global SCC⁸⁶, noting:

- Scaling of global SCC to sub regions or populations:
 - Was rejected by the U.S. Seventh Circuit Court of Appeals.⁸⁷
 - Is not appropriate for global problems. For a global problem like climate change, consideration of local effects only is untenable, stating, “It’s worth asking what would happen if the US were to ignore global effects. If other countries were to follow suit, then a large proportion of global climate impacts would be ignored, falling between the cracks.”
 - Contradicts ethical arguments in favor of considering irreversible impacts of climate change like species extinction in other regions.
- While arguments have been made to use higher discount rates for the SCC, such as a 7 percent rate consistent with past federal government practice and internal corporate rates of return, there are valid arguments in favor of much lower or zero discount rates:
 - Accounting for the various uncertainties surrounding estimates of the SCC would increase the SCC value by 70 percent to 420 percent over current estimates.⁸⁸
- The federal SCC was ruled “reasonable and the best available measure to determine the environmental cost of CO₂” in 2016.⁸⁹

⁸³ US Bureau of Economic Analysis, 2020. Activities of U.S. Affiliates of Foreign Multinational Enterprises, 2018. <https://www.bea.gov/sites/default/files/2020-11/imne1120.pdf>

⁸⁴ For example, during 2014-2015 disruptions to west coast port services, Washington lost nearly \$770 million in economic activity, and over \$550 million in exports were not shipped, despite \$153 million shifting to air transportation. https://www.joc.com/port-news/longshoreman-labor/international-longshore-and-warehouse-union/us-west-coast-congestion-cost-washington-770-million-study-says_20160222.html

⁸⁵ During the significant worldwide disruption caused by the COVID-19 pandemic, Washingtonians encountered inconsistencies in product availability, and higher or uncertain prices due to worldwide disruptions to supply chains. <https://www.whitehouse.gov/cea/written-materials/2021/04/12/pandemic-prices-assessing-inflation-in-the-months-and-years-ahead/>

⁸⁶ CarbonBrief, 2017. Q & A: The social cost of carbon. February 14, 2017. <https://www.carbonbrief.org/qa-social-cost-carbon>

⁸⁷ *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. <http://media.ca7.uscourts.gov/cgi-bin/rssExec.pl?Submit=Display&Path=Y2016/D08-08/C:14-2159:J:Ripple:aut:T:fnOp:N:1807496:S:0>

⁸⁸ van den Bergh, J and W Botzen, 2014. A lower bound to the social cost of CO₂ emissions. *Nature Clim Change* 4, 253–258 (2014). <https://doi.org/10.1038/nclimate2135>

⁸⁹ *In the Matter of the Further Investigation into Environmental and Socioeconomic Costs under Minnesota Statutes Section 216B.2422, Subdivision 3*. State of Minnesota Office of Administrative Hearings. For the Public Utilities

In 2021, a group of prominent economists published arguments in favor of the global SCC, particularly as compared to a cost-based or cost-effectiveness approach to policy analysis that does not reflect the benefits of reduced or avoided climate change.⁹⁰ The authors argue that in contrast to more limited scope approaches, “the SCC inherently builds in the notion of reciprocity among countries because it reflects the global damages of emissions. A future in which all countries seek to guide domestic policy by using the SCC can lead to progress on addressing climate change in a globally efficient and least-cost way.”

That same year, using an empirical approach involving risk-free real rates of return on assets – consistent with Ecology’s approach to discount rates – economists at University of California Santa Barbara and University of Chicago argued for a maximum discount rate of 2 percent based on current trajectories.⁹¹ The authors also noted the discount rate appears to have entered a phase of decline over time (following a downward trend since about 1985), which could support arguments for using a diminishing discount rate.

We note that the federal SCC was called into question by a federal district court in 2022.⁹² This decision was subsequently stayed by the Fifth Circuit Court of Appeals.⁹³ The Fifth Circuit stated, “We conclude the standing inquiry shows the Government Defendants’ likelihood of success on the merits in this appeal, and the other factors, including the public interest, favor granting a stay of the injunction.” This ruling indicates that the Louisiana District Court’s injunction was unwarranted and issued in error. The plaintiffs sought an emergency order from the United States Supreme Court to vacate the Fifth Circuit’s stay, which the Supreme Court denied.⁹⁴ On remand, the Fifth Circuit ruled the plaintiffs did not have standing to bring the lawsuit, vacated the district court’s injunction, and dismissed the case.⁹⁵

The U.S. District Court for the Eastern District of Missouri denied a similar challenge to the SCC.⁹⁶ Also, the claims brought in these legal challenges focused in part on statutory and regulatory structures for federal rulemaking that do not apply to Ecology’s rulemaking processes.

Commission. OAH 80-2500-31888. MPUC E-999/CI-14-643. https://mn.gov/oah/assets/2500-31888-environmental-socioeconomic-costs-carbon-report_tcm19-222628.pdf

⁹⁰ Aldy, JE, MJ Kotchen, RN Stavins, and JH Stock, 2021. Keep climate policy focused on the social cost of carbon. *Science*, Vol. 373, Issue 6557. 20 August 2021.

⁹¹ Carleton, T and M Greenstone, 2021. Updating the United States Government's Social Cost of Carbon. University of Chicago, Becker Friedman Institute for Economics Working Paper No. 2021-04. November 12, 2021.

<https://ssrn.com/abstract=3764255> or <http://dx.doi.org/10.2139/ssrn.3764255>

⁹² *Louisiana v. Biden*, Federal District Court for the District of Louisiana, Case No. 2:21-CV-01074. Memorandum Decision, 2/11/2022

⁹³ *Louisiana v. Biden*, United States Court of Appeals for the Fifth Circuit, Case No. 22-30087. Document: 00516220740. Filed: 03/01/2022.

⁹⁴ *Louisiana v. Biden*, 142 S.Ct. 2750, Case No. 21A658 (May 26, 2022).

⁹⁵ *Louisiana v. Biden*, 64 F.4th 674, Case No. 22-30087 (April 5, 2023).

⁹⁶ *Missouri v. Biden*, 558 F.Supp.3d 754, Case No. 4:21-cv-00287-AGF (Aug. 31, 2021).

Present value costs of this amendment

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.⁹⁷ Using the SCC values for each corresponding year to the estimated emissions from chillers used for heating or heating and cooling, we estimated the PV of this benefit associated with avoided leakage from new chillers to be \$1.5 million to \$3.4 million over 20 years.

In Section 3.2.1.1, we estimated that approximately one automated commercial ice machine installed in 2025 in the state could be affected by our rule, given the revised baseline EPA Technology Transitions rule effective date of 2026. By using a lower-emitting refrigerant consistent with our previous assumptions in this section⁹⁸, and GWP values consistent with the types of prohibited refrigerants used in these machines⁹⁹, this could reduce GHG emissions in 2025 by between 72,000 and 110,000 lbs. CO₂e, using higher commercial leak rates of 16% to 24%. Beginning in 2026, compliance in ice machines will be driven by the Technology Transitions rule. Applying the 2025 SCC for the 2.5% discount rate, and discounting to present value (PV), this results in PV benefits of between approximately \$3,000 and \$5,000.

Qualitative and unquantified benefits of reduced GHG emissions

We note that the SCC values continue to develop over time based on advances in climate modeling and economic modeling reflecting improved and expanded data and understanding of climate change, economic relationships with ecological services, and response behavior modeling. Values that are currently unquantified or partially quantified in the SCC include:

- Environmental justice:
 - Disproportionate burdens of climate change.
 - Reduced access to resources for prevention and resilience.
 - Baseline health and economic disparities of vulnerable populations and overburdened communities.
- Health:
 - Respiratory illness
 - Lyme disease
 - Death, injuries, and illnesses from omitted natural disaster and migration
 - Water, food, sanitation, shelter
- Agriculture:
 - Weeds, pests, pathogens

⁹⁷ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

⁹⁸ See page 66.

⁹⁹ CARB, 2023. High-GWP refrigerants. <https://ww2.arb.ca.gov/resources/documents/high-gwp-refrigerants-AR4> GWP values for R507 and R404A.

- 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
- 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 severe 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

We also note that there are climate change impacts that may be particularly acute in coastal, forested regions, including wildfire incidence and severity, and flood damage.

Finally, SCC values may lag in reflecting climate change costs as new events and observations develop. For example, they may not fully capture the likely scope of the impacts of wildfire and smoke events, whether local or stemming from distant geographies. As the climate warms, impact models are adapted and updated, but increased unexpected volatility can confound modeling methods or structures. This results in underestimated impacts of climate change. In discussing the historic 2023 wildfire season in Canada (which also significantly degraded air quality across the eastern United States), one economist noted that, “It’s come on faster than we thought, even informed people. You couldn’t model this out if you tried. We’ve always been concerned about this escalation of damages, but seeing it happen is so stark.”¹⁰⁰

Wildfires

Climate change and land-use change are projected to make wildfires more frequent and intense, with a global increase of extreme fires of up to 14 percent by 2030, 30 percent by the end of 2050 and 50 percent by the end of the century, according to a recent report by the UN Environment Programme.¹⁰¹ The report notes, “the true cost of wildfires – financial, social, and environmental – extends for days, weeks, and even years after the flames subside.” It also recommends developing an understanding of full wildfire costs, noting that, “One assessment estimated the annualized economic burden from wildfire for the United States to be between \$71.1 billion to \$347.8 billion.” That corresponds to \$216 to \$1,056 per every person in the country each year, on average. Based on the 7.615 million population of Washington¹⁰², this equals between \$1.6 billion and \$8.0 billion every year, on average, but this range is likely higher in the western states, since we experience a larger proportion of wildfires than the country in general.

Washington is particularly vulnerable to wildfire losses, not only from direct fire impacts to valuable natural spaces (as we saw in the over 600 thousand acres of Washington burned by just the large and highly significant wildfires in 2021) and human landscapes (as we saw in 2020’s devastation of 85 percent of Malden and Pine City), but also from secondary impacts to forestlands, wildlife and habitat, soil erosion, and stream and river quality and temperature. Wildfires are also a risk to businesses, both private and governmental, as illustrated by our state’s working forests.

In 2018, researchers found that commercial timber forests can burn 30 percent more severely than managed federal forestlands.¹⁰³ A study of the impact of the 2020 Labor Day wildfires in

¹⁰⁰ Dave Sawyer, principal economist at the Canadian Climate Institute. Seattle Times, 2023. Canada offers lesson in the economic toll of climate change. <https://www.seattletimes.com/business/canada-offers-lesson-in-the-economic-toll-of-climate-change/>.

¹⁰¹ United Nations Environment Programme, 2022. Spreading like Wildfire – The Rising Threat of Extraordinary Landscape Fires. A UNEP Rapid Response Assessment. Nairobi.

¹⁰² US Census Bureau, 2022. QuickFacts: Washington. <https://www.census.gov/quickfacts/WA>

¹⁰³ Zald, HSJ and C Dunn, 2018. Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape. Ecological Applications (2018). DOI: 10.1002/eap.1710.

Oregon found that nearly a million acres of burned managed forest lands would have generated end products worth \$30 billion, but could generate only \$2.6 billion in salvage harvests.¹⁰⁴ That reflects a 91.3 percent value loss of managed timber lands. The same study found that private forest owners represent 64 percent of that salvage value.

In 2020, the Washington Department of Natural Resources spent an estimated \$20 million on aviation readiness and support for large fires.¹⁰⁵ That same year they incurred direct costs of over \$12.5 million responding to wildfire incidents in 2020, and estimated additional damages of:¹⁰⁶

- \$20 million to utilities.
- \$15 million to state agency infrastructure.
- \$10 million to other government infrastructure.

Wildfires also cause hazardous air quality in broad regions, impacting rural as well as densely populated areas.

Heat impacts

Lessons learned from the extreme northwest heat wave of 2021 include assessment that climate change may result in more heat-related deaths than previously estimated. The 2021 heat dome that brought record-breaking temperatures to the Pacific Northwest and British Columbia, resulted in 138 heat-related deaths in Washington, making it the deadliest weather event in state history.¹⁰⁷ Using the risk-based value of avoiding 100 percent risk of death (called “mortality risk valuation” or the “value of statistical life (VSL)”, though it is not the value of any individual’s life, and is statistically extrapolated from individuals’ willingness to accept fatality risks for a premium) as used by the US EPA,¹⁰⁸ each of these deaths resulted in losses to society of \$10.5 million in current dollars, and the heat dome resulted in at least \$1.45 billion in lost lives during just one event. Extreme heat events are forecast to happen more frequently and be more severe due to climate change.

In addition to fatal events, the US CDC assessed heat-related visits to emergency departments during the heat dome event. They found a nearly 70-fold increase in people seeking emergency care at the peak of the heat event.¹⁰⁹ Particularly in times of overburdened or overwhelmed

¹⁰⁴ Oregon Forest Resources Institute, 2021. Economic Impacts to Oregon’s Forest Sector – 2020 Labor Day Fires. September 2021.

¹⁰⁵ WA Department of Natural Resources, 2020. Impacts and Costs of Wildfire Season 2020. Presentation to the Senate Agriculture, Water, Natural Resources, and Parks. December 2, 2020.

¹⁰⁶ Ibid.

¹⁰⁷ WA Department of Health, 2021. Heat Wave 2021. <https://doh.wa.gov/emergencies/be-prepared-be-safe/severe-weather-and-natural-disasters/hot-weather-safety/heat-wave-2021>

¹⁰⁸ US Environmental Protection Agency, 2022. Mortality Risk Valuation. <https://www.epa.gov/environmental-economics/mortality-risk-valuation>

¹⁰⁹ Schramm, PJ, A Vaidyanathan, L Radhakrishnan, A Gates, K Harnett, and P Breyse, 2021. Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021. US Centers for

medical resources (as we have seen during the COVID-19 pandemic), this size of increased demand for urgent medical care could result in catastrophic delays and increased illness or death. The average cost of a single healthcare visit related to a high heat event is \$12,544.¹¹⁰

Ongoing drought and the 2021 heat dome also affected harvests:

- At least 30 percent impact to raspberries: The overall Whatcom County raspberry harvest fell 30 to 40 percent, with individual growers experiencing losses between 15 and 75 percent.¹¹¹
- At least ten percent impact to cherries: The overall cherry harvest, largely in the Yakima Valley, fell at least 10 percent.¹¹²
- \$85 million impact to blueberries: The Washington Blueberry Commission estimated \$85 million in yield loss and quality impacts.¹¹³
- Wheat harvests:
 - A 34-fold increase in the share of “poor” or “very poor” condition spring wheat.¹¹⁴
 - A 6-fold increase in the share of “poor” or “very poor” condition winter wheat.¹¹⁵
- Shellfish harvests:
 - 40 percent losses of seeded oysters.¹¹⁶
 - A 56 percent increase in vibriosis cases.¹¹⁷ Vibriosis is an illness in humans caused by shellfish contaminated with *Vibrio* bacteria, which are naturally occurring but present in high concentrations in warmer temperatures.¹¹⁸

Disease Control and Prevention. Weekly 70(90), pp. 1020-2021. July 23, 2021.

<https://www.cdc.gov/mmwr/volumes/70/wr/mm7029e1.htm>

¹¹⁰ Knowlton, K, M Rotkin-Ellman, L Geballe, W Max, and GM Solomon, 2011. Six Climate Change-Related Events in the United States Accounted for About \$14 Billion in Lost Lives and Health Costs. *Health Affairs* 30(11), pp. 2167-2176. DOI: 10.1377/hlthaff.2011.0229. Based on total healthcare expenditures of \$740 million (2011-dollars) across 760,000 individual encounters with the healthcare system, updated for inflation to 2022-dollars.

¹¹¹ Bratt, C, 2021. June ‘heat dome’ cut raspberry volume 30%. *Lynden Tribune*. December 10, 2021.

¹¹² Zhou, A, 2021. Western lawmakers seek more federal aid for farmers, ranchers hurt by extreme heat, drought. *Seattle Times*. July 27, 2021.

¹¹³ Ibid.

¹¹⁴ Ingwersen, J, 2021. ‘Wither away and die:’ US Pacific Northwest heat wave bakes wheat, fruit crops. *Reuters*. July 12, 2021.

¹¹⁵ Ibid.

¹¹⁶ Hagenbuch, B, 2021. In hot water: Heat dome recovery looks bleak for small-scale shellfish farms. *National Fisherman*. August 17, 2021.

¹¹⁷ Ibid.

¹¹⁸ <https://www.cdc.gov/vibrio/faq.html>

- 5 – 30 percent oyster mortality in the Salish Sea.¹¹⁹
- Higher losses among shellfish species in smaller, sheltered waters, and those that live nearer the surface, such as cockles.¹²⁰

Flood damages

A recent study by the Center for Western Weather and Water Extremes, at the University of California San Diego, modeled the impacts of various climate change scenarios on atmospheric rivers (long, flowing regions of the atmosphere that carry water vapor) impacting western states.¹²¹ Using flood insurance data, the study estimated county-level increases in annual costs of flood damage, through 2090, due to the contribution of climate change to frequency, duration, and magnitude of atmospheric rivers.

For most counties around Puget Sound, this forecasted increase in costs is between \$10 million and \$100 million each year (per county) compared to what they spent in the 1990s, while for Snohomish, King, and Lewis counties, the forecasted increase in costs is over \$100 million per year (per county). This is at least a doubling of annual flood damage costs in western Washington.

The east side of the state is largely forecasted to incur an additional up to \$1 million each year, with some counties incurring up to \$10 million more annually (per county). This is up to a doubling of annual costs for most eastern Washington counties, except for Pend Oreille, Spokane, Whitman, Columbia, and Asotin counties, where the increase in flood damage costs is forecasted to be between two and four times as high as it was in the 1990s.

4.2.1.2 Setting maximum GWP thresholds for new refrigeration equipment

The rule amendments are likely to result in benefits beginning in 2025, of lower GHG emissions resulting from the decreased use and eventual disposal of refrigeration equipment with GWP exceeding our thresholds when the rule requirements are more stringent than the baseline, as listed in Chapter 2.

We estimated these benefits using the following numbers of end-use facilities that would be impacted by the rule amendments.

¹¹⁹ Royal, T, 2022. Heat dome found to be deadly for some shellfish species, but not for others. Northwest Treaty Tribes. January 10, 2022.

¹²⁰ Ibid.

¹²¹ Corringham, TW, J McCarchy, T Shulgina, A Gershunov, DR Cayan, and FM Ralph, 2022. Climate change contributions to future atmospheric river flood damages in the western United States. Nature Scientific Reports 12:13747. <https://doi.org/10.1038/s41598-022-15474-2>

Table 16. Facilities by type of system, Dun & Bradstreet.

Category	Count
Retail refrigeration	5,687
Cold storage warehouse	1,317
IPR (except chillers)	484

We estimated a difference of total lbs. of CO₂e each year corresponding to entire equipment charge volumes, within the ranges of small and large. We then scaled these avoided emissions values by the corresponding annual leak rates identified by CARB,¹²² summarized using averages by category, below.

Table 17. Leak rates by category and size.

End-use Category	Size	Leak Rate
Retail	Large	24.20%
Retail	Small	15.60%
Cold Storage	Large	14.80%
Cold Storage	Small	3.70%
IPR	Large	12.30%
IPR	Small	9.10%

We also assumed gradual phasing-out of high-emitting refrigerants, consistent with assumptions made by CARB,¹²³ and summarized in Table 7.

Based on the above inputs, we estimated annual emissions reductions beginning with between about 6,000 MT CO₂e and 22,000 MT CO₂e in 2025.

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.¹²⁴ Applying the SCC (see discussion and values in Section 2.3.1.1) for each year, and discounting to 2023, we estimated 20-year PV benefits of \$9.0 million to \$35.8 million.

In our Preliminary Regulatory Analyses, we compared the proposed rule amendments to a baseline that included the proposed EPA Technology Transitions rule. The proposed Technology Transitions rule included a 2025 effective date for GWP thresholds on refrigeration equipment.

¹²² California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

¹²³ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

¹²⁴ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

During the public comment period for this rulemaking, the EPA adopted the final Technology Transitions rule, with effective dates of 2026 or 2028 (depending on system attributes). Because we made conservative assumptions in our Preliminary Regulatory Analyses (that capital expenditures would occur in 2025 and begin to generate benefits of avoided emissions, and that this would be the result of Ecology’s rule amendments rather than the later baseline restrictions), we have not adjusted our benefit estimates for this Final Regulatory Analyses document.

Using Data Axle facility counts, these benefits fall in proportion to the number of each facility category, summarized in the table below. 20-year PV benefits fall to between \$3.7 million and \$15.0 million.

Table 18. Facilities by type of system, Data Axle.

Category	Count
Retail refrigeration	1,270
Cold storage warehouse	2,152
IPR (except chillers)	459

The ability to sell refrigeration equipment manufactured before January 1, 2024 will impact these benefit estimates to the extent that this equipment will result in future GHG emissions during leakage and/or disposal, though in the case of later effective dates it will do so to a smaller degree than the proposed rule would have. Limiting sales of this equipment to before 2026 will reduce the degree to which this allowance reduces benefits. The adopted sell through provisions will serve to reduce potential program leakage over time, by eliminating the possibility that older equipment not meeting restrictions will continue to circulate, leak, and emit GHGs well into the future. This is particularly important because the SCC rises over time, as the incremental impacts of each unit of GHGs emitted contributes to an increasingly warming world and larger incremental economic impacts of climate change.

Simultaneously, they reduce incentives to build up additional stock before the effective dates of the restrictions, which would exacerbate potential future emissions risk.

The rule requirements we initially proposed during this rulemaking included retrofitted equipment in the definition of new equipment. The adopted rule amendments instead separate retrofits and assign them a later effective date of January 1, 2029. This will mitigate compliance costs resulting from the adopted GWP thresholds. Due to data limitations, however, we could not identify which facilities would purchase new equipment versus retrofit existing equipment. We have therefore retained the benefit estimates above from the Preliminary Regulatory Analyses for this rulemaking, and acknowledge they are likely overestimates as they do not capture cost-mitigation associated with later effective dates for retrofitted equipment. The degree of this overestimation, however, aligns with similar overestimates of costs (see Section 3.2.1.2).

4.2.1.3 Setting maximum GWP thresholds for new air conditioning equipment

The rule amendments are likely to result in benefits beginning in 2024, of lower GHG emissions resulting from the decreased use and eventual disposal of air conditioning equipment with GWP exceeding our threshold and sold in 2024.

To estimate benefits, we used CARB data on the numbers of the following types of new stationary air conditioning units in California by year.¹²⁵ We then scaled this data for small self-contained air conditioning equipment to Washington State using the relative share of homes with air conditioning in each state (53% in Washington versus 72% in California)¹²⁶ and relative numbers of households (2.9 million in Washington versus 13.2 million in California).¹²⁷ We note that climate change may result in increased rates of air conditioning adoption over time in areas of Washington that do not currently have high air conditioning rates.

For each year, we estimated avoided emissions, based on leak rates reported by CARB, below.¹²⁸ As the rule amendments affect only small self-contained air conditioners sold in 2024, we used the data for small residential air conditioning, including the range of years until it was disposed of.

Table 19. Annual and end-of-life leak rates.

Category	Annual Leak Rate	End of Life	Lifetime Low	Lifetime High
Small residential AC	1.50%	98.50%	5	12
Variable refrigerant flow or volume systems	5.00%	80.00%	15	15
Nonresidential	8.50%	38.00%	20	20

We estimated annual avoided GHG emissions of between 54,000 and 215,000 MT CO₂e in the first year. These avoided emissions would be avoided in each year of each unit’s lifetime, followed by avoided end-of-life emissions between 1.3 million and 5.1 million (in 2029 or 2036, respectively).

Ecology estimates costs and benefits that occur at different times using 20-year present values (PVs). A PV discounts future costs or benefits accounting for inflation and the opportunity cost of having funds later versus now.¹²⁹ Applying the SCC for each year, and discounting to 2023, we estimated 20-year PV benefits of \$138.4 million to \$653.1 million.

¹²⁵ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

¹²⁶ Energy Institute at HAAS, 2022. How Many US Households Don’t Have Air Conditioning? Energy Institute Blog. Posted August 15, 2022 by Lucas Davis.

¹²⁷ US Census Bureau, 2022. QuickFacts database. <https://www.census.gov/quickfacts/fact/table/US/HCN010217>.

¹²⁸ California Air Resources Board, 2020. Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols, Propellants, and Foam End-Uses Regulation. Standardized Regulatory Impact Assessment. March 19,2020.

¹²⁹ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89

The ability to sell air conditioning equipment manufactured before January 1, 2024 will impact these benefit estimates to the extent that this equipment will result in future GHG emissions during leakage and/or disposal, though in the case of later effective dates it will do so to a smaller degree than the proposed rule would have. Limiting sales of this equipment to before 2026 will reduce the degree to which this allowance reduces benefits. The adopted sell through provisions will serve to reduce potential program leakage over time, by eliminating the possibility that older equipment not meeting restrictions will continue to circulate, leak, and emit GHGs well into the future. This is particularly important because the SCC rises over time, as the incremental impacts of each unit of GHGs emitted contributes to an increasingly warming world and larger incremental economic impacts of climate change.

Simultaneously, they reduce incentives to build up additional stock before the effective dates of the restrictions, which would exacerbate potential future emissions risk.

The rule requirements we initially proposed during this rulemaking included retrofitted equipment in the definition of new equipment. The adopted rule amendments instead separate retrofits and assign them a later effective date of January 1, 2029. This will mitigate compliance costs resulting from the adopted GWP thresholds. Due to data limitations, however, we could not identify which facilities would purchase new equipment versus retrofit existing equipment. We have retained the benefit estimates above from the Preliminary Regulatory Analyses for this rulemaking. We acknowledge they are likely overestimates as they do not capture cost-mitigation associated with later effective dates for retrofitted equipment. The degree of this overestimation, however, is consistent similar overestimates of costs (see Section 3.2.1.3).

4.2.1.4 Setting maximum GWP thresholds for small containers and nonessential consumer products

We do not expect this amendment to result in benefits as compared to the baseline. See Chapter 2 for discussion of baseline and the rule amendments.

4.2.1.5 Establishing exemptions

These rule amendments are likely to result in mitigation of what compliance costs would otherwise be if the additional exemptions were not adopted. See Chapter 2 for discussion of baseline and the rule amendments.

4.2.1.6 Amending and adding labeling requirements

Given the simultaneous removal and addition of alternative compliance options for labeling under these rule amendments, we do not expect them to result in significant benefits as compared to the baseline, beyond the benefit of providing clarity.

4.2.1.7 Adding recordkeeping requirements

percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

These amendments require records are kept for two years longer than the baseline. These requirements are likely to result in benefits associated with additional and clear information about product contents and compliance along the supply chain.

4.2.1.8 Establishing a variance process and criteria

These amendments are likely to result in benefits by mitigating the extent to which the GWP thresholds may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities, which could also impact consumers.

4.2.2 Amendments to requirements for facilities

4.2.2.1 Establishing refrigerant management program (RMP) registration requirements

These rule amendments are likely to result in benefits of comprehensive tracking of information and data from facilities, wholesalers, distributors, and reclaimers that use or deal with refrigerants. This will provide better information to Ecology, and support program tracking, future regulatory decisions, and the effective and confident reduction in the use of refrigerants with a GWP greater than 150 in Washington.

4.2.2.2 Setting implementation fees and annual fees

These rule amendments result in benefits of a fully funded RMP and the services it provides.

Since fees under the rule amendments reflect actual costs of the expected workload related to implementing the RMP, they are also a proxy for the value of services provided. This applies regardless of underlying facility counts and ultimate scope of facilities paying fees. Fees do not, however, reflect the added value related to timely and comprehensive management of the program. By fully funding the program, the rule amendments fund the processing, technical support, and tracking services provided by Ecology in support of the goals of the authorizing statute. This ensures timely service and potentially opportunities for efficiencies through additional support from Ecology staff.

We note that there is a significant difference in fees used to fund the RMP, depending on the underlying facility dataset (see Section 3.2.2.2). If facility counts are low, the service demands for the program would also be lower, resulting in a lower funding need and aggregate value of services provided. Similarly, if facility counts are high, service demands would also be higher, resulting in the larger funding need and aggregate value of services provided.

4.2.2.3 Requiring leak inspection and monitoring

These rule amendments are likely to result in benefits of earlier identification of leaks. This could, in turn, result in earlier repair of leaks, reducing GHG emissions that might otherwise go unnoticed for longer periods of time.

We note that in addition to being a regulatory requirement under the 2021 law, increased leak inspections are incentivized by the cost of refrigerants. Leaks result in a need to replace

refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly.

Using the total affected small, medium, and large facilities identified in Section 2.3.2.3, and using Dun & Bradstreet facility counts, we assumed total volumes for each size of facility would, conservatively, be reflected by the low end of their respective ranges (i.e. 50, 200, and 1500 lbs.). Using the annual leak rates, as a percentage of total volume (see Section 3.2.2.3) we calculated the total leakage emissions within each year 2024 – 2043. Applying the SCC values listed in Table 15, we identified the costs associated with each year’s potential leakage emissions, ranging between a high of \$8,983 in 2028 and a low of \$2,769 in 2043. These values vary nonlinearly over time by each year’s program coverage and SCC value. Earlier repair of leaks would avoid ongoing GHG emissions from leaks, and reduce these social costs.

We could not confidently forecast to what degree requirements for leak inspection and ALD would affect repair timing and frequency, or ultimate emissions. We observe, however, that in PV-terms, discovering and appropriately addressing leaks a year earlier in the low case would result in PV benefits of between approximately \$1,690 (if this occurred at all affected facilities in 2043) in avoided GHG emissions and SCC and \$66,930 (if this occurred in 2024).¹³⁰ In the high-estimate case, these values would be \$8,199 to \$315,140, respectively. If we assume these requirements would result in all leaks being identified up to a year earlier than they would be under the baseline, the PV of this benefit would be between \$481,000 and \$2.3 million over 20 years.

Using Data Axle facility counts, this benefit would rise to between \$3.5 million and \$20.6 million in PV.

The magnitude of this benefit relies heavily on assumed baseline leak frequency and how much earlier leaks would be detected and addressed under the rule. Under the most optimistic baseline assumption, the incentive of avoiding refrigerant replacement costs would drive nearly immediate leak detection, and the benefits of the rule relative to this would decrease toward zero. As leaks exist under the baseline, and have the potential to continue in cases where other facility context and business decisions drive when leaks are identified and addressed, we do not expect this most optimistic assumption to be realistic.

Under the most pessimistic baseline assumption, potential for leaks is not monitored and any leak is ongoing for an indefinite period of time. This assumption would drive our benefits estimate up, to reflect the ongoing GHG emissions of unidentified leaks over time. If leaks continued indefinitely, ongoing GHG emissions would compound, and the rule amendments could result in a 20-year PV benefit of between \$49.0 million and \$285.4 million using Data Axle facility counts.

¹³⁰ Ecology discounts future values to present values using an estimate of the social rate of time preference, based on the historic average risk-free rate of return on US Treasury I Bonds. The current historic average rate is 0.89 percent. As we are using the Social Cost of Carbon (SCC) elsewhere in this analysis, and the closest discount rate for which SCC values are available is 2.5 percent, we used a 2.5 percent real discount rate throughout this analysis to give equal treatment to future costs and benefits regardless of whether they were related to the SCC.

Baseline assumptions about leak monitoring behavior and associated speed with which leaks are addressed also affect benefits related to avoiding the cost of replacing leaked refrigerant. These costs would depend on the types of refrigerant used, and their pricing over time. As an illustrative example, we considered the corresponding optimistic and pessimistic baseline leak monitoring scenarios, using Data Axle facility counts and an assumed baseline refrigerant cost of \$3 per lb. consistent with our cost estimates in Chapter 3. These combined assumptions would similarly result in a low-end (optimistic) benefit of zero if we assume leaks are identified and addressed almost immediately under the baseline. Using the most pessimistic baseline assumption of indefinite leakage, these benefits would rise to a 20-year PV benefit of between \$3.2 billion and \$18.6 billion. Under the more moderate assumption that under the rule amendments leaks are identified and addressed up to a year earlier than under the baseline, this range becomes \$222.9 million to \$1.3 billion in 20-year PV.

4.2.2.4 Setting leak rate thresholds and establishing notification requirements

These rule amendments are likely to result in benefits of:

- Consistent and comprehensive leak rate calculation and notification.
- Consistent follow up when leaks resulting in leak rates that exceed thresholds are repaired.

4.2.2.5 Establishing requirements for leak repair, timing, and verification

The rule amendments are likely to result in repairs being required earlier than under EPA requirements.

To the extent that these rule amendments would result in earlier repair of leaks, they would result in benefits of reduced GHG emissions. See Section 4.2.3.2 for discussion of the potential values of this benefit.

We note that in addition to being a regulatory requirement, rapid leak repair is incentivized by the cost of refrigerants. Leaks result in a need to replace refrigerant. The longer equipment is allowed to leak, the more replacement refrigerant will be needed, and at higher refrigerant prices this can be costly. There may be multiple reasons and internal business decisions for a facility to delay repairs, and in these cases the amendments require documentation (an additional cost) that would benefit both Ecology's RMP and potentially the business by necessitating careful consideration and focus on leak repair decisions.

4.2.2.6 Establishing requirements for retrofit and retirement plans

These rule amendments are likely to result in earlier retrofit or retirement than under the baseline, for some facilities. For facilities not covered under the baseline, they could result in earlier retrofit or retirement. Earlier retrofit or retirement could have associated benefits of eliminating leaks that would have occurred and may not have been repaired in a timely fashion. See Section 4.2.3.2 Leak detection and monitoring for discussion of the potential benefits related to the leak detection requirements.

4.2.2.7 Establishing an exemption process and criteria

These amendments are likely to result in benefits by mitigating the extent to which the leak repair, retrofit, and retirement requirements may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities, which could also impact consumers.

4.2.2.8 Establishing reporting requirements

These rule amendments likely result in benefits associated with comprehensive and consistent information for Ecology to track progress in achieving the goals of the law in Chapter 70A.60 RCW, as well as in ongoing regulatory planning.

4.2.2.9 Establishing recordkeeping requirements

These rule amendments are likely to result in two additional years of benefits associated with comprehensive and consistent information for Ecology to track progress in achieving the goals of the law in Chapter 70A.60 RCW, including inspection of records and follow up.

4.2.3 Amendments to requirements for wholesalers, distributors, and reclaimers

The rule amendments establish requirements for refrigerant wholesalers, distributors, and reclaimers, as follows. As the requirements for wholesalers, distributors, and wholesalers align with a subset of requirements for facilities, the baseline and rule amendments for these requirements are discussed in the corresponding sections listed below.

- Establishing registration requirements (see Section 4.2.2.1).
- Establishing reporting requirements (see Section 4.2.2.8).
- Establishing recordkeeping requirements (see Section 4.2.2.9).

4.2.4 Amendments to requirements for service technicians

4.2.4.1 Establishing required service practices

We do not expect these amendments to result in benefits as compared to the baseline. This includes the additional requirement regarding adding charge to leaky systems, as it is consistent with other service practices in combination with the requirements and exemption options for leak repairs.

4.2.5 Making additional updates to Chapter 173-443 WAC to reflect other changes in the law

We do not expect these amendments to have material impacts on benefits as compared to the baseline. They are made for purposes of clarity and consistency.

4.2.6 Making corresponding changes to the Air Quality Fee Rule

These rule amendments will likely result in benefits of a fully funded RMP and the services it provides. See Section 4.2.3.1 for discussion.

Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Summary of costs and benefits of the rule amendments

In Chapters 3 and 4, we identified the following costs and benefits likely to result from the rule amendments. As discussed those chapters, we considered two distinct datasets in identifying the potential numbers of affected facilities (see, e.g., Section 3.1.1 for discussion).

Table 20. 20-year PV costs and benefits.

Facility Dataset	PV Cost Range	PV Benefits Range
Dun & Bradstreet	\$39 million – \$364 million	\$157 million – \$700 million
Data Axle	\$403 million – \$624 million	\$222 million – \$750 million

The underlying PV costs and benefits of separate sections of the rule are listed in tables in Appendix B.

We note that as the number of potentially covered facilities increases, the PV cost and benefit ranges increasingly overlap. This is due to large increases in quantifiable costs associated with activities such as leak detection and monitoring, registration, and reporting, for which there are no fully quantifiable benefits for comparison. The following benefits are uncertain or variable in their magnitude and scope, and so are discussed qualitatively and including illustrative dollar values in Chapter 4:

- Qualitative and unquantified benefits of reduced GHG emissions, including reduced impacts related to:
 - Environmental justice.
 - Health.
 - Agriculture.
 - Oceans.
 - Forests.
 - Wildfire.
 - Ecosystems.
 - Productivity and economic growth.
 - Water.
 - Transportation.
 - Energy.
 - Catastrophic impacts and tipping points.
 - Inter- and intra-regional conflict.
- Exemptions: Mitigation of compliance costs.
- Recordkeeping requirements: Additional and clear information about product contents and compliance along supply chains.
- Variances: Mitigation of the extent to which GWP thresholds may result in significant compliance hardship, supply chain disruption, or disproportionate impacts on small businesses and retail food facilities.

- RMP registration: Comprehensive data tracking of facilities, wholesalers, distributors, and reclaimers. This supports program tracking, future regulatory decisions, and effective and confident reduction in the use of high-emitting refrigerants in Washington.
- Ecology management of the RMP: Value added services including timely service to covered entities and opportunities for efficiencies and technical support.
- Earlier detection and repair of leaks: Depending on the speed at which leaks are identified and addressed under the baseline, potential for millions of dollars in avoided GHG emissions impacts, and potential for billions of dollars in avoided additional refrigerant purchases. These benefits decrease in proportion to how quickly leaks would be addressed under the baseline.

Under the APA, quantitative and qualitative costs and benefits must be considered when making a determination about the rule.

5.2 Conclusion

We conclude, based on a reasonable understanding of the quantified and qualitative costs and benefits likely to arise from the rule amendments, as compared to the baseline, that the benefits of the rule amendments are greater than the costs.

Chapter 6: Least-Burdensome Alternative Analysis

6.1 Introduction

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

- (a) Clearly state in detail the general goals and specific objectives of the statute that the rule implements;
- (b) Determine that the rule is needed to achieve the general goals and specific objectives stated under (a) of this subsection, and analyze alternatives to rule making and the consequences of not adopting the rule;
- (c) Provide notification in the notice of proposed rulemaking 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, we are required to determine that the contents of the rule are the least burdensome set of requirements that achieve the goals and objectives of the authorizing statute(s).

We assessed alternative rule content, and determined whether it met the goals and objectives of the authorizing statute(s). Of those that would meet the goals and objectives, we determined whether those chosen for inclusion in the rule amendments were the least burdensome to those required to comply with them.

6.2 Goals and objectives of the authorizing statute

The authorizing statute for this rule is Chapter 70A.60 RCW, Hydrofluorocarbons – Emissions Reduction. Its goals and objectives are:

- Reduce hydrofluorocarbon emissions by:
 - Establishing a maximum global warming potential threshold for HFCs.
 - Regulating HFCs in air conditioning and heat pumps.

- Applying the same emission control requirements to HFCs as apply to ozone-depleting substances.
- Establishing a program to reduce leaks and encourage refrigerant recovery.
- Directing the state building code council to adopt codes that are consistent with the goal of reducing greenhouse gas emissions associated with HFCs.
- Establishing a state procurement preference for recycled refrigerants.
- Allowing the consideration of global warming potential of refrigerants used in equipment under utility conservation programs.

6.3 Alternatives considered and why they were excluded

We considered the following alternative rule content, and did not include it in the rule amendments for the reasons discussed in each subsection below.

- Not require automatic leak detection with a 10-ppm detection level.
- Allow for later GWP threshold effective dates for some types of equipment.
- Raise the leak rate threshold under the RMP for grocery retailers.
- Require an earlier GWP threshold effective date for room air conditioners and residential dehumidifiers.
- Allow later and longer sell through of refrigeration and air conditioning equipment.

6.3.1 Not require automatic leak detection with a 10-ppm detection level.

Ecology believes automatic leak detection is necessary on the largest refrigeration equipment because it has the highest capacity for emissions, meaning a lower level of leak detection would not meet the goals and objectives of the statute. Requiring ALD with a 10-ppm detection level will result in some expenses for facilities to install or modify existing systems, however, Ecology believes that the cost will be mitigated by the reduction of refrigerant leaks over the long term. Ecology is also allowing a two-year window for owners/operators of such equipment to transition their equipment to a low GWP refrigerant. Facilities will not need to install ALD if they commit to transitioning their equipment within two years after the January 2025 due date.

6.3.2 Allow for later GWP threshold effective dates for some types of equipment.

Ecology is ensuring that relevant building code safety standards have been updated as required by RCW 70A.60.020, so that low GWP refrigerants may be used for end-use applications subject to the rule. Ecology also ensured that there are EPA-approved alternative refrigerants available before the effective date for each type of end-use application. Ecology believes the adopted effective dates are achievable and necessary to reduce emissions. The effective dates in our

rule are the same or later than the effective dates for the same equipment under EPA's Technology Transitions Rule.

6.3.3 Raise the leak rate threshold under the RMP for grocery retailers.

The leak rate threshold that Ecology has adopted is 16% for retail food refrigeration. This rate is lower than the national average of 20 to 25% for this type of refrigeration. A higher threshold than 16% does not achieve the emissions reduction goals set by the authorizing statute. Under the statute, Ecology must adopt a leak rate threshold that achieves more reduction than EPA's existing refrigerant management rules.

6.3.4 Require an earlier GWP threshold effective date for room air conditioners and residential dehumidifiers

RCW 70A.60.020, which was added by the 2021 law, authorizes but does not require Ecology to set a 750 GWP threshold for substances used in new stationary air conditioning (excluding chillers) and sets the earliest dates such prohibitions could begin. In particular, the 2021 law established January 1, 2023 as the earliest possible effective date for dehumidifiers and room air conditioners. The development, proposal, and adoption process for the rule amendments was not likely to be complete by this earliest statutory date. During our rule development process we consulted with industry stakeholders, and identified that a 2024 effective date would provide extra time for system design, testing, and production of room air conditioners and residential dehumidifiers that would use substances with GWP below the threshold. The alternative of an earlier effective date would have imposed higher compliance burden, and the 2024 date facilitates compliance while meeting the objectives of the statute.

6.3.5 Allow later and longer sell through of refrigeration and air conditioning equipment

During this rulemaking, we initially proposed allowing sales of refrigeration and air conditioning equipment not meeting new rule requirements to be sold if it was manufactured before the effective date of the relevant GWP restriction. During the public comment period, we received feedback that indefinite sale of these products would result in ongoing GHG emissions.

We determined that to meet the goals and objectives of the statute related to reducing GHG emissions, an end date for this sell through provision was necessary. An end date reduces incentives for overproduction and stockpiling of equipment with high-GHG refrigerant. This, in turn, prevents delayed and higher GHG emissions from these products, which would reduce the net effectiveness of the program. It would also impose increasingly high SCC costs on the public over time, as the value of the SCC rises over time. We chose to include an end date of January 1, 2026 in the adopted rule amendments.

6.4 Conclusion

After considering alternatives to the rule's contents, within the context of the goals and objectives of the authorizing statute, we determined that the rule represents the least-burdensome alternative of possible rule contents meeting the goals and objectives.

Chapter 7: Regulatory Fairness Act Compliance

7.1 Introduction

The Regulatory Fairness Act (RFA; RCW 19.85.070) requires Ecology to perform a set of analyses and make certain determinations regarding the rule amendments. This chapter presents the:

- Analysis of relative compliance cost burden.
- Consideration of lost sales or revenue.
- Cost-mitigating elements of the rule, if required.
- Small business and local government consultation.
- Industries likely impacted by the rule.
- Expected impact on jobs.

A small business is defined by the RFA as having 50 or fewer employees, at the highest ownership and operator level. Estimated compliance costs are determined as compared to the baseline (the regulatory environment in the absence of the rule amendments, limited to existing federal and state requirements). Analyses under the RFA only apply to costs to “businesses in an industry” in Washington State. This means the impacts, for this part of our analyses, are not evaluated for government agencies.

7.2 Analysis of relative compliance cost burden

We calculated the estimated per-business costs to comply with the rule amendments, based on the costs estimated in Chapter 3 of this document. In this section, we estimate compliance costs per employee.

The average affected small business likely to be covered by the rule amendments employs approximately 9 people. The largest ten percent of affected businesses employ an average of 21,210 people. Based on cost estimates in Chapter 3, we estimated the following compliance costs per employee, for the Dun & Bradstreet facility dataset.

Table 21: First Year Compliance Costs per Employee for Small Businesses, Dun & Bradstreet.

Type of Cost	Low	High
Amending prohibitions on the use of certain substances in specified new products and equipment	\$52.22	\$210.71

Type of Cost	Low	High
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.*	\$5,414.69	\$5,745.28
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	N/A	N/A
Establishing refrigerant management program (RMP) registration requirements	\$2.62	\$2.62
Setting implementation fees and annual fees	\$59.09	\$59.09
Requiring leak detection and monitoring	\$60.92	\$134.35
Setting leak rate thresholds and establishing notification requirements	\$4.56	\$4.56
Establishing requirements for leak repair, timing, and verification**	N/A	N/A
Establishing requirements for retrofit and retirement plans***	N/A	N/A
Establishing reporting requirements	\$13.05	\$13.05

* First year costs based on conservative assumption that all capital costs are incurred in the first year. These costs may occur later, or be financed through borrowing or credit, but due to high variability in the types of facilities covered, we chose to take the most conservative approach rather than fail to identify potential disproportionate impacts.

** N/A indicates all affected manufacturing businesses are large

*** N/A indicates identified costs were small per-dollar opportunity costs of potential earlier leak repair, depending on timing, and could not be estimated as whole dollar amounts.

Table 22. First Year Compliance Costs per Employee for Large Businesses, Dun & Bradstreet.

Type of Cost	Low	High
Amending prohibitions on the use of certain substances in specified new products and equipment	\$0.02	\$0.09
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.*	\$2.25	\$2.38
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	N/A	N/A
Establishing refrigerant management program (RMP) registration requirements	\$0.00	\$0.00
Setting implementation fees and annual fees	\$0.02	\$0.02
Requiring leak detection and monitoring	\$0.03	\$0.06
Setting leak rate thresholds and establishing notification requirements	\$0.00	\$0.00

Establishing requirements for leak repair, timing, and verification**	N/A	N/A
Establishing requirements for retrofit and retirement plans***	N/A	N/A
Establishing reporting requirements	\$0.01	\$0.01

* First year costs based on conservative assumption that all capital costs are incurred in the first year. These costs may occur later, or be financed through borrowing or credit, but due to high variability in the types of facilities covered, we chose to take the most conservative approach rather than fail to identify potential disproportionate impacts.

** N/A indicates all affected manufacturing businesses are large

*** N/A indicates identified costs were small per-dollar opportunity costs of potential earlier leak repair, depending on timing, and could not be estimated as whole dollar amounts.

We performed the same calculations and comparisons for costs based on the Data Axle dataset. They are summarized in the tables below.

Table 23: First Year Compliance Costs per Employee for Small Businesses, Data Axle.

Type of Cost	Low	High
Amending prohibitions on the use of certain substances in specified new products and equipment	\$52.22	\$210.71
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.*	\$6,645.48	\$3,637.46
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	n/a	n/a
Establishing refrigerant management program (RMP) registration requirements	\$2.62	\$11.94
Setting implementation fees and annual fees	\$59.09	\$697.72
Requiring leak detection and monitoring	\$40.18	\$658.26
Setting leak rate thresholds and establishing notification requirements	\$5.53	\$36.74
Establishing requirements for leak repair, timing, and verification**	n/a	n/a
Establishing requirements for retrofit and retirement plans***	n/a	n/a
Establishing reporting requirements	\$15.22	\$150.78

* First year costs based on conservative assumption that all capital costs are incurred in the first year. These costs may occur later, or be financed through borrowing or credit, but due to high variability in the types of facilities covered, we chose to take the most conservative approach rather than fail to identify potential disproportionate impacts.

** N/A indicates all affected manufacturing businesses are large

*** N/A indicates identified costs were small per-dollar opportunity costs of potential earlier leak repair, depending on timing, and could not be estimated as whole dollar amounts.

Table 24. First Year Compliance Costs per Employee for Large Businesses, Data Axle.

Type of Cost	Low	High
Amending prohibitions on the use of certain substances in specified new products and equipment	\$0.02	\$0.09
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.*	\$2.76	\$1.51
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	n/a	n/a
Establishing refrigerant management program (RMP) registration requirements	\$0.00	\$0.00
Setting implementation fees and annual fees	\$0.02	\$0.29
Requiring leak detection and monitoring	\$0.02	\$0.27
Setting leak rate thresholds and establishing notification requirements	\$0.00	\$0.02
Establishing requirements for leak repair, timing, and verification**	n/a	n/a
Establishing requirements for retrofit and retirement plans***	n/a	n/a
Establishing reporting requirements	\$0.01	\$0.06

* First year costs based on conservative assumption that all capital costs are incurred in the first year. These costs may occur later, or be financed through borrowing or credit, but due to high variability in the types of facilities covered, we chose to take the most conservative approach rather than fail to identify potential disproportionate impacts.

** N/A indicates all affected manufacturing businesses are large

*** N/A indicates identified costs were small per-dollar opportunity costs of potential earlier leak repair, depending on timing, and could not be estimated as whole dollar amounts.

We note that the estimated costs in Chapter 3 are based on facility and equipment size and type, and so do not capture any potential correlation between employment size and costs. In other words, for the tables above, we used the same total costs for both small and large businesses. This likely results in an overestimate of disproportionate impacts. To the extent that, in reality, costs are correlated with the number of employees (e.g., a smaller facility will have fewer or smaller equipment and systems containing refrigerant, as well as having fewer employees), the per-employee costs above for small businesses will be smaller, and the per-employee costs for large businesses will be larger. Since our data did not allow us to quantify the degree of this correlation, we conservatively assumed the same costs regardless of the number of employees working at the facility or employed by a business or its parent company.

The intent of the RFA is to identify whether the rule would have disproportionate impacts on small businesses. By using conservative assumptions throughout our cost analysis (see Chapter 3), we reduce the likelihood that disproportionate impacts would not be identified or apparent. We conclude that the rule amendments are likely to have disproportionate impacts on small businesses, and therefore Ecology must include elements in the rule amendments to mitigate this disproportion, as far as is legal and feasible.

7.3 Loss of sales or revenue

Businesses that would incur costs could experience reduced sales or revenues if the rule amendments significantly affect the prices of the goods they sell. The degree to which this could happen is strongly related to each business's production and pricing model (whether additional lump-sum costs would significantly affect marginal costs), as well as the specific attributes of the markets in which they sell goods, including the degree of influence each firm has on market prices, as well as the relative responsiveness of market demand to price changes.

We used the REMI E3+ model for Washington State to estimate the impact of the rule amendments on directly affected markets, accounting for dynamic adjustments throughout the economy. The model accounts for: inter-industry impacts; price, wage, and population changes; and dynamic adjustment of all economic variables over time.

In developing the economics model for this analysis, we examined results using two distinct datasets identifying potentially impacted facilities in Washington (Data Axle and Dun & Bradstreet). See Section 3.1.1 or 4.1.1 for discussion of these datasets. The results of the REMI E3+ model shows that the rule would impact a variety of industries (see 7.6, below), costing the Washington economy an estimated \$3 million to \$94 million in output (total amount of goods and services produced by Washington businesses) in the first year across all sectors.

Output losses peak in 2025 at between \$489 million and \$618 million when the majority of capital costs are assumed to be incurred and decline thereafter. In the first quarter of 2023, Washington state's annual GDP was estimated at \$761 billion. \$489 million is equivalent to 0.064% of the state's GDP and \$618 million is 0.081% of the state's GDP.¹³¹

Due to the variability in when large capital expenditures would be incurred (when new systems or retrofits would need to be installed), and the resulting uncertainty in whether costs would be incurred as a result of Ecology's rule amendments or the baseline, we made the conservative assumption that costs would be incurred immediately. In reality, some portion of these costs will be incurred later, reducing present value compliance costs and impacts to output. Also, if these large capital costs occur after the baseline effective dates for restrictions, they are baseline costs, and impacts to output as a result of this rule will be smaller.

In all scenarios, costs in output to the economy decline over time and in the high-cost Dun & Bradstreet model, a net positive output across the economy is seen in 2030. The outputs using Data Axle's facility information incurs higher costs in certain industries with non-quantifiable

¹³¹ [GDP by State | U.S. Bureau of Economic Analysis \(BEA\)](#)

benefits. This resulted in a longer recovery time for the economy to experience positive output in these models.

Table 25. Low-Cost modeled impacts to output accounting for social cost of carbon (millions of \$).

Cost Impact	2025	2033	2043
Data Axle	-\$489	-\$120	-\$78
Dun & Bradstreet	-\$617	-\$7	-\$6

Table 26. High-Cost modeled impacts to output accounting for social cost of carbon (millions of \$).

Cost Impact	2025	2033	2043
Data Axle	-\$538	-\$180	-\$122
Dun & Bradstreet	-\$594	\$44	\$66

7.4 Action taken to reduce small business impacts

The RFA (19.85.030(2) RCW) states that:

“Based upon the extent of disproportionate impact on small business identified in the statement prepared under RCW 19.85.040, the agency shall, where legal and feasible in meeting the stated objectives of the statutes upon which the rule is based, reduce the costs imposed by the rule on small businesses. The agency must consider, without limitation, each of the following methods of reducing the impact of the proposed rule on small businesses:

- a) Reducing, modifying, or eliminating substantive regulatory requirements;
- b) Simplifying, reducing, or eliminating recordkeeping and reporting requirements;
- c) Reducing the frequency of inspections;
- d) Delaying compliance timetables;
- e) Reducing or modifying fine schedules for noncompliance; or
- f) Any other mitigation techniques including those suggested by small businesses or small business advocates.”

We considered all of the above options, the goals and objectives of the authorizing statutes (see Chapter 6), and the scope of this rulemaking. We limited compliance cost-reduction methods to those that:

- Are legal and feasible.
- Meet the goals and objectives of the authorizing statute.
- Are within the scope of this rulemaking.

Modifying regulatory requirements, changing reporting requirements, reducing the frequency of inspections, or delaying compliance timetables would not meet statutory objectives or are not feasible and within the scope of this rulemaking.

Finally, we included the following elements in the rule amendments to reduce costs to small businesses.

- Businesses that have refrigeration equipment with a refrigerant charge capacity of less than 50 lbs. are not required to comply with the requirements of the rule.¹³²
- Exemptions from requirements of the rule may be granted if an exemption will not increase the overall risk to human health and the environment and the facility is a retail food facility or a small business, compliance with the requirements would result in extreme financial hardship, and the applicant has made a good faith effort to mitigate any potential noncompliance.

7.5 Small business and government involvement

We involved small businesses and local governments in its development of the rule amendments. Ecology:

- Met with Washington Food Industry Association and Air Conditioning Contractors Association representatives in June 2021.
- Presented a rulemaking overview at North American Sustainable Refrigeration Council conference in September 2021 (including a session focused on impacts to small businesses) and September 2022.
- Held seven open stakeholder meetings in 2022 and 2023.
- Met with the Washington chapter of the United Association of the Plumbers and Pipefitters Industry.
- Held a webinar on the legislative leak report to review Ecology methods for setting leak thresholds in the RMP.
- Met with the Washington Air Conditioning Contractors Association in December 2022.

During the public comment period for this rulemaking, we received feedback expressing concern about impacts specific to small retail stores and the compliance burden they will face. We acknowledge that small stores face a complex set of circumstances, including current trends in inflation and food prices, affecting profitability.

Small stores are a subset of affected facilities in our overall analysis, and we note that impacts specific to them (resulting from the rule, or from baseline and external factors) are not apparent in aggregated data and analysis. This is partly because limitations in the data available

¹³² The economic model assumes that smaller systems are correlated with smaller businesses and therefore eliminating fees for small RMP systems would predominantly include more small businesses.

across all impacted entities made it necessary to make simplifying assumptions to avoid underestimating costs and to capture potential costs in ranges of estimates:

- Compliance cost estimates: Cost estimates reflect an assumption that physical facility size translates to a single system, rather than multiple smaller systems that may fall below regulatory thresholds. Smaller stores that use multiple pieces of refrigeration equipment could have lower costs than estimated.
- Estimates of disproportionate costs: Our cost per employee comparison considers a range of costs, to ensure we did not fail to capture potential disproportion. But this means it includes unlikely scenarios in which small businesses incur the high end of costs (associated with larger single systems) despite those costs being more likely for larger businesses.
- Impacts to output and employment: Our macroeconomic model (REMI E3+) models price and employment impacts based on a model structure that aggregates the retail sector, and was not able to capture distributional impacts across differently sized facilities. It also develops forecasts based on the costs discussed in previous bullet points, which are intended to overestimate compliance costs. This means the subset of impacts to output and employment that falls on small stores may, on one hand, be overestimated, but may also be more difficult to adjust business practices to, including ability to maintain profitability if needed, by:
 - Reducing labor costs across a smaller number of employees.
 - Reducing other operating costs, including supplier decisions, quantity or type of products available, in light of inflationary trends or contractual obligations.
 - Passing costs on to consumers, in light of trends in food prices. This may be difficult in locations serving consumers with more elastic demand (who are likely to reduce their purchases more in response to price increases than others are) or income constraints.

7.6 North American Industry Classification System (NAICS) codes of impacted industries

The rule amendments likely impact the following industries, with associated NAICS codes. NAICS definitions and industry hierarchies are discussed at <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2017>.

Table 27. Industries and their associated NAICS codes that are impacted by the rule.¹³³

NAICS Code	Description
115x	Support Activities for Agriculture and Forestry
221x	Utilities
311x	Food Manufacturing
312x	Beverage and Tobacco Product Manufacturing
313x	Textile Mills
323x	Printing and Related Support Activities
324x	Petroleum and Coal Products Manufacturing
325x	Chemical Manufacturing
326x	Plastics and Rubber Products Manufacturing
327x	Nonmetallic Mineral Product Manufacturing
332x	Fabricated Metal Product Manufacturing
334x	Computer and Electronic Product Manufacturing
335x	Electrical Equipment, Appliance, and Component Manufacturing
336x	Transportation Equipment Manufacturing
339x	Miscellaneous Manufacturing
423x	Merchant Wholesalers, Durable Goods
424x	Merchant Wholesalers, Nondurable Goods
425x	Wholesale Trade Agents and Brokers
441x	Motor Vehicle and Parts Dealers
444x	Building Material and Garden Equipment and Supplies Dealers
445x	Food and Beverage Retailers
488x	Support Activities for Transportation
493x	Warehousing and Storage
512x	Motion Picture and Sound Recording Industries
518x	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services
522x	Credit Intermediation and Related Activities
524x	Insurance Carriers and Related Activities
531x	Real Estate
532x	Rental and Leasing Services
541x	Professional, Scientific, and Technical Services
551x	Management of Companies and Enterprises
561x	Administrative and Support Services
611x	Educational Services
621x	Ambulatory Health Care Services
622x	Hospitals
623x	Nursing and Residential Care Facilities
711x	Performing Arts, Spectator Sports, and Related Industries
712x	Museums, Historical Sites, and Similar Institutions
713x	Amusement, Gambling, and Recreation Industries
721x	Accommodation
722x	Food Services and Drinking Places
811x	Repair and Maintenance
812x	Personal and Laundry Services
813x	Religious, Grantmaking, Civic, Professional, and Similar Organizations

7.7 Impact on jobs

We used the REMI E3+ model for Washington State to estimate the impact of the rule amendments on jobs in the state, accounting for dynamic adjustments throughout the economy.

The rule amendments will result in transfers of money within and between industries, as compared to the baseline. The modeled impacts on employment are the result of multiple small increases and decreases in employment, prices, and other economic variables across all industries in the state.

The results of the REMI E3+ model show a peak job loss of 2,557 to 3,212 jobs one year after implementation of the rule. In both the low-cost and high-cost scenarios of rule compliance, job loss decreases continually after 2025. The highest impacted industries in the state will be the construction industry and retail trade, as these industries are highly sensitive to the general level of economic activity in the state. Results are presented in full-time employee (FTE) equivalents, and reflect the total impacts of multiple smaller reductions. They do not reflect the loss of job positions.

Due to the variability in when large capital expenditures would be incurred (when new systems or retrofits would need to be installed), and the resulting uncertainty in whether costs would be incurred as a result of Ecology’s rule amendments or the baseline, we made the conservative assumption that costs would be incurred immediately. In reality, some portion of these costs will be incurred later, reducing present value compliance costs and impacts to employment. Also, if these large capital costs occur after the baseline effective dates for restrictions, they are baseline costs, and impacts to jobs as a result of this rule will be smaller.

Table 28: Low-cost impacts on jobs (Data Axle).

Industry	2025 FTE Impact	Percent of total 2024 FTEs	2043 FTE Impact	Percent of total 2043 FTEs
Whole state	-2557	-0.05%	-284	-0.01%
Construction	-483	-0.15%	1	0.00%
Food services and drinking places	-127	-0.05%	-17	0.00%
Retail trade	-350	-0.07%	-26	-0.01%
Real estate	-114	-0.05%	-13	-0.01%
Offices of health practitioners	-79	-0.05%	-9	0.00%

¹³³ The x in the 4-digit NAICS codes listed in the table represent subcategories within NAICS codes that described. The analysis was done using 6-digit NAICS codes.

Table 29. High-cost impacts on jobs (Data Axle).

Industry	2025 FTE Impact	Percent of total 2024 FTEs	2043 FTE Impact	Percent of total 2043 FTEs
Whole state	-2822	-0.06%	-430	-0.01%
Construction	-533	-0.16%	-11	0.00%
Retail trade	-362	-0.07%	-23	0.00%
Food services and drinking places	-138	-0.05%	-20	-0.01%
Real estate	-125	-0.05%	-15	-0.01%
State and Local Government	-157	-0.03%	-43	-0.01%

Table 30. Low-cost impacts on jobs (Dun & Bradstreet).

Industry	2025 FTE Impact	Percent of total 2024 FTEs	2043 FTE Impact	Percent of total 2043 FTEs
Whole state	-3212	-0.06%	-16	0.00%
Construction	-582	-0.18%	5	0.00%
Offices of health practitioners	-90	-0.06%	-2	0.00%
Food services and drinking places	-153	-0.06%	-1	0.00%
Real estate	-149	-0.07%	-1	0.00%
Individual and family services; Community and vocational rehabilitation services	-49	-0.04%	-1	0.00%

Table 31. High-cost impacts on jobs (Dun & Bradstreet).

Industry	2025 FTE Impact	Percent of total 2024 FTEs	2043 FTE Impact	Percent of total 2043 FTEs
Whole state	-3090	-0.06%	269	0.00%
Construction	-558	-0.17%	9	0.00%
Educational services; private	-38	-0.04%	-2	0.00%
Individual and family services; Community and vocational rehabilitation services	-49	-0.04%	5	0.00%
Religious organizations; Grantmaking and giving services and social advocacy organizations	-30	-0.05%	0	0.00%
Offices of health practitioners	-88	-0.06%	3	0.00%

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Appendix A: Administrative Procedure Act (RCW 34.05.328) Determinations

- A. RCW 34.05.328(1)(a) – Clearly state in detail the general goals and specific objectives of the statute that this rule implements.**

See Chapter 6.

- B. RCW 34.05.328(1)(b) –**

- 1. Determine that the rule is needed to achieve the general goals and specific objectives of the statute.**

See chapters 1 and 2.

- 2. Analyze alternatives to rulemaking and the consequences of not adopting this rule.**

Chapter 70A.60 RCW requires Ecology to adopt rules that establish a refrigerant management program (RMP) to reduce leaks and encourage refrigerant recovery from large refrigeration and air conditioning systems operating in Washington. The law also requires Ecology to enforce a Global Warming Potential (GWP) threshold for refrigerants used in ice rinks. In addition, Ecology must adopt this rule to establish the RMP registration, annual reporting, leak inspections, and leak repair requirements as directed by the statute.

Chapter 70A.60 RCW also authorizes Ecology to adopt rules that establish GWP thresholds for substances used in new stationary refrigeration and air conditioning equipment that is sold, supplied, or offered for sale in Washington. The consequences of not adopting the GWP thresholds for new refrigeration and air conditioning equipment would be slower progress toward achieving Washington’s emissions reduction targets through continued use of refrigerants with a GWP greater than 150 in new equipment sold into Washington.

Please see the Least Burdensome Alternative Analysis, Chapter 6 of this document, for discussion of alternative rule content considered.

- C. RCW 34.05.328(1)(c) - A preliminary cost-benefit analysis was made available.**

When filing a rule proposal (CR-102) under RCW 34.05.320, Ecology provides notice that a preliminary cost-benefit analysis is available. At adoption (CR-103 filing) under RCW 34.05.360, Ecology provides notice of the availability of the final cost-benefit analysis.

- D. RCW 34.05.328(1)(d) – Determine that probable benefits of this 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.**

See Chapters 1 – 5.

- E. RCW 34.05.328 (1)(e) - Determine, after considering alternative versions of the analysis required under RCW 34.05.328 (b), (c) and (d) 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 in Chapter 6.

Please see Chapter 6.

F. RCW 34.05.328(1)(f) - Determine that the rule does not require those to whom it applies to take an action that violates requirements of another federal or state law.

This rule would not require covered parties to violate existing federal and state laws and rules. As required the by the legislature, Ecology is harmonizing requirements with other state and federal HFC reduction and RMP rules wherever feasible.

G. RCW 34.05.328 (1)(g) - Determine that the rule does not impose more stringent performance requirements on private entities than on public entities unless required to do so by federal or state law.

The requirements in this rule apply to manufacturers and commercial and retail consumers of new refrigeration and air conditioning equipment and certain nonessential consumer products. The rule also applies to owners of large refrigeration and air conditioning systems currently in use in Washington and to refrigerant wholesalers, distributors, and reclaimers. All requirements apply to both private and public entities.

H. RCW 34.05.328 (1)(h) Determine if the rule differs from any federal regulation or statute applicable to the same activity or subject matter.

Yes.

If **yes**, the difference is justified because of the following:

- (i) A state statute explicitly allows Ecology to differ from federal standards.

RCW 70A.60.030(7)(f) requires Ecology to adopt rules applying leak rate thresholds “that achieve greater emission reductions than the federal regulations adopted by the [U.S. EPA], and that reflect levels of achievable superior performance established for the GreenChill voluntary program implemented by the [U.S. EPA].”

- (ii) Substantial evidence that the difference is necessary to achieve the general goals and specific objectives stated in Chapter 6.

I. RCW 34.05.328 (1)(i) – Coordinate the rule, to the maximum extent practicable, with other federal, state, and local laws applicable to the same subject matter.

To harmonize the rule with other HFC programs, Ecology is consulting regularly with the California Air Resources Board and the New York Department of Environmental Conservation, along with several other states in the United States Climate Alliance working on HFC rules.

Appendix B: Subcategories of Present Value Costs and Benefits

Table 32. 20-year PV costs and benefits, low estimate, Dun & Bradstreet facility counts.

Summary	PV Cost	PV Benefit
Adding centrifugal chillers used for heating or for heating and cooling to existing prohibitions on the use of certain refrigerants	\$79,558	\$1,527,452
Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.	-\$25,812,527	\$8,959,161
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	\$11,104,972	\$138,391,643
Establishing refrigerant management program (RMP) registration requirements	\$375,585	Qualitative – see Chapter 4
Setting implementation fees and annual fees	\$7,443,265	\$7,443,265
Requiring leak detection and monitoring	\$34,856,179	Qualitative – see Chapter 4
Setting leak rate thresholds and establishing notification requirements	\$2,072,923	Qualitative – see Chapter 4
Establishing requirements for leak repair, timing, and verification	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing requirements for retrofit and retirement plans	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing reporting requirements	\$8,472,992	Qualitative – see Chapter 4
TOTAL	\$38,592,945	\$156,321,520

Table 33. 20-year PV costs and benefits, high estimate, Dun & Bradstreet facility counts.

Summary	PV Cost	PV Benefit
Amending prohibitions on the use of certain substances in specified new products and equipment	\$385,211	\$3,358,591
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.	\$292,536,326	\$35,836,643
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	\$11,104,972	\$653,135,654
Establishing refrigerant management program (RMP) registration requirements	\$375,585	Qualitative – see Chapter 4
Setting implementation fees and annual fees	\$7,443,265	\$7,443,265
Requiring leak detection and monitoring	\$41,695,082	Qualitative – see Chapter 4
Setting leak rate thresholds and establishing notification requirements	\$2,072,923	Qualitative – see Chapter 4
Establishing requirements for leak repair, timing, and verification	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing requirements for retrofit and retirement plans	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing reporting requirements	\$8,472,992	Qualitative – see Chapter 4
TOTAL	\$364,086,356	\$699,774,153

Table 34. 20-year PV costs and benefits, low estimate, Data Axle facility counts.

Summary	PV Cost	PV Benefit
Adding centrifugal chillers used for heating or for heating and cooling to existing prohibitions on the use of certain refrigerants	\$79,558	\$1,527,452
Setting maximum GWP thresholds for certain refrigerants used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.	-\$62,836,435	\$3,748,280
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	\$11,104,972	\$138,391,643
Establishing refrigerant management program (RMP) registration requirements	\$1,713,345	Qualitative – see Chapter 4
Setting implementation fees and annual fees	\$78,627,164	\$78,627,164
Requiring leak detection and monitoring	\$270,663,413	Qualitative – see Chapter 4
Setting leak rate thresholds and establishing notification requirements	\$16,691,009	Qualitative – see Chapter 4
Establishing requirements for leak repair, timing, and verification	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing requirements for retrofit and retirement plans	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing reporting requirements	\$87,176,863	Qualitative – see Chapter 4
TOTAL	\$403,219,889	\$222,294,539

Table 35. 20-year PV costs and benefits, high estimate, Data Axle facility counts.

Summary	PV Cost	PV Benefit
Amending prohibitions on the use of certain substances in specified new products and equipment	\$385,211	\$3,358,591
Setting GWP thresholds for prohibited substances used in new refrigeration equipment with a refrigerant charge capacity of more than 50 lbs.	\$123,645,506	\$14,993,122
Setting GWP thresholds for prohibited substances used in new air conditioning equipment	\$11,104,972	\$653,135,654
Establishing refrigerant management program (RMP) registration requirements	\$1,713,345	Qualitative – see Chapter 4
Setting implementation fees and annual fees	\$78,627,164	\$78,627,164
Requiring leak detection and monitoring	\$305,015,820	Qualitative – see Chapter 4
Setting leak rate thresholds and establishing notification requirements	\$16,691,009	Qualitative – see Chapter 4
Establishing requirements for leak repair, timing, and verification	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing requirements for retrofit and retirement plans	Qualitative – see Chapter 3	Qualitative – see Chapter 4
Establishing reporting requirements	\$87,176,863	Qualitative – see Chapter 4
TOTAL	\$624,359,890	\$750,114,531