Preliminary Regulatory Analyses:

Including the:

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

Chapter 173-446 WAC

Climate Commitment Act Program

By

Kasia Patora

For the

Air Quality Program

Washington State Department of Ecology

Olympia, Washington

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Contact Information

Air Quality Program

P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360-407-6800

Website: Washington State Department of Ecology[1]

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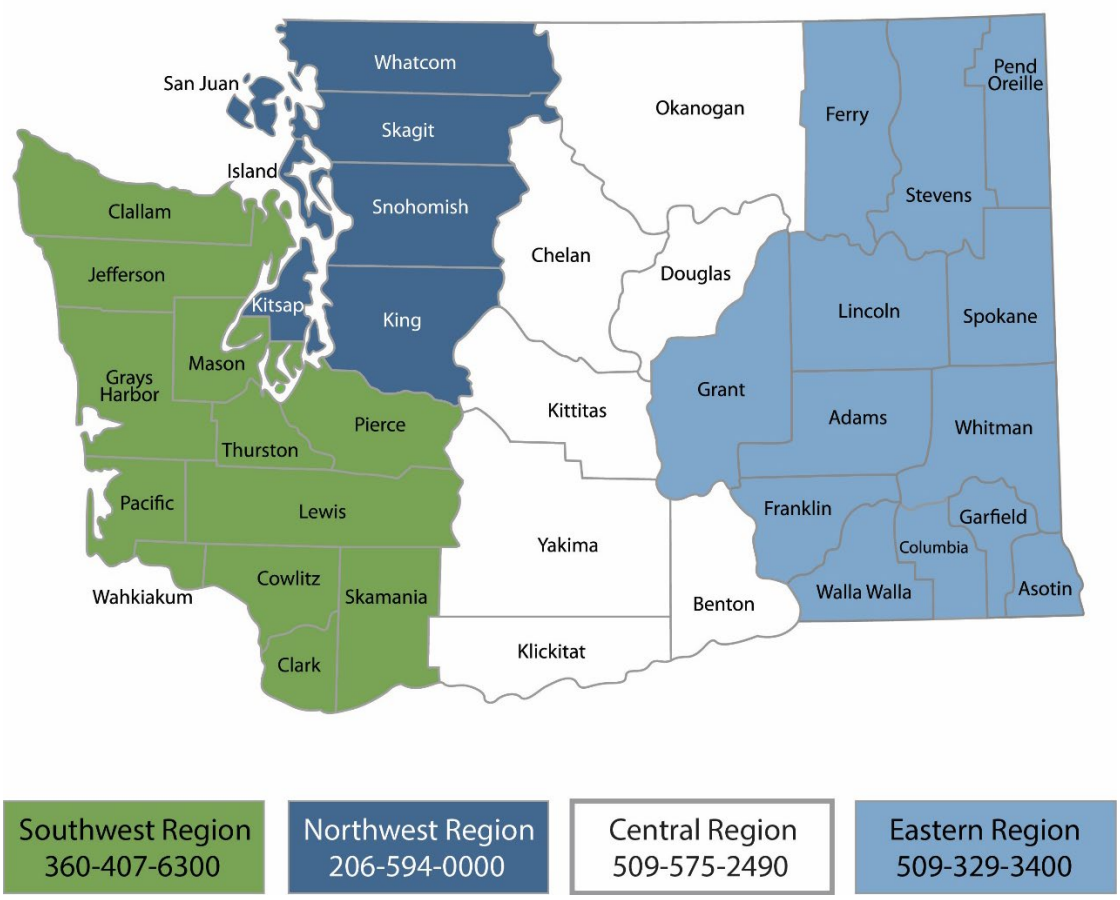
Department of Ecology's Regional Offices

Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	P.O. Box 47775 Olympia, WA 98504	360-407-6300
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
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	P.O. Box 46700 Olympia, WA 98504	360-407-6000

Preliminary Regulatory Analyses

Including the:

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Chapter 173-446 WAC, Climate Commitment Act Program

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DEPARTMENT OF
ECOLOGY
State of Washington

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Acronyms

APA	Administrative Procedure Act
APCR	Allowance Price Containment Reserve
CBA	Cost Benefit Analysis
CCA	Climate Commitment Act
CO_2e	Carbon dioxide equivalent
ECR	Emissions Containment Reserve
EITE	Emissions-intensive and trade-exposed
EPE	Electric power entity
FTE	Full-time employee equivalent
GHG	Greenhouse gas
LBA	Least Burdensome Alternative Analysis
MT	Metric tons
NAICS	North American Industry Classification System
RCW	Revised Code of Washington
RFA	Regulatory Fairness Act
SCC	Social Cost of Carbon
VRERA	Voluntary Renewable Electricity Reserve Account
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 proposed Climate Commitment Act Program rule (Chapter 173-446 WAC; the "rule"). This includes the:

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

All determinations are based on the best available information at the time of publication. We encourage feedback (including specific data) that may improve the accuracy of this analysis.

Reason for the proposed rule

In 2021, the Washington State Legislature passed the Climate Commitment Act (CCA), which establishes a comprehensive program to reduce greenhouse gas pollution and help achieve the greenhouse gas limits set in state law. The program is codified in Chapter 70A.65 RCW, Greenhouse Gas Emissions – Cap and Invest Program, and will start Jan. 1, 2023. In the CCA, the Legislature directs Ecology to adopt rules to implement a cap on greenhouse gas emissions, including mechanisms for the sale and tracking of tradable emissions allowances, along with compliance and accountability measures. The CCA also directs Ecology to design allowance auctions to allow for linkage to similar programs in other jurisdictions as much as possible.

Summary of the proposed rule

The proposed rule would set requirements in the following areas:

- General Requirements (proposed WAC 173-446-010 through -080).
- Program Account Requirements (proposed WAC 173-446-100 through -150).
- Allowance Budgets and Distribution of Allowances (proposed WAC 173-446-200 through -260).
- Allowance Auctions (proposed WAC 173-446-300 through -385).
- Compliance Instrument Transactions (proposed WAC 173-446-400 through -440).
- Offsets (proposed WAC 173-446-500 through -595).

Regulatory baseline

The regulatory 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 proposed rule.

For this rulemaking, the regulatory baseline includes:

- Greenhouse Gas Emissions – Cap and Invest Program law, Chapter 70A.65 RCW.

- Limiting Greenhouse Gas Emissions law, Chapter 70A.45 RCW.
- Reporting of Emissions of Greenhouse Gases rule, Chapter 173-441 WAC.
- Washington Clean Air Act law, Chapter 70A.15 RCW.
- Clean Energy Transformation Act law, Chapter 19.405 RCW, and rule, Chapter 173-444 WAC.
- Transportation Fuel – Clean Fuels Program law, Chapter 70A.535 RCW.
- Motor Vehicle Emission Standards law, Chapter 70A.30 RCW.

There are also rules that are currently in the process of rulemaking, but have not yet been adopted. These rules are not part of the regulatory baseline for our primary analysis, but since they are likely future regulations, we analyzed the proposed rule compared to a regulatory baseline that includes them (see Appendix B).

- Directed by Chapter 70A.65 RCW: Criteria for Emissions-Intensive, Trade-Exposed Industries, Chapter 173-446A WAC.
- Authorized by Chapter 70A.30 RCW: Clean Vehicle Standards rule, Chapter 173-423 WAC.
- Directed by Chapter 70A.535 RCW: Clean Fuels Program rule, Chapter 173-424 WAC.

Costs

We estimated annual and total present value costs of allowance purchases, emissions abatement, and offset credit purchases in Chapter 3. Here, we summarize total present value costs with and without offset use.

Table 1: Total present value costs

Cost Category	Present Value through 2050, no offset use (billions of $)	Present Value through 2050, maximum offset use (billions of $)
Allowance purchases	**$37.45**	**$34.44**
Offset credit purchases	**$0.00**	**$2.56**
Emissions abatement	**$11.11**	**$11.11**
Total	**$48.56**	**$48.11**

Benefits

We estimated annual and total present value benefits of emissions reductions, natural gas revenues, market revenues to the State, and sales of offset credits in Chapter 4. Here we summarize total quantifiable present value benefits, with and without offset use. Quantifiable benefits should be considered in conjunction with benefits discussed qualitatively or partially quantified, discussed below the table.

Table 2: Total present value benefits

Cost Category	Present Value through 2050, no offset use (billions of $)	Present Value through 2050, maximum offset use (billions of $)
Revenues to Washington	**$33.83**	**$31.12**
Revenues to natural gas utilities	**$3.62**	**$3.32**
Avoided Social Cost of Carbon	**$17.27**	**$17.27**
Revenues to sellers of offset credits	**$0.00**	**$2.56**
Total	**$54.72**	**$54.27**

Qualitative and partially quantifiable benefits

Additional avoided impacts of climate change not included in the SCC:

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

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

Wildfires

- Based on a national average of comprehensive wildfire impacts, **wildfires cost Washingtonians at least $1.6 to $8 billion each year.**
- In 2020, Washington spent an estimated **$20 million on aviation readiness and support** for large fires.
- The WA Department of Natural Resources incurred **direct costs of over $12.5 million** responding to wildfire incidents in 2020, and estimated additional damages of:
    - **$20 million** to utilities.
    - **$15 million** to state agency infrastructure.
    - **$10 million** to other government infrastructure.
- During a severe wildfire season, which are forecast to increase due to climate change, burned **managed (working) forests can lose over 90 percent of the value of their timber,** even when salvage harvest is accounted for.

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

Heat impacts

- The 2021 heat dome event in the Pacific Northwest resulted in **at least $1.45 billion in lost lives.**
- **Extreme heat events are forecast to increase due to climate change,** corresponding to wildfire events as well.
- Even when extreme heat events do not result in death, they significantly increase burden on healthcare services. During the 2021 heat dome event, the **number of people needing emergency room services increased 70-fold.** Healthcare visits related to a high heat event **costs $12,544 per visit** on average.
- At least **30 percent impact to raspberries**: The aggregate Whatcom County raspberry harvest fell 30 to 40 percent, with individual growers experiencing losses between 15 and 75 percent.
- At least **ten percent impact to cherries**: The overall cherry harvest, largely in the Yakima Valley, fell at least 10 percent.
- **$85 million impact to blueberries**: The Washington Blueberry Commission estimated $85 million in yield loss and quality impacts.
- Wheat harvests:
    - A **34-fold increase in the share of "poor" or "very poor" condition spring wheat**.
    - A **6-fold increase in the share of "poor" or "very poor" condition winter wheat**.
- Shellfish harvests:
    - **40 percent losses of seeded oysters**.
    - A **56 percent increase in vibriosis cases**. 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.
    - **5 – 30 percent oyster mortality** in the Salish Sea.
    - Higher losses among shellfish species in smaller, sheltered waters, and those that live nearer the surface, such as cockles.

Environmental justice improvements

Wildfires account for *at least* 25 to 50 percent of fine particulate matter in Washington, compounding health and quality of life impacts for overburdened populations that are more likely to live or work outdoors near high-traffic roadways and/or in wildfire smoke prone areas.

Heat-related mortality is more likely to affect people who:

- Have lower income.
- Have less shade and more impervious or paved surfaces.
- Are unsheltered or have inadequate housing.
- Have less education.
- Live alone.
- Are elderly.
- Lack transportation.
- Lack recreational spaces.
- Experience more job or income insecurity.

Other pollutants

Table 3: Value of damages from select criteria pollutants as reported in EPA rulemakings

Criteria Pollutant	Damages per MT in Current Dollars	Equivalent Mortality Risk (based on VSL)
$PM_{2.5}$	**$1.74 – 1.92 million**	**16 – 18 percent or 1 in 6**
Volatile Organic Compounds (VOCs)	**$1,347 - 1,468**	**0.01 percent or 1 in 10,000**
Nitrogen Oxides (NOx)	**$5,624 – 6,111**	**0.005 percent or 1 in 2,000**

CBA determination

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

Alternatives considered

We considered the following alternatives for rule content during the rule development process, and did not include those elements in the proposed rule for the reasons discussed in each subsection below.

- Setting different price controls.
- Establishing different total allowance budget trajectory.
- Adopting additional offset protocols for additional offset project categories.
- Allowing separate bid guarantees for parallel auctions.
- Requiring covered entities to affirmatively register for the program.

- Requiring all of the no cost allowances provided to EITE facilities to be from future vintage years.
- Putting a lower amount of the annual allowance budget into the APCR. (The minimum required under the regulatory baseline is 2 percent.)
- Not including an annual APCR auction.
- Applying the holding limits to all allowances in a compliance account.
- Putting allowances not sold at a single auction directly into the ECR.
- Implementing the ECR trigger price.

LBA determination

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

RFA compliance

The analyses required under the RFA, and their inclusion in a Small Business Economic Impact Statement, are based on whether the proposed rule would impose compliance costs on small businesses. A rule is otherwise exempt from these analyses under RCW 19.85.020(4).

Based on available information, we did not identify any small businesses that would be covered entities and therefore required to comply with the proposed rule. The average business that is likely to be a covered entity under the proposed rule employs 19,273 people.

However, we do not have full information concerning all potential covered entities. For example, about half of the 50-60 expected electric power entities that would potentially start reporting under recent amendments to the GHG reporting rule[2] (Chapter 173-441 WAC), would also be covered entities. Based on the size of other covered entities, we do not expect these electric power entities to be small businesses.

While it may be reasonable to assume that electric power entities are all large businesses, we cannot be certain of all their attributes. This is particularly true for EPEs for which we have uncertainty about emissions levels. Due to uncertainty about the employment attributes of electric power entities, we chose to complete a Small Business Economic Impact Statement and complete work required under the RFA, to fully understand potential disproportion in the impacts of the proposed rule.

As the RFA requires analyses specifically related to employment impacts and price or output impacts (as they play into revenue and profits), we also determined this analysis would be the most appropriate space to discuss other macroeconomic modeling we performed to fully understand the potential impacts of the proposed rule.

Since there is uncertainty in the employment levels of potential small business electric power

[2] WA Department of Ecology, 2022. Rulemaking for Chapter 173-441 WAC. Administrative Order #21-07.

entities, we chose to examine the full range of 1 – 50 employees that defines a small business in the RFA.

Table 4: Average annual present value compliance costs per employee, through 2050

Type of cost (or total cost)	Low	High
Average small business employment	**1**	**50**
Average employment at largest ten percent of businesses	**127,498**	**127,498**
Small business cost per employee	**$266,802**	**$13,216,164**
Largest business cost per employee	**$105**	**$104**

We conclude that, **if the proposed rule does impose compliance costs on small businesses, it may disproportionately affect them**. Therefore Ecology must include elements in the proposed rule to mitigate this potential disproportion, as far as is legal and feasible.

Consumption price impacts

Table 5: Impacts to consumption price levels (direct+indirect+induced), no amenity value, percent

Year	Statewide Price Level	Motor vehicle fuels, lubricants, and fluids	Electricity	Natural Gas	Fuel Oil
2030	**0.28%**	**1.50%**	**2.80%**	**-4.20%**	**1.40%**
2040	**0.07%**	**0.40%**	**1.00%**	**0.30%**	**0.40%**
2050	**0.03%**	**0.20%**	**0.60%**	**2.00%**	**0.20%**

Percent difference from REMI reference scenario price levels

Table 6: Impacts to consumption price levels (direct+indirect+induced), SCC amenity value, percent

Year	Statewide Price Level	Motor vehicle fuels, lubricants, and fluids	Electricity	Natural Gas	Fuel Oil
2030	**0.28%**	**1.25%**	**1.91%**	**-2.78%**	**1.22%**
2040	**0.07%**	**0.32%**	**0.54%**	**0.17%**	**0.31%**
2050	**0.03%**	**0.14%**	**0.28%**	**0.87%**	**0.14%**

Percent difference from REMI reference scenario price levels

We note that potential consumption price impacts were significantly mitigated by the ability of covered parties to use frontloaded APCR allowances and otherwise intertemporally optimize their behavior to smooth allowance price trajectories and lower overall compliance costs. They were also mitigated by requirements to use consigned no cost allowance revenues to counteract impacts to consumers, and additional allowance releases of APCR allowances and price ceiling units when allowance prices reached the proposed rule's APCR trigger prices or the ceiling price.

Output Impacts

Table 7: Impacts to output, no amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-$2.25**	**-$0.29**	**-$0.41**	**-$0.88**	**-$0.12**	**$1.42**	**-$1.172**
2040	**-$2.62**	**-$0.21**	**-$0.23**	**-$0.62**	**-$0.09**	**$0.37**	**-$0.961**
2050	**-$1.47**	**-$0.10**	**-$0.15**	**-$0.31**	**-$0.05**	**$0.03**	**-$0.293**

Table 8: Impacts to output, SCC amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-$1.84**	**-$0.29**	**-$0.38**	**-$0.86**	**-$0.11**	**$1.48**	**-$1.136**
2040	**-$1.45**	**-$0.20**	**-$0.14**	**-$0.56**	**-$0.07**	**$0.48**	**-$0.859**
2050	**$0.00**	**-$0.09**	**-$0.01**	**-$0.22**	**-$0.02**	**$0.11**	**-$0.164**

Impacts to prices and output do not reflect significant structural changes to the state economy, such as local development of new or expanded green industries over time.

Impacts to employment

Table 9: Impacts to employment, no amenity value, thousands of FTEs

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-0.28**	**-0.19**	**-2.05**	**-2.16**	**-0.77**	**8.48**	**0.352**
2040	**-5.49**	**-0.11**	**-0.87**	**-1.17**	**-0.52**	**1.86**	**-0.175**
2050	**-3.88**	**-0.04**	**-0.46**	**-0.45**	**-0.26**	**-0.08**	**0.255**

Table 10: Impacts to output, SCC amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**1.99**	**-0.19**	**-1.92**	**-2.11**	**-0.69**	**8.88**	**0.424**
2040	**0.28**	**-0.10**	**-0.50**	**-1.05**	**-0.31**	**2.52**	**0.018**
2050	**2.64**	**-0.04**	**0.02**	**-0.31**	**0.01**	**0.38**	**0.488**

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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 proposed Climate Commitment Act Program rule (Chapter 173-446 WAC; the "rule"). This includes the:

- Preliminary 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 proposed 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.

All determinations are based on the best available information at the time of publication. We encourage feedback (including specific data) that may improve the accuracy of this analysis.

1.1.1 Background

In 2021, the Washington State Legislature passed the Climate Commitment Act (CCA), which establishes a comprehensive program to reduce greenhouse gas pollution and help achieve the greenhouse gas limits set in state law. The program is codified in Chapter 70A.65 RCW, Greenhouse Gas Emissions – Cap and Invest Program, and will start Jan. 1, 2023. In the CCA, the Legislature directs Ecology to adopt rules to implement a cap on greenhouse gas emissions, including mechanisms for the sale and tracking of tradable emissions allowances, along with compliance and accountability measures. The CCA also directs Ecology to design allowance auctions to allow for linkage to similar programs in other jurisdictions as much as possible.

1.2 Summary of the proposed rule

The proposed rule would set requirements in the following areas:

- General Requirements (proposed WAC 173-446-010 through -080).
- Program Account Requirements (proposed WAC 173-446-100 through -150).
- Allowance Budgets and Distribution of Allowances (proposed WAC 173-446-200 through -260).
- Allowance Auctions (proposed WAC 173-446-300 through -385).
- Compliance Instrument Transactions (proposed WAC 173-446-400 through -440).
- Offsets (proposed WAC 173-446-500 through -595).

1.3 Document organization

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

- **Regulatory baseline and the proposed rule (Chapter 2):** Description and comparison of the regulatory baseline (what would occur in the absence of the proposed rule) and the proposed rule requirements.
- **Likely costs of the proposed rule (Chapter 3):** Analysis of the types and sizes of costs we expect impacted entities to incur as a result of the proposed rule.
- **Likely benefits of the proposed rule (Chapter 4):** Analysis of the types and sizes of benefits we expect to result from the proposed rule.
- **Cost-benefit comparison and conclusions (Chapter 5):** Discussion of the complete implications of the CBA.
- **Least-Burdensome Alternative Analysis (Chapter 6):** Analysis of considered alternatives to the contents of the proposed rule.
- **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: Regulatory baseline and Proposed Rule

2.1 Introduction

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

2.2 Regulatory baseline

The regulatory 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 proposed rule.

For this rulemaking, the regulatory baseline includes:

- Greenhouse Gas Emissions – Cap and Invest Program law, Chapter 70A.65 RCW.
- Limiting Greenhouse Gas Emissions law, Chapter 70A.45 RCW.
- Reporting of Emissions of Greenhouse Gases rule, Chapter 173-441 WAC.
- Washington Clean Air Act law, Chapter 70A.15 RCW.
- Clean Energy Transformation Act law, Chapter 19.405 RCW, and rule, Chapter 173-444 WAC.
- Transportation Fuel – Clean Fuels Program law, Chapter 70A.535 RCW.
- Motor Vehicle Emission Standards law, Chapter 70A.30 RCW.

There are also rules that are currently in the process of rulemaking, but have not yet been adopted. While these rules are directed and authorized by existing statutes, they not part of the regulatory baseline for this analysis. Since they are likely future regulations, however, we analyzed the proposed rule compared to a baseline that includes them (see Appendix C).

- Directed by Chapter 70A.65 RCW: Criteria for Emissions-Intensive, Trade-Exposed Industries, Chapter 173-446A WAC.
- Authorized by Chapter 70A.30 RCW: Clean Vehicle Standards rule, Chapter 173-423 WAC.
- Directed by Chapter 70A.535 RCW: Clean Fuels Program rule, Chapter 173-424 WAC.

2.2.1 Separability of regulatory baseline and proposed rule

Ecology included some of the proposed rule requirements as explicitly part of the regulatory baseline, while it based others on Ecology's discretion. In some cases, however, it is difficult to conceptually and analytically separate the regulatory baseline from discretionary elements of

the adopted rule – for example, where the regulatory baseline CCA establishes Cap and Invest Program scope and some definitions, but the proposed rule includes additional definitions, processes, or requirements needed to fully define the Cap and Invest Program and facilitate compliance. When this is the case, the actual impacts of the implementation details Ecology chose to adopt are not separable from the impacts of the overall program established under the regulatory baseline. To avoid underestimating costs in these cases, we estimated the costs and benefits accounting for individual elements of the regulatory baseline only wherever they were identifiably separable from the proposed rule.

2.2.2 Primary regulatory baseline and sensitivity analyses

The specific requirements of some regulatory baseline rules that are currently in the process of rulemaking are not yet finalized. Though they may be adopted in their final form by the time the Cap and Invest Program is adopted in rule per statutory requirements, we cannot be certain of their specific requirements and attributes at this time. While the Regulatory Analyses that will be conducted for rules adopted after the Cap and Invest Program may include the Cap and Invest Program in their regulatory baseline (as an adopted rule, excluded from analysis under the APA, RCW 34.05.310(4)(c)), we believe that due to the scope and novelty of this proposed Cap and Invest Program rule, it is reasonable to consider baselines both with and without these future regulations.

We therefore analyzed the impacts of the proposed rule both with and without additional future regulations, by using a primary regulatory baseline for our analyses, and including sensitivity analyses accounting for highly likely future regulations to the extent possible (see Appendix C).

2.3 Proposed rule

The proposed rule would set requirements in the following areas:

General Requirements (proposed WAC 173-446-010 through -080)

- Purpose.
- Definitions.
- Applicability.
- Covered emissions.
- Covered entity registration.
- Electric utilities registration.
- General market participant registration.
- Cap-and-invest consultants and advisors.
- New or modified covered entities.
- Exiting the program.

- Allowances.

Program Account Requirements (proposed WAC 173-446-100 through -150)

- Program accounts required.
- Disclosure of corporate associations – Indicia of corporate association.
- Disclosure of corporate associations – types of disclosures required.
- Disclosure of corporate association – information to be submitted.
- Designation and certification of account representatives.
- Designation of account viewing agents.
- Accounts for registered entities.

Allowance Budgets and Distribution of Allowances (proposed WAC 173-446-200 through -260)

- Total program baseline.
- Total program allowance budgets.
- Distribution of allowances to Emissions-Intensive and Trade-Exposed Entities.
- Distribution of allowances to electric utilities.
- Distribution of allowances to natural gas utilities.
- Removing and Retiring Allowances.
- Allowance distribution dates.

Allowance Auctions (proposed WAC 173-446-300 through -385)

- Auctions of current and prior year allowances.
- Public notice.
- Registration for an auction.
- Auctions - prohibited actions.
- Suspension and revocation of registration.
- Bid guarantee.
- Purchase limits.
- Auction floor price and ceiling price.
- Administration of auction: lots.
- Bids.
- Determination of actual maximum bid value.
- Maximum bid value in excess of bid guarantee.

- Acceptance of bids.
- Payment for purchases.
- Summary of auction.
- Auction of future year allowances.
- Allowance Price Containment Reserve Account.
- Emissions Containment Reserve Account.
- Price ceiling units.
- Price ceiling unit Sales.

Compliance Instrument Transactions (proposed WAC 173-446-400 through -440)

- Compliance instruments transactions – general information.
- Transfers among registered entities – process.
- Transaction requests – information required by Ecology.
- Transfers to Ecology – process.
- Transfers of no cost allowances from an electric utility to an electrical generating facility or to a federal power marketing administrator.
- Transfer of no cost allowances from a utility's holding account to its limited use holding account for consignment to auction
- Compliance instrument transactions – prohibited actions.

Offsets (proposed WAC 173-446-500 through -595)

- General requirements for Ecology offset credits and registry offset credits.
- Requirements for compliance offset protocols.
- Requirements for offset projects using Ecology compliance offset protocols.
- Authorized Project Designee.
- Listing of offset projects using Ecology compliance offset protocols.
- Monitoring, reporting, and record retention requirements for offset projects.
- Verification of GHG emissions reductions and GHG removal enhancements from offset projects.
- Requirements for offset verification services.
- Offset verifier and verification body accreditation.
- Conflict of interest requirements for verification bodies and offset verifiers for verification of offset project data reports.
- Issuance of registry offset credits.

- Issuance of Ecology offset credits.
- Process for issuance of Ecology offset credits.
- Registration of Ecology offset credits.
- Forestry offset reversals.
- Transferability of Ecology offset credits.
- Invalidation of Ecology offset credits.
- Approval requirements for offset project registries.
- Offset project registry requirements.
- Direct environmental benefits in the state.

2.3.1 General Requirements

2.3.1.1 Purpose

Regulatory baseline

In Chapter 70A.65 RCW, the Legislature finds that climate change is "an existential crisis with major negative impacts on environmental and human health" and that meeting greenhouse gas (GHG) emissions limits established in law (Chapter 70A.45 RCW) will "require coordinated, comprehensive, and multisectoral implementation of policies, programs, and laws, as other enacted policies are insufficient to meet the limits." Chapter 70A.65 RCW directs Ecology to "implement a cap on greenhouse gas emissions from covered entities and a program to track, verify, and enforce compliance through the use of compliance instruments."

Proposed

The proposed rule would implement the requirements of the GHG emissions Cap and Invest Program created by RCW 70A.65.060 through 70A.65.210. This program establishes a declining cap on GHG emissions from covered entities consistent with the limits established in RCW 70A.45.020, and a program to track, verify, and enforce compliance with the cap through compliance instruments.

Expected impact

We expect the proposed rule to result in costs of actions taken to comply with the Cap and Invest Program, for covered entities, opt-in entities, and general market participants. We also expect it to result in benefits of reduced GHG emissions, for the public, environment, and economy as well as benefits to overburdened communities and vulnerable populations.

2.3.1.2 Definitions

Regulatory baseline

Chapter 70A.65 RCW includes multiple definitions associated with the Cap and Invest Program, environmental justice, and greenhouse gases and emitters. By reference, it includes definitions in:

- Environmental Justice, Chapter 70A.02 RCW.
- Limiting Greenhouse Gas Emissions, Chapter 70A.45 RCW.
- Washington Clean Air Act, Chapter 70A.15 RCW.
- Washington Clean Energy Transformation Act, Chapter 19.405 RCW.

Collectively, these definitions support implementation and consistency in the Cap and Invest Program the law directs Ecology to implement.

Proposed

The proposed rule includes many definitions verbatim from the regulatory baseline, and adds definitions that further support Cap and Invest Program implementation, including, but not limited to, definitions related to:

- Emissions and crediting baselines. Note that the proposed rule uses "baseline" to refer to emissions quantities and project attributes under current, historic, or business-as-usual behaviors and regulations. It does not have the same meaning as the regulatory baseline discussed in this document. We have made efforts to ensure clarity when the term does not refer to the regulatory baseline of the Cost-Benefit Analysis.
- Offset verification.
- Designation of account representatives.
- Transactions and prices.
- Closed and curtailed entities.
- Offset projects.
- References to definitions in Chapter 173-441 WAC – Reporting of Emissions of Greenhouse Gases:
    - Electricity importer.
    - Electric power entity.
    - Facility.
    - First jurisdictional deliverer.
    - Greenhouse gas.
    - North American Industry Classification System (NAICS).
    - Point of delivery.
    - Reporter.
    - Any terms not otherwise defined in the proposed rule or other referenced definitions in law or rule.
- References to definitions in Chapter 173-446A WAC – Criteria for Emissions-Intensive, Trade-Exposed Industries.

- Any terms not otherwise defined in the proposed rule or other referenced definitions in law or rule.

- References to definitions in Chapter 19.405 RCW – Washington Clean Energy Transformation Act:
  - Retail electric load.

Expected impact

Definitions do not, in and of themselves, create any costs or benefits. They are, however, relevant to the proposed rule's requirements, and contribute to the costs and/or benefits of those requirements. Relevant sections below that involve terms defined in the proposed rule reflect their overall costs and/or benefits.

2.3.1.3 Applicability

Regulatory baseline

RCW 70.65.080 establishes program coverage for the Cap and Invest Program as follows:

First compliance period

A person is a covered entity at the beginning of the first compliance period if their reported emissions, under RCW 70A.15.2200 for any year from 2015 through 2019, exceeded any of the following thresholds:

Table 11: Covered entities in the first compliance period

Entity	GHG emissions
Facility owner or operator	**Facility emissions are at least 25,000 MT CO_2e**
First jurisdictional deliverer who is a generator of electricity in the state	**GHG emissions associated with generation are at least 25,000 MT CO_2e**
First jurisdictional deliverer who is importing electricity into the state	**Cumulative annual total of GHG emissions associated with the imported electricity are at least 25,000 MT CO_2e**
Supplier of fossil fuel other than natural gas	**Combustion or oxidation of fuel (in Washington) would result in GHG emissions of at least 25,000 MT CO_2e**

Entity	GHG emissions
Natural gas suppliers	**Combustion or oxidation (in Washington) of natural gas that is (excluding supply, delivery, or purchase at other covered parties or opt-in entities):** • **Supplied by a natural gas supplier and would result in GHG emissions of at least 25,000 MT CO_2e.** • **Delivered by a person who is not a natural gas company and has a tariff with a natural gas company to deliver to an end-use customer in Washington, that would result in GHG emissions of at least 25,000 MT CO_2e.** • **Purchased directly by an end-use customer in Washington from a person that is not a natural gas company and has the natural gas delivered through an interstate pipeline to a distribution system owned by the purchaser in amounts that would result GHG emissions of at least 25,000 MT CO_2e.**

Second compliance period

An owner or operator of a waste to energy facility, used by a county or city solid waste management program, is a covered entity as of the beginning of the second compliance period if their reported emissions under RCW 70A.15.2200 or emissions data required under Chapter 70A.65 ECW for any year from 2023 through 2025 are at least 25,000 MT CO_2e.

Subsequent compliance periods

A railroad company is a covered entity beginning January 1, 2031 if their reported or provided emissions for any year from 2027 through 2029 are at least 25,000 MT CO_2e

The regulatory baseline law also includes:

- Types of emissions that are not covered.
- Circumstances under which a person is no longer a covered entity.
- Coverage of new or modified emission sources.
- Coverage of existing emission sources that do not currently exceed the 25,000 MT CO_2e threshold but do so in the future.

Proposed

The proposed rule would establish applicability identical to the regulatory baseline.

Expected impact

We expect the proposed rule to result in costs of allowance purchases or GHG emissions reductions by GHG emitters, and benefits of GHG emissions reductions to the public, environment, and economy. The proposed rule does not differ from the statute in its establishment of applicability. This means the regulatory baseline is technically responsible for associated costs and benefits of applicability.

However, since Ecology used its discretion in other sections of the rule that interact with the applicability of the Cap and Invest Program, we could not analytically separate the proposed rule from the regulatory baseline. In other words, we could not analyze the impacts of other proposed rule requirements without including the applicability established under the regulatory baseline. This means estimated costs and benefits reflect the impacts of the Program as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

2.3.1.4 Covered emissions

Regulatory baseline

Chapter 70A.65 RCW defines covered emissions as "emissions for which a covered entity has a compliance obligation under RCW 70A.65.080." The section referenced sets the applicability of the program, as discussed above in section 2.3.1.3.

Proposed

The proposed rule would establish additional specificity in emissions covered under the Cap and Invest Program, including:

- Data sources forming the basis for covered emissions, including reported emissions under Chapter 173-441.
- Criteria for exempting reported emissions from covered emissions, including certain emissions and activity types.
- Clarifying which covered entity is responsible for a given type of covered emissions in order to avoid double counting. These clarifying divisions include:
    - Facilities.
    - Natural gas suppliers.
    - Suppliers of fossil fuels that are not natural gas.
    - Suppliers of carbon dioxide.
    - First jurisdictional deliverers of imported electricity.

Expected impact

We expect the proposed rule to result in costs of allowance purchases or GHG emissions reductions by GHG emitters, and benefits of GHG emissions reductions to the public, environment, and economy.

The proposed rule would add specificity to the emissions covered under the Cap and Invest Program. This means the regulatory baseline is technically responsible for associated costs and benefits of emissions covered under the Cap and Invest Program. However, since Ecology used its discretion in specifying which emissions would be included, as well as including clarity about the emissions that are covered and not covered for different entities, we could not analytically separate the proposed rule from the regulatory baseline.

In other words, we could not analyze the impacts of additional specificity added to regulatory baseline covered emissions, without including the covered emissions established under the regulatory baseline. This means estimated costs and benefits reflect the impacts of emissions coverage as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

2.3.1.5 Covered entity registration

Regulatory baseline

Chapter 70A.65 requires registration for:

- Covered entities.
- Opt-in entities that are responsible for GHG emissions and are not covered entities.
- General market participants that are not covered entities or opt-in entities.

Proposed

The proposed rule would require any reporter under Chapter 173-441 WAC that reports at least 25,000 MT CO_2e of covered emissions in any year, starting in 2015, that meets applicability requirements to be automatically registered as a covered entity. A reporter that is not a covered entity would be able to register as an opt-in entity, by request to Ecology.

A party that is not a reporter but emits GHGs in Washington would be able to voluntarily participate in the Cap and Invest Program as an opt-in entity by:

- Reporting voluntarily under Chapter 173-441 WAC.
- Requesting to be registered as an opt-in entity.

Note that opt-in entities would incur compliance obligations as covered entities do.

The proposed rule also includes notice requirements for Ecology and a process for entities that believe they were registered in error.

Expected impact

We expect the proposed rule to result in labor time costs associated with registration as well as benefits of full information about GHG allowance market participants. The proposed rule would add automatic registration for covered entities, as well as registration processes and requirements for opt-in entities and general market participants, all of which are required to register under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of registration itself, but Ecology discretion is responsible for the specific processes entities must use to register. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of registration as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as registration, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect

transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.1.6 Electric utilities registration

Regulatory baseline

Chapter 70A.65 requires registration for:

- Covered entities.
- Opt-in entities that are responsible for GHG emissions and are not covered entities.
- General market participants that are not covered entities or opt-in entities.

Proposed

The proposed rule would require all electric utilities in Washington that are not reporters to register to receive no cost allowances. This provision is necessary because, while not all electric utilities have compliance obligations as first jurisdictional deliverers of electricity, they all receive no cost allowances. All electric utilities need to have accounts to handle those allowances, and must therefore register in order to have the required accounts. They would need to provide to Ecology:

- Name, addresses, contact information, party type, date and place of incorporation, and ID number.
- Names and addresses of the utility's directors and officers with authority to make legally binding decisions on behalf of the utility, and partners with more than 10 percent of control over the partnership.
- Names and contact information for persons controlling more than 10 percent of the voting rights attached to all the outstanding voting securities of the utility.
- A business number, if one has been assigned to the utility by a Washington State agency.
- A government issued taxpayer or Employer Identification Number, or a U.S. Federal Tax Employer Identification Number.
- Disclosure of all other parties with whom the utility has a direct corporate association or indirect corporate association.
- Names and contact information for all employees of the utility with knowledge of the utility's market position.
- Information required for individuals serving as cap-and-invest consultants and advisors.

Expected impact

We expect the proposed rule to result in registration costs as well as benefits of full information about GHG allowance market participants. The proposed rule would add specific information that electric utilities would be required to submit to register, to the general regulatory baseline requirement of registration. This means the regulatory baseline is technically responsible for

associated costs and benefits of registration itself, but Ecology discretion is responsible for the specific process utilities must use to register. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of utility registration as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as registration, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.1.7 General market participant registration

Regulatory baseline

Chapter 70A.65 requires registration for:

- Covered entities.
- Opt-in entities that are responsible for GHG emissions and are not covered entities.
- General market participants that are not covered entities or opt-in entities.

Proposed

The proposed rule would require parties that are not covered entities or opt-in entities but want to participate in the allowance or offset credit market to apply for approval as general market participants. A general market participant could:

- Not be a covered entity or opt-in entity.
- Intend to purchase, hold, sell, or voluntarily retire compliance instruments.
- Operate a registered offset project.

They would need to:

- Have a primary residence in the United States.
- Disclose any parties for which they provide consulting services.
- Follow specific procedures if they also provide or are associated with a provider of cap and invest consulting services that gain access to the market position of another registered entity.
- Consent to being regulated by Ecology under the Cap-and-Invest program, including consent to the jurisdiction of Washington courts and administrative tribunals with respect to actions taken by Ecology to enforce applicable requirements of the program.

The following would not be eligible to be general market participants:

- Parties identified as having corporate associations with other registered entities.
- Account representatives for other registered entities.

- Account viewing agents for other registered entities.
- Parties identified as cap and invest consultants, unless disclosed.
- Employees of reporters under Chapter 173-441 WAC or the proposed rule.
- Offset verifiers and accredited verification bodies.
- Offset project registries.
- Emissions reporting verifiers.

The proposed rule would require a party to register as a general market participant by submitting to Ecology:

- Name, addresses, contact information, party type, date and place of incorporation, and ID number.
- Names and addresses of directors and officers with authority to make legally binding decisions on behalf of the general market participant, and partners with more than 10 percent of control over the partnership.
- Names and contact information for persons controlling more than 10 percent of the voting rights attached to all the outstanding voting securities of the party.
- A business number, if one has been assigned to the party by a Washington State agency.
- A government issued taxpayer or Employer Identification Number, or a U.S. Federal Tax Employer Identification Number.
- Disclosure of all other parties with whom the party has a direct corporate association or indirect corporate association.
- Names and contact information for all employees of the party with knowledge of the party's market position.
- Information required for cap-and-invest consultants and advisors.

Expected impact

We expect the proposed rule to result in registration costs as well as benefits of full information about GHG allowance market participants. The proposed rule would add specific information that general market participants would be required to submit to register, to the general regulatory baseline requirement of registration. This means the regulatory baseline is technically responsible for associated costs and benefits of registration itself, but Ecology discretion is responsible for the specific process general market participants must use to register. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of general market participant registration as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as registration, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission

allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.1.8 Cap-and-invest consultants and advisors

Regulatory baseline

The regulatory baseline does not directly address cap-and-invest consultants or advisors. However, the regulatory baseline requires Ecology to adopt measures to guard against bidder collusion and minimize the potential for market manipulation. The transparency required under this provision will help meet those requirements.

Proposed

The proposed rule would define cap-and-invest consultants or advisors and their activities, and require a party employing cap-and-invest consultants and advisors to disclose to Ecology:

- Name.
- Contact information.
- Physical work address of the Cap-and-Invest Consultant or Advisor.
- Employer.

Expected impact

We expect the proposed rule to result in disclosure costs as well as benefits of full information about GHG allowance market participants and the concomitant reductions in market manipulation and bidder collusion. The proposed rule would require parties using Cap-and-Invest Consultants and Advisors to disclose certain information to Ecology. Transaction costs, such as use of Consultants or Advisors, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.1.9 New or modified covered entities

Regulatory baseline

Chapter 70A.65 RCW requires emission sources that are covered entities under the law but do not begin operation until after January 1, 2023 or 2027 (as relevant to source type) to be covered under the Cap and Invest Program beginning in the year their emissions exceed applicable thresholds.

Proposed

The proposed rule would set the same requirements as the regulatory baseline, adding specificity and clarity by:

- Specifying January 1, 2023 as the relevant date for new facilities, suppliers, and first jurisdictional deliverers.

- Specifying January 1, 2027 as the relevant date for waste to energy facilities.
- Setting November 1 compliance deadlines for the year following the year their emissions were at least 25,000 MT CO_2e.

Expected impact

We do not expect specification of dates within the years set under the regulatory baseline to generate costs or benefits beyond clarity in coverage dates.

2.3.1.10 Exiting the program

Regulatory baseline

Chapter 70A.65 RCW sets the criteria for exiting the Cap and Invest Program. A covered entity is no longer covered as of the beginning of a compliance period if in the previous compliance period:

- It reported emissions below 25,000 MT CO_2e for each year during an entire compliance period.
- It has ceased all processes requiring GHG reporting.

Proposed

The proposed rule sets criteria for exiting the program that are identical to the regulatory baseline.

Expected impact

The proposed rule does not differ from the regulatory baseline's criteria for exiting the Cap and Invest Program. These criteria further define the applicability of the Program, and we could not analytically separate the proposed rule from the regulatory baseline.

2.3.1.11 Allowances

Regulatory baseline

Beyond defining an allowance as "an authorization to emit up to one metric ton of carbon dioxide equivalent," Chapter 70A.65 RCW does not include specific attributes of allowances.

Proposed

The proposed rule would require Ecology to:

- Create GHG allowances to cover annual allowance budgets.
- Assign each allowance a unique serial number.

Regarding allowance retirement, the proposed rule would designate the vintage of an allowance as the year it is designed to cover, and would require older vintage allowances to be retired before newer ones. It also specifies that allowances do not expire and may be banked.

Expected impact

We expect the proposed rule to result in costs of allowance purchases or GHG emissions reductions by GHG emitters, and benefits of GHG emissions reductions to the public,

environment, and economy. The proposed rule would add specific attributes to the allowances defined under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of the existence of allowances. However, since Ecology used its discretion in specifying allowance attributes, we could not analytically separate the proposed rule from the regulatory baseline. In other words, we could not analyze the difference between an allowance in general and allowances with the same definition but additional serial numbers and vintages. Moreover, allowances themselves would generate neither costs nor benefits, but would contribute to the costs and benefits of their allocation, purchase, trading, or retirement, as discussed in subsequent sections. We therefore do not expect this element of the proposed rule to result in costs or benefits in and of itself.

2.3.2 Program Account Requirements

2.3.2.1 Program accounts required

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to use an electronic tracking system that allows two accounts to each covered or opt-in entity:

- Compliance account: for transferring allowances to Ecology for retirement.
- Holding account: for trading allowances. The number of allowances a registered entity may have in its holding account must be below the holding limit in the proposed rule. Current holding account information must be publicly available.

The statute also specifies that:

- General market participants are each allowed an account, to hold, trade, sell, or transfer allowances.
- Ecology must maintain an account for retiring allowances transferred by registered entities and from the voluntary renewable reserve account.
- Ecology must maintain a public roster of all covered entities, opt-in entities, and general market participants on its website.
- Ecology must include a voluntary renewable reserve account[3] in the Cap and Invest Program.

Proposed

The proposed rule would add specifics and timing to the regulatory baseline requirements, including:

- Up to 30 days after registration notice for registered entities to make corporate association disclosures and designate account representatives.

[3] Note that the proposed rule calls this the Voluntary Renewable Electricity Reserve Account.

- After submission of the above information, Ecology sets up the required accounts for each registered entity.

It would also allow a registered entity that is a member of a direct corporate association to apply for a consolidated entity account or register separately (with allocation of the purchase and holding limits across accounts).

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond added clarity regarding timing of disclosures and accounts.

2.3.2.2 Disclosure of corporate associations – Indicia of corporate association

Regulatory baseline

Chapter 70A.65 RCW requires entities that register to describe any direct or indirect affiliation with other registered entities.

Proposed

The proposed rule would identify specific types of corporate associations and define their attributes. For direct corporate association, these are based on:

- Ownership interest in or control over a second party.
- Indicators of ownership (greater than 50 percent).
- Connection through more than one direct corporate association.
- Connection through a third party with shared direct corporate association.

For indirect corporate association, they are based on not having a direct corporate association, but indicators of ownership are greater than 20 percent but less than 50 percent.

The proposed rule also specifies situations in which:

- Electric utilities have direct corporate associations with others.
- An individual with access to market positions of multiple registered entities performs a shared role that creates a corporate association.
- An individual acting as a cap-and-invest consultant or advisor performs a shared role that creates a corporate association.

Expected impact

We expect the proposed rule to result in disclosure costs as well as benefits of full information about GHG allowance market participants. The proposed rule would add specific information that registered entities would be required to disclose as part of disclosing direct corporate associations as required under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of direct corporate association disclosure itself, but Ecology discretion is responsible for the specific information that must be disclosed. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of direct corporate

association disclosure as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as disclosures, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.2.3 Disclosure of corporate associations – Types of disclosures required

Regulatory baseline

Chapter 70A.65 RCW requires entities that register to describe any direct or indirect affiliation with other registered entities.

Proposed

The proposed rule would require registered entities to disclose all direct and indirect corporate associations, and information about associated parties. It would allow this to be accomplished using one or more existing governmental forms:

- Exhibit 21 of the Form 10-K submitted to the Securities and Exchange Commission by the registrant or an affiliate of the registrant.
- Application for market-based rate authority, or update to such application, submitted by the registrant or an affiliate of the registrant to the Federal Energy Regulatory Commission pursuant to 18 CFR Part 35 and Order 697.
- Application for registration with the National Futures Association, or update to such application, submitted by the registrant or an affiliate of the registrant as required by the Commodity Futures Trading Commission pursuant to the Commodity Exchange Act.
- Form 40 or Form 40S filed by the registrant or an affiliate of the registrant in accordance with the Commodity Futures Trading Commission's reporting rules.
- Part 1A of a Form ADV filed with the Securities and Exchange Commission by a registered investment advisor responsible for managing the registrant.

The proposed rule also includes entities that would be exempt from disclosure.

Expected impact

We expect the proposed rule to result in disclosure costs as well as benefits of full information about GHG allowance market participants. The proposed rule would add governmental forms that could be used to satisfy disclosure requirements, as part of disclosing direct corporate associations as required under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of disclosure itself, but Ecology discretion is responsible for the specific information that must be disclosed. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of disclosure as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as disclosures, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.2.4 Disclosure of corporate association – Information to be submitted

Regulatory baseline

Chapter 70A.65 RCW requires entities that register to describe any direct or indirect affiliation with other registered entities.

Proposed

The proposed rule would require registered entities to provide (about themselves and each reportable corporate association):

- Name, contact information, and physical address.
- Tracking system identification number.
- Names and addresses of the party's directors and officers with authority to make legally binding decisions on behalf of the party, and partners with over 10 percent of control over the partnership.
- Names and contact information for individuals or parties controlling over 10 percent of the voting rights attached to all the outstanding voting securities of the party.
- Business number, if one has been assigned by a Washington State agency.
- A government issued Taxpayer Identification Number or Employer Identification Number, or for parties located in the United States, a U.S. Federal Tax Employer Identification Number.
- Place and date of incorporation.
- Names and contact information for all employees of the party with knowledge of the party's market position.
- For direct corporate associations with registered entities only, the percentage share of the holding limit and purchase limit assigned to each party opting out of account consolidation.

Expected impact

We expect the proposed rule to result in disclosure costs as well as benefits of full information about GHG allowance market participants. The proposed rule would add specific information that registered entities would be required to submit as part of disclosing corporate associations as required under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of disclosure itself, but Ecology discretion is responsible for the specific information that must be disclosed. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated

costs and benefits reflect the impacts of disclosure as a whole, though Ecology's discretion in setting proposed rule requirements is not responsible for all of them.

Transaction costs, such as disclosures, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.2.5 Designation and certification of account representatives

Regulatory baseline

Chapter 70A.65 RCW does not include requirements for designation and certification of account representatives. However, RCW 70A.65 does require Ecology to oversee the market and adopt measures to prevent market manipulation. Limiting those who can act on behalf of a registered entity as account representatives helps accomplish this goal.

Proposed

The proposed rule would require registered entities to designate between two and five account representatives to perform any operations within the Cap-and-Invest Program on its behalf. One of them must be a primary account representative. Registered entities would be required to submit:

- Name and contact information of the registered entity.
- The following information concerning each designated account representative:
    - Name and contact information at the individual's home address.
    - Date of birth.
    - Copies of at least two identity documents.
- The name and contact information of the individual's employer.
- Confirmation from a financial institution located in the United States that the individual has a deposit account with the institution.
- Any conviction for a criminal offense declared in any jurisdiction during the previous five years constituting a felony under U.S. federal law or Washington law, or the equivalent thereof.
- A declaration signed by a director or by any other officer, or a resolution of the board of directors of the registered entity attesting that the account representatives have been duly designated to act on behalf of the registered entity for the purposes of this program.
- An attestation from an attorney confirming the link between an account representative and the registered entity.
- A declaration signed by each of the account representatives.

Expected impact

We expect the proposed rule to result in designation costs as well as benefits of full information about designated representatives, and security and quality assurance of Cap and Invest Program activities. The proposed rule would require registered entities to submit specific information to designate account representatives. Transaction costs, such as account representative designation, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.2.6 Designation of account viewing agents

Regulatory baseline

Chapter 70A.65 RCW does not include requirements for designation of account viewing agents. However, RCW 70A.65 does require Ecology to oversee the market and adopt measures to prevent market manipulation. Limiting those who can view accounts to only designated account representatives and account viewing agents helps accomplish this goal.

Proposed

The proposed rule would allow primary or alternate account representatives to authorize up to five account viewing agents. These agents would be able to view all information contained in the tracking system involving the registered entity's accounts, information, and transfer records. Account representatives would be required to submit a notice of delegation including:

- The name, address, email address, and telephone number of each primary account representative or alternate account representative.
- The name, address, email address, and telephone number of each account viewing agent.
- An attestation signed by the officer of the registered entity who is responsible for the conduct of the account viewing agent.

Expected impact

We expect the proposed rule to result in designation costs as well as benefits of full information about account viewing agents, and security and quality assurance of Cap and Invest Program activities. The proposed rule would require registered entities to submit specific information to designate account viewing agents. Transaction costs, such as account viewing agent designation, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.2.7 Accounts for registered entities

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to use an electronic tracking system that allows two accounts for each covered or opt-in entity:

1. A compliance account for transferring compliance instruments to Ecology for retirement.
2. A holding account for trading allowances. The number of allowances a registered entity may have in its holding account must be below the holding limit in the proposed rule. Current holding account information must be publicly available.

The statute also specifies that:

- General market participants are each allowed an account, to hold, trade, sell, or transfer compliance instruments.
- Ecology must maintain an account for retiring compliance instruments transferred by registered entities and from the voluntary renewable reserve account.
- Ecology must maintain a public roster of all covered entities, opt-in entities, and general market participants on its website.

Proposed

The proposed rule would require Ecology to set up two accounts for covered and opt-in entities after receiving complete documentation.

1. A compliance account for transferring allowances to Ecology for retirement.
2. A holding account for trading allowances. The number of allowances a registered entity may have in its holding account must be below the holding limit in the proposed rule.

For general market participants, Ecology would be required to set up only a holding account.

The proposed rule would set holding limits, defining the maximum total number of allowances of the current or prior vintage, and of each vintage subsequent to the current year, that a registered entity may hold in its holding account and, where applicable, its compliance account. It would limit general market participants to no more than ten percent of the total number of allowances of any vintage.

Finally, the proposed rule would require Ecology to post information about the contents of each holding account, including but not limited to the number of allowances in the account, on Ecology's Cap-and-Invest public website. The website also would also include a public roster of all covered entities, opt-in entities, and general market participants.

Expected impact

We expect the proposed rule to result in the benefit of preventing market manipulation, in line with regulatory baseline requirements. This element of the proposed rule adds specificity to the regulatory baseline primarily by setting specific holding limits. We expect holding limits to result in a benefit of limiting the ability of registered entities to hold a long position and manipulate the allowance market. By holding large numbers of allowances in a limited market, individual entities could affect market price stability.

2.3.3 Allowance Budgets and Distribution of Allowances

2.3.3.1 Total program baseline

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to determine emissions baselines as follows:

- By October 1, 2022: Adopt annual allowance budgets for the first compliance period of the program, calendar years 2023 through 2026. Ecology must determine an emissions baseline establishing the proportionate share that the total greenhouse gas emissions of covered entities for the first compliance period bears to the total anthropogenic greenhouse gas emissions in the state during 2015 through 2019, for the Cap and Invest Program commencing on January 1, 2023.
- By October 1, 2026: Add to the emissions baseline by incorporating the proportionate share that the total GHG emissions of new covered sectors in the second compliance period bear to the total anthropogenic greenhouse gas emissions in the state during 2023 through 2025. Ecology must adopt annual allowance budgets for the second compliance period of the program, calendar years 2027 through 2030.
- By October 1, 2028: Adopt annual allowance budgets for calendar years 2031 through 2040.

Annual allowance budgets must be set to achieve the proportionate share of reductions by covered entities necessary to achieve the 2030, 2040, and 2050 statewide emissions limits established in RCW 70A.45.020.

Allowances do not expire and may be banked.

Proposed

The proposed rule specifies the methods used to establish a total program emissions baseline. This would include subtotal emissions baselines calculated individually for each reporter or sector, and a total program emissions baseline that would be the sum of these subtotal emissions baselines. The rule includes methods to calculate these subtotal emissions baselines for:

- Facilities that are not emissions-intensive and trade-exposed (EITE) facilities.
- EITE facilities.
- Suppliers of natural gas.
- Suppliers of fossil fuel other than natural gas.
- Carbon dioxide suppliers.
- Electric power entities.

For the second compliance period, subtotal emissions baselines for new sectors of covered entities would be added to the total program emissions baseline. For subsequent compliance periods, subtotal emissions baselines for new covered sectors would be added to the previous

program emissions baseline. For new sectors of covered reporters, Ecology would not be required to adjust the total program emissions baseline.

Table 12: Total program baselines

Emissions Years	Total Program Baseline (annual MT CO_2e)
2023-2026	**68,132,501**
2027-2030	**Set by rule by October 1, 2026**
2031 and subsequent years	**Set by rule by October 1, 2028**

Expected impact

We expect the proposed rule to result in costs of compliance instrument purchases or GHG emissions reductions by GHG emitters, and benefits of GHG emissions reductions to the public, environment, and economy. The proposed rule would set a total program emissions baseline for the first compliance period (emissions years 2023 – 2026), as required under the regulatory baseline. This means the regulatory baseline is technically responsible for associated costs and benefits of the total program emissions baseline itself, but Ecology discretion is responsible for adding details based on statutory requirements. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of the total program emissions baseline as a whole, though Ecology's discretion in setting the quantity of annual MT CO_2e is not responsible for all of them.

2.3.3.2 Total program allowance budgets

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to determine emissions baselines as follows:

- By October 1, 2022: Adopt annual allowance budgets for the first compliance period of the program, calendar years 2023 through 2026. Ecology must determine an emissions baseline establishing the proportionate share that the total greenhouse gas emissions of covered entities for the first compliance period bears to the total anthropogenic greenhouse gas emissions in the state during 2015 through 2019, for the Cap and Invest Program commencing on January 1, 2023.
- By October 1, 2026: Add to the emissions baseline by incorporating the proportionate share that the total GHG emissions of new sectors of covered entities in the second compliance period bear to the total anthropogenic greenhouse gas emissions in the state during 2023 through 2025. Ecology must adopt annual allowance budgets for the second compliance period of the program, calendar years 2027 through 2030.
- By October 1, 2028: Adopt annual allowance budgets for calendar years 2031 through 2040.

Annual allowance budgets must be set to achieve the proportionate total share of reductions by all covered entities necessary to achieve the 2030, 2040, and 2050 statewide emissions limits established in RCW 70A.45.020

Allowances do not expire and may be banked.

Proposed

The proposed rule would establish required methods for setting the total allowances in the program for each year.

Table 13: Methods for setting total allowances in the program

Year	Method
2023	**93 percent of total program baseline for 2023 – 2026**
2024 – 2026	**Decreases annually by an additional 7.0 percent of total program baseline for 2023 – 2026**
2027	**The 2026 total program allowance budget plus adjustment for newly covered sectors, reduced by an additional 7.0 percent of total program baseline for 2027 – 2030**
2028 – 2030	**Decreases annually by an additional 7.0 percent of total program baseline for 2027 – 2030**
2031	**The 2030 total program allowance budget plus adjustment for newly covered sectors, reduced by an additional 1.9 percent of total program baseline for 2031 and later**
2032 – 2042	**Decreases annually by an additional 1.9 percent of total program baseline for 2031 and later**
2043 – 2050	**Decreases annually by an additional 2.5 percent of total program baseline for 2031 and later**

Table 14: Total program allowances for the first compliance period

Emissions Year	Total Covered Emissions (MT CO_2e)
2023	**63,363,226**
2024	**58,593,951**
2025	**53,824,676**
2026	**49,055,401**

Expected impact

We expect the proposed rule to result in costs of compliance instrument purchases or GHG emissions reductions by GHG emitters, and benefits of GHG emissions reductions to the public, environment, and economy. The proposed rule would set required methods for determining total covered emissions, for each emissions year through 2050, as required under the regulatory baseline. It would numerically specify total covered emissions for the first compliance period (emissions years 2023 – 2026). This means the regulatory baseline is technically responsible for associated costs and benefits of total covered emissions itself, but Ecology is responsible for applying the method specified under the regulatory baseline to the total program emissions baseline, so to the extent Ecology had discretion in detailing the contents of the total program emissions baseline, we could not separate this in our analysis. This means estimated costs and benefits reflect the impacts of total covered emissions as a whole, though Ecology's discretion in setting the quantity of annual MT CO_2e is not responsible for all of them.

2.3.3.3 Distribution of allowances to Emissions-Intensive and Trade-Exposed entities

Regulatory baseline

Chapter 173-446A WAC establishes criteria for emissions intensity and trade exposure, as required by Chapter 70A.65 RCW.

Chapter 70A.65 RCW also requires emissions-intensive and trade-exposed (EITE) facilities in specific industries to receive no cost allowances. They are listed below, with corresponding North American Industry Classification System (NAICS) codes.

Table 15: Industries receiving no cost allowances as EITE

Industry description	NAICS Codes
Metals manufacturing, including iron and steel making, ferroalloy and primary metals manufacturing, secondary aluminum smelting and alloying, aluminum sheet, plate, and foil manufacturing, and smelting, refining, and alloying of other nonferrous metals	**Beginning with 331**
Paper manufacturing, including pulp mills, paper mills, and paperboard milling	**Beginning with 322**
Aerospace product and parts manufacturing	**Beginning with 3364**
Wood products manufacturing	**Beginning with 321**
Nonmetallic mineral manufacturing, including glass container manufacturing	**Beginning with 327**
Chemical manufacturing	**Beginning with 325**
Computer and electronic product manufacturing, including semiconductor and related device manufacturing	**Beginning with 334**
Food manufacturing	**Beginning with 311**
Cement manufacturing	**327310**
Petroleum refining	**324110**
Asphalt paving mixtures and block manufacturing from refined petroleum	**324121**
Asphalt shingle and coating manufacturing from refined petroleum	**324122**
All other petroleum and coal products manufacturing from refined petroleum	**324199**

For the first compliance period, EITE facilities must receive no cost allowances equal to their carbon intensity multiplied by their actual production. If facilities use a mass-based approach, they must receive no cost allowances equal to their mass-based emissions baseline.

For subsequent compliance periods, annual allocations of no cost allowances must be adjusted according to the benchmark reductions schedules below, multiplied by the facilities' actual production.

- First compliance period: 100 percent of baseline emissions.
- Second compliance period: 97 percent of baseline emissions.
- Third compliance period: 94 percent of baseline emissions.

EITE facilities are required to submit their carbon intensity baselines for the first compliance period to Ecology. During the first compliance period, EITE facilities must record their facility-specific carbon intensity baseline based on actual production. For the second compliance period, the benchmark for each EITE facility is 3 percent below the first period's carbon intensity baseline. For the third compliance period, the benchmark is 3 percent below the second period benchmark.

For subsequent compliance periods, Ecology must provide a report to the appropriate committees of the state Senate and House of Representatives that describes alternative methods for determining the amount and a schedule of allowances to be provided to facilities owned or operated by each covered entity designated as an EITE facility through 2050. If the legislature does not adopt a compliance obligation for EITE facilities by December 1, 2027, those facilities must continue to receive no cost allowances as provided in the third four-year compliance period that begins January 1, 2031.

Proposed

The proposed rule would establish methods required for determining allocation baselines for EITE facilities, and lists data sources Ecology may use with adjustment as necessary. These methods are consistent with the regulatory baseline, and facilitate consistency and compliance through direction to data and regulatory sources supporting allocation baseline determination.

The proposed rule would also require Ecology to assign an allocation baseline by November 15, 2022 to any EITE facility that submitted their information by September 15, 2022.

EITE facilities would be given no cost allowances according to the reduction schedule:

- First compliance period: 100 percent of the facility's allocation baseline for each year.
- Second compliance period: 97 percent of the facility's allocation baseline for each year.
- Third compliance period: 94 percent of the facility's allocation baseline for each year.

Finally, the proposed rule would prohibit any adjustments to budgets or allocations that would:

- Reduce air quality in an overburdened community.
- Negatively impact tribal lands and resources.

Expected impact

We expect the proposed rule to mitigate impacts of the Cap and Invest Program on EITE facilities, resulting in reduced leakage of GHG emissions. GHG emissions leakage occurs when GHG emissions reductions in the state are offset by associated emission increases in other jurisdictions, for example if a company shifts production to another facility out of state, or if costs impact output prices such that a market shifts its demand to producers out of state. The proposed rule would set required methods for allocating no cost allowances to EITE facilities, for the first three compliance periods, in line with the regulatory baseline.

This means the regulatory baseline is technically responsible for associated costs and benefits of no cost allowances allocated to EITE facilities, and their allocation during the first three compliance periods, but Ecology discretion is responsible for the specific methods for

determining total allocation baselines for EITE facilities. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of no cost allowances as a whole, though Ecology's discretion in setting methods for determining total EITE facility allocation baselines, is not responsible for all of them.

2.3.3.4 Distribution of allowances to electric utilities

Regulatory baseline

Chapter 70A.65 RCW also allows electric utilities subject to Chapter 19.405 RCW, the Washington Clean Energy Transformation Act, to receive no cost allowances to mitigate the cost burden of the Cap and Invest Program on electricity consumers.

It requires Ecology to adopt rules in consultation with the Department of Commerce and the Utilities and Transportation Commission, establishing the methods and procedures for allocating allowances for investor-owned electric utilities, and for consumer-owned utilities. The rules must take into account the cost burden of the program on electricity customers.

It also requires Ecology to adopt an allocation schedule in rule for the first compliance period, consistent with a forecast approved by the Utilities and Transportation Commission for investor-owned utilities, or by the governing boards of consumer-owned utilities, of each utility's supply and demand, and the resulting cost burden resulting from inclusion of the covered entities in the first compliance period. Ecology is also required to adopt an allocation schedule for the second compliance period and for 2031 through 2045. Utilities may not receive no cost allowances after 2045.

During the first compliance period, no cost allowances may be consigned to auction for the benefit of ratepayers, deposited for compliance, or a combination of both. Requirements for future compliance periods must be established by Ecology by future rulemakings.

Benefits of all allowances consigned to auction must be used by consumer-owned and investor-owned electric utilities for the benefit of ratepayers, with the first priority the mitigation of any rate impacts to low-income customers.

Proposed

Under the proposed rule, allowances allocated to electrical utilities for a compliance period would be based on the cost burden effect of the Cap and Invest Program. Ecology would be required to use the following method to determine how cost burden and its effect will be used to allocate allowances to each electric utility for each emissions year.

Ecology would determine the generation resource fuel type forecasted to be used to provide retail electric load for a utility for the compliance period.

The proposed rule would set the following emission factors to determine the emissions associated with the projected generation mix.

- For generation that is projected to be served by natural gas the factor will be 0.4354 MT CO_2e per MWh.

- For generation that is projected to be served by coal the factor will be 1.0614 MT CO_2e per MWh, unless that generation is coal transition power as defined in RCW 80.80.010 in which case the factor is zero, as required by RCW 70A.65.080(7)(c).
- For generation identified as a non-emitting or a renewable resource in the clean energy implementation plan, use an emission factor of zero.
- For any generation from which the fuel type source is unknown or unknowable, and for unspecified market purchases, use the unspecified emission factor using the procedures identified in WAC 173-444-040.

The cost burden effect from the emissions for each utility would be calculated according to an equation in the proposed rule. One allowance would be allocated for each metric ton of emissions of the cost burden effect for each electric utility, for each emissions year as projected through this process.

Finally, Ecology would allocate allowances to a Voluntary Renewable Electricity Reserve Account (VRERA). The number of allowances allocated to the VRERA for the first compliance period would be 1/3 of one percent of the total program allowance budget for each year.

Expected impact

We expect the proposed rule to result in the benefit of mitigating impacts of the Cap and Invest Program on electric utilities and their ratepayers. Costs incurred either directly or indirectly (due to compliance costs putting upward pressure on electricity prices throughout the market) under the regulatory baseline and the proposed rule could be passed on to ratepayers, and allocation of no cost allowances is intended to reduce these costs and prevent significant increases in electricity bills.

The proposed rule would set required methods for allocating no cost allowances to electric utilities, in line with the regulatory baseline, but would specify emission factors and cost burden effect calculation. This means the regulatory baseline is technically responsible for associated costs and benefits of no cost allowances allocated to electric utilities, but Ecology discretion is responsible for the specific methods for determining allocation amounts. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of no cost allowances as a whole, though Ecology's discretion is not responsible for all of them.

While it is not specified in the proposed rule what the percentage of the total program budget would be allocated to the VRERA for the second compliance period and subsequent compliance periods, we assume one-third of one percent will continue to be allocated.

2.3.3.5 Distribution of allowances to natural gas utilities

Regulatory baseline

Chapter 70A.65 RCW also requires allocation of no cost allowances to natural gas utilities for the benefit of ratepayers.

It requires Ecology to adopt rules in consultation with the Utilities and Transportation Commission, establishing the methods and procedures for allocating allowances for natural gas

utilities. Allocations must allow utilities to cover their emissions and decline proportionally with the cap.

It also requires Ecology to adopt an allocation schedule in rule for the first compliance period, in consultation with the Utilities and Transportation Commission, for the provision of these allowances.

Beginning in 2023, 65 percent of no cost allowances must be consigned to auction. Rules must increase this percentage by five percent each year until a total of 100 percent is reached. Revenues from allowances sold at auction must be returned by providing nonvolumetric credits on ratepayer utility bills, prioritizing low-income customers, or used to minimize cost impacts on low-income, residential, and small business customers. Remaining allowances may be consigned to auction for the benefit of ratepayers, deposited for compliance, or both.

To qualify for no cost allowances, covered entities that are natural gas utilities must provide copies of their greenhouse gas emissions reports filed with the US Environmental Protection Agency (EPA) under 40 C.F.R. Part 98 subpart NN - suppliers of natural gas and natural gas liquids for calendar years 2015 through 2021 to Ecology by March 31, 2022.

To continue receiving no cost allowances, a natural gas utility must provide to the department the US EPA subpart NN greenhouse gas emissions report or equivalent information for each reporting year in the manner and by the dates provided by RCW 70A.15.2200(5) as part of greenhouse gas reporting.

Proposed

Under the proposed rule, allowances allocated to natural gas suppliers for a compliance period would be based on specified data sources and methods. Ecology would assign an allocation baseline to each supplier of natural gas using the methods for subtotal emissions baselines discussed above in section 2.3.3.1. Allowance allocation would be based on the supplier's allocation baseline.

A supplier of natural gas that is a covered entity under the Cap and Invest Program would be required to submit a GHG report under Chapter 173-441 WAC for each emissions year 2015 through 2021 by March 31, 2022 in order to qualify for no cost allowances in the first compliance period. A supplier of natural gas that becomes a covered entity after 2023 would need to submit a complete GHG report for each emissions year 2015 through the current reporting year by the reporting deadline for the year they become a covered reporter in order to qualify for no cost allowances.

Prior to the beginning of a new compliance period, Ecology may make an upward or downward adjustment in the allocation baseline for a supplier of natural gas effective starting in the next compliance period.

The proposed rule would establish methods for establishing total no cost allowances allocated to a supplier of natural gas:

- 2023: 93 percent of allocation baseline.
- 2024 – 2030: Decreases by an additional 7 percent of their allocation baseline.

- 2031 - 2042: Their 2030 total allowance budget reduced annually by an additional 1.9 percent of their allocation baseline.
- 2043 – 2049: Decreases annually by an additional 2.5 percent of their allocation baseline.

The proposed rule would require no cost allowances allocated to natural gas utilities to be consigned to auction for the benefit of ratepayers, deposited for compliance, or a combination of both. Trading, transfer, or sale would not be allowed.

Expected impact

We expect the proposed rule to result in the benefit of mitigating impacts of the Cap and Invest Program on natural gas utilities and their ratepayers. Costs incurred either directly or indirectly (due to compliance costs putting upward pressure on natural gas prices throughout the market) under the regulatory baseline and the proposed rule could be passed on to ratepayers, and allocation of no cost allowances is intended to reduce these costs and prevent significant increases in natural gas bills.

The proposed rule would set required methods for allocating no cost allowances to natural gas utilities, in line with the regulatory baseline, but would specify the rate of decline. This means the regulatory baseline is technically responsible for associated costs and benefits of no cost allowances allocated to natural gas utilities, but Ecology discretion is responsible for the specific methods for determining allocation amounts. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of no cost allowances as a whole, though Ecology's discretion is not responsible for all of them.

2.3.3.6 Removing and retiring allowances

Regulatory baseline

Chapter 70A.65 RCW does not specify methods for removing and retiring allowances.

Proposed

The proposed rule would establish processes for removal and retirement of allowances to account for the use of offset credits.

To ensure consistency with proportional GHG emission limits, the proposed rule would enable Ecology to remove and retire allowances if the analysis of the state's progress toward the greenhouse gas limits indicates insufficient progress toward those limits based on the proportion of covered emissions in the program relative to total statewide greenhouse gas emissions.

Ecology would be required to remove and retire allowances from the VRERA in recognition of the generation of renewable electricity that is directly delivered to Washington and used for the purposes of voluntary renewable electricity programs.

Expected impact

We do not expect the proposed procedures used to retire allowances to result in costs or benefits. These impacts are administrative impacts to Ecology.

Removal and retirement of allowances would constrict allowance supply, putting upward pressure on prices. We cannot, however, confidently forecast when this would happen.

2.3.3.7 Allowance distribution dates

Regulatory baseline

Chapter 70A.65 RCW does not specify distribution dates for no cost allowances.

Proposed

Under the proposed rule, Ecology will distribute:

- Vintage 2023 no cost allowances to natural gas and electric utilities by September 1, 2023.
- Preliminary distribution of vintage 2023 no cost allowances to EITE facilities based on 2021 production data by September 1, 2023.
- Final reconciliation of no cost allowances for EITE facilities based on 2023 production data by October 24, 2024.
- No cost allowances to natural gas and electric utilities, of the vintage of the year in which they are distributed, by October 24 of each year after 2023.
- Preliminary distribution of no cost allowances to EITE facilities based on production data from the prior year, of the vintage of the year following the year in which they are distributed, by October 24 of 2023, and every October 24 thereafter.
- Final reconciliation of no cost allowances for EITE facilities for the prior year based on production data for the prior year, by October24 of 2024, and every October 24 thereafter.

Expected impact

We do not expect the distribution dates of allowances, processes for distribution, or processes for reconciliation between preliminary and final distribution of no cost allowances to result in differentiable costs or benefits. The proposed rule provides clarity in procedures and timing.

2.3.4 Allowance Auctions

2.3.4.1 Auctions of current and prior year allowances

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to distribute allowances through auction, and specifies that an allowance is not a property right. It requires Ecology to:

- Hold up to four auctions each year, plus reserve auctions.

- Auction allowances from the current allowance budget and those remaining from previous years.
- Notify and communicate results of auctions to the Environmental Justice Council.
- Auction future vintage allowances in at least two parallel auctions each year.
- Hire a contractor to run the auctions, and an administrator to manage bid guarantees.
- Adopt requirements for auction registration and participation, including:
    - Submitting an application 30 days before an auction, and receiving approval notice in order to participate.
    - Having separate representatives for each registered entity participating in an auction.
- Adopt provisions that guard against bidder collusion and minimize potential for market manipulation, including cancellation or rejection of auction applications for:
    - Providing false or misleading facts.
    - Withholding material information that could influence a decision by the department.
    - Violating any part of the auction rules.
    - Violating registration requirements.
    - Violating any of the rules regarding the conduct of the auction.
- Design auctions to allow linkage with GHG trading programs in other jurisdictions to the maximum extent practicable.

The law also allows Ecology to:

- Require a bid guarantee.
- Impose additional purchase and holding limits to protect the integrity of auctions.

Proposed

The proposed rule builds on the regulatory baseline requirements to fully design allowance auctions. Under the proposed rule, Ecology would submit allowances to auctions held four times each year, each with a single round of bidding. Auctions would include:

- Allowances reserved by Ecology for the purpose of auctions.
- Allowances consigned to auction by electric utilities and natural gas utilities:
    - Electric utilities may choose to consign up to 100 percent of their allowances to auction.
    - Natural gas utilities may choose to consign up to 100 percent of their allowances to auction, and must consign a portion of their no cost allowances to auction.

Table 16: Minimum share of natural gas utility no cost allowances consigned to auction

Year	Minimum Share Consigned
2023	**65%**
2024	**70%**
2025	**75%**
2026	**80%**
2027	**85%**
2028	**90%**
2029	**95%**
2030	**100%**

The proposed rule would require all auction proceeds from auctions consigned by natural gas utilities to be used for the benefit of customers.

Expected impact

We expect the proposed rule to result in the benefit of mitigating impacts of the Cap and Invest Program on electric utilities and natural gas utilities and their ratepayers. Costs incurred either directly or indirectly (due to compliance costs putting upward pressure on prices throughout the market) under the regulatory baseline and the proposed rule could be passed on to ratepayers, and allocation of no cost allowances is intended to reduce these costs and prevent significant increases in electric and natural gas bills.

The proposed rule would set required minimum percentages of no cost allowances that natural gas utilities must consign to auction in each year, consistent with the regulatory baseline, and allow electric utilities flexibility in the number of no cost allowances consigned to auction. This means the regulatory baseline is technically responsible for associated costs and benefits of no cost allowances consigned to auction for the benefit of ratepayers, but Ecology discretion is responsible for the specific methods for determining allocation amounts. As a result, we could not analytically separate the proposed rule from the regulatory baseline. This means estimated costs and benefits reflect the impacts of no cost allowances consigned to auction as a whole, though Ecology's discretion is not responsible for all of them.

2.3.4.2 Public notice

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to notify the Environmental Justice Council at least 60 days before auctions, and to provide a summary results report and post-auction public proceeds report within 60 days after auctions. It also requires Ecology to communicate the results of the previous calendar year's auctions to the environmental justice council on an annual basis beginning in 2024.

Proposed

The proposed rule builds on the regulatory baseline by adding specifics of notices. It would require Ecology to provide notice of auctions to the Environmental Justice Council and to the public. Notices would include the following information about auction:

- Date, time, and location.

- Rule requirements.
- Number of available allowanced.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits. These are purely administrative costs to Ecology, and the proposed rule builds on the administrative actions required under the regulatory baseline.

2.3.4.3 Registration for an Auction

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt requirements for auction registration and participation, including:

- Submitting an application 30 days before an auction, and receiving approval notice in order to participate.
- Having separate representatives for each registered entity participating in an auction.

Proposed

Under the proposed rule, a registered entity would be required to apply to Ecology before bidding in each auction. To apply to bid in an auction they would need to:

- Update their information at least 40 days before the auction.
- Submit information to Ecology at least 30 days before the auction:
    - Name, contact information and holding account number of the registered entity.
    - Names and identification numbers of all designated account representatives of the registered entity.
    - Name and contact information of any consultant that provides advice related to the auction participant's bidding strategy and, if applicable, the name of the consultant's employer.
    - Form of bid guarantee to be given.
- Submit their bid guarantee at least 12 days before the auction.

Cap-and-Invest Consultants or Advisors advising on bidding strategy would need to provide Ecology with:

- Names of the registered entities they are advising.
- Description of the advisory services they are providing.
- Assurance under penalty of perjury that the advisor is not transferring to or otherwise sharing information with other auction participants.

Expected impact

We expect the proposed rule to result in registration costs as well as benefits of full information about GHG allowance market participants. The proposed rule would specify the required information registered entities must submit to register to participate in an auction.

Transaction costs, such as registration, would be a part of overall private costs associated with auction participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases.

2.3.4.4 Auctions – Prohibited actions

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt provisions that guard against bidder collusion and minimize potential for market manipulation.

Proposed

To prevent bidder collusion and minimize the potential for market manipulation, the proposed rule would not allow a registered entity that is registered to participate in an auction to release or disclose any bidding information including, but not limited to:

- Intent to participate or refrain from participating in an auction.
- Auction approval status.
- Intent to bid.
- Bidding strategy.
- Bid price or bid quantity.

It would also prohibit coordinating bidding strategies of more than one auction participant.

Expected impact

We expect the proposed rule to result in benefits of preventing bidder collusion and minimizing the potential for market manipulation. We do not expect this element of the proposed rule to result in costs, as no costs are associated with not releasing or disclosing bidding information.

2.3.4.5 Suspension and revocation of registration

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt provisions that guard against bidder collusion and minimize potential for market manipulation, including cancellation or rejection of auction applications for:

- Providing false or misleading facts.
- Withholding material information that could influence a decision by the department.
- Violating any part of the auction rules.
- Violating registration requirements.

- Violating any of the rules regarding the conduct of the auction.

It also states that a registered entity may not release or disclose any bidding information including:

- Intent to participate or refrain from participation.
- Auction approval status.
- Intent to bid.
- Bidding strategy.
- Bid price or bid quantity.
- Information on the bid guarantee provided to the financial services administrator.

Proposed

The proposed rule includes the regulatory baseline criteria for cancellation or rejection of auction applications, and prohibition against disclosing bidding information. Exemptions would be allowed for entities within direct corporate associations.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits aside from the benefits of preventing bidder collusion and minimizing the potential for market manipulation.

2.3.4.6 Bid guarantee

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to:

- Hire a qualified, independent contractor to run the auctions.
- Hire a qualified financial services administrator to:
    - Hold the bid guarantees.
    - Evaluate bid guarantees.
    - Inform the department of the value of bid guarantees once the bids are accepted.

It also allows Ecology to require a bid guarantee, payable to the financial services administrator, in an amount greater than or equal to the sum of the maximum value of the bids to be submitted by the registered entity.

Finally, it prohibits registered entities from buying more than their bid guarantee.

Proposed

The proposed rule would build on the regulatory baseline by specifying attributes of bid guarantees, including:

- Denomination: US dollars.

- Validity: 26 or more days after auction.
- Form: wire transfer, irrevocable letter of credit, or bond.
- Value: at least the registered entity's proposed maximum bid value, based on the highest product of each bid price and the number of allowances proposed for purchase at that price or a higher price.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits as compared to the regulatory baseline. The bid guarantee is required under the regulatory baseline, while the proposed rule allows flexibility that does not require additional effort on the part of auction participants.

2.3.4.7 Purchase limits

Regulatory baseline

Chapter 70A.65 RCW defines a purchase limit as "the limit on the number of allowances one registered entity or a group of affiliated registered entities may purchase from the share of allowances sold at an auction." The statute specifies that

- A covered entity or opt-in entity that is not a member of a direct corporate association shall not purchase more than 10 percent of the allowances available.
- A general market participant that is not a member of a direct corporate association shall not purchase more than 4 percent of the allowances available.

Proposed

Under the proposed rule, registered entities would be required to comply with the purchase limits specified in statute.

For purposes of auction purchase limits, all members of a direct corporate association would be considered to be a single party.

Expected impact

We expect this element of the proposed rule to result in the benefit of preventing auction participants from manipulating the market or cornering the market in such a way that affects the ability of other entities to comply efficiently with the law and proposed rule. We do not expect this element of the proposed rule to result in costs, as purchase limits and treatment of direct corporate associations are specified under the regulatory baseline.

2.3.4.8 Auction floor price and ceiling price

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to:

- Adopt an auction floor price and schedule for annual increases.
- Adopt an auction ceiling price.

- Place at least two percent of allowances in an allowance Price Containment Reserve (APCR), during 2023 – 2026.
- Adopt rules for separate auctioning allowances from the APCR when settlement prices approach the ceiling price.
- Distribute allowances from the APCR by auction when new covered or opt-in entities enter the program and the Emissions Containment Reserve (ECR) are exhausted.
- Limit auctioning of allowances from the APCR to covered and opt-in entities.
- Set the reserve auction floor price or price tiers.
- Establish the number of allowances to be placed in the APCR after the first compliance period.

Proposed

The proposed rule would set an auction floor price of $19.70 in 2022-dollars.The floor price would increase by 5 percent plus the inflation rate each year. Each December, Ecology would announce the floor price for the next year, based on the current year's inflation index through December.

The proposed rule would also set a ceiling price of $72.29 in 2022-dollars. The ceiling price would increase by 5 percent plus the inflation rate each year. Each December, Ecology would announce the ceiling price for the next year, based on the current year's inflation index through December.

Expected impact

We expect the proposed rule to maintain allowance market success by setting an auction price floor and ceiling, as required by the regulatory baseline. The allowance price floor would prevent allowances from being auctioned below that price, maintaining incentives for GHG emissions reductions by those entities that can do so most cost-effectively when allowances would otherwise sell for very low prices due to high supply relative to demand for allowances. Ecology based the proposed price floor on the California allowance floor price trajectory. This consistency facilitates potential future linkage with other jurisdictions.

The allowance price ceiling would set an upper benchmark against which to set Tier prices for APCR auctions and to help determine when to hold APCR auctions. The price ceiling is also the price of last resort for covered or opt-in entities needing price ceiling units to meet their compliance obligations. The price ceiling thus comes into play in the event that allowances would sell for very high prices due to low supply relative to demand for allowances. This is intended to control the costs of the Cap and Invest Program, and resulting potential impacts to covered entities and the economy. Ecology based the proposed price ceiling on the California allowance price ceiling. This consistency facilitates potential future linkage with other jurisdictions.

2.3.4.9 Administration of auction: Lots

Regulatory baseline

The regulatory baseline does not address auctions of allowances by lot, beyond direction to facilitate Cap and Invest Program linkage with other programs. Other programs typically auction allowances in lots.

Proposed

Under the proposed rule, Ecology would divide allowances that are to be auctioned into lots. Each lot would be 1,000 allowances, except the final lot of a given vintage if fewer than 1,000 allowances remain. Each lot would only contain one vintage of allowances.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond the benefits of providing efficient units for the auction to use, and clarity in what happens in the event of a final lot of a given vintage containing fewer than 1,000 allowances.

2.3.4.10 Bids

Regulatory baseline

The regulatory baseline does not specify attributes of bids.

Proposed

The proposed rule would set requirements for bids. Bids submitted would need to:

- Include the bid price.
- Include the number of lots the bidder wishes to purchase.
- Be sealed and submitted in a form approved by Ecology.

Bids would be rejected if they would result in exceeding holding or purchase limits, or exceed the bidder's bid guarantee, starting with a registered entity's lowest bid and continuing in increasing order by bid price.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits, as bids are necessary under the regulatory baseline, and the attributes specified under the proposed rule are minimal. The process for rejection of bids is consistent with other administrative requirements under the regulatory baseline and proposed rule requirements, including holding limits and purchase limits.

2.3.4.11 Determination of actual maximum bid value

Regulatory baseline

Chapter 70A.65 RCW allows Ecology to "require a bid guarantee, payable to the financial services administrator, in an amount greater than or equal to the sum of the maximum value of the bids to be submitted by the registered entity."

Proposed

The proposed rule would require Ecology to determine whether each registered entity's actual maximum bid value is greater than their bid guarantee. Actual maximum bid value would be based on the highest product of each bid price and the number of allowances proposed for purchase at that price or a higher price.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits, as it is a clarification of the bid guarantee required under the regulatory baseline, and accounts for rejected bids.

2.3.4.12 Maximum bid value in excess of bid guarantee

Regulatory baseline

Chapter 70A.65 RCW allows Ecology to "require a bid guarantee, payable to the financial services administrator, in an amount greater than or equal to the sum of the maximum value of the bids to be submitted by the registered entity."

Proposed

Under the proposed rule, if the actual maximum bid value of a registered entity's bids exceeds the value of the registered entity's bid guarantee, Ecology would remove lots from the bids until the actual maximum bid value would no longer exceed bid guarantee.

The proposed rule specifies the process Ecology must use for removed lots in the auction.

Expected impact

We do not expect this element of the proposed rule to result in costs, beyond administrative process costs to Ecology. It would result in potential benefits of registered entities not having entire bids rejected for being in excess of the bid guarantee, by providing a process for removing lots from the bid until that is no longer the case.

2.3.4.13 Acceptance of bids

Regulatory baseline

Chapter 70A.65 RCW prohibits accepting bids below the auction floor price.

Proposed

The proposed rule would build on the regulatory baseline by specifying the process for Ecology to accept bids, starting with the highest bid price. It would also set out the process for dealing with multiple bids submitted at the lowest accepted bid price or at the Tier 1 or Tier 2 price for APCR auctions.

Ecology would distribute each allowance for which a bid has been accepted. The auction settlement price is the lowest accepted bid price, and this is the price to be paid by all bidders for each allowance.

Expected impact

We do not expect this element of the proposed rule to result in costs, as it reflects administrative processes for Ecology. It would facilitate benefits associated with APCR.

2.3.4.14 Payment for purchases

Regulatory baseline

The regulatory baseline does not address specifics of payment for purchases of allowances at auction.

Proposed

The proposed rule would set processes for payment.

Expected impact

While it specifies processes for payment, we do not expect this element of the proposed rule to result in costs or benefits beyond administrative and procedural costs for Ecology.

2.3.4.15 Summary of auction

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to submit a summary results report and post-auction public proceeds report to the Environmental Justice Council within 60 days after each auction. It does not address auction summaries for the public beyond information about covered entities, opt-in entities, general market participants, and holding accounts on the Ecology website.

Proposed

The proposed rule would require Ecology to make the following available to the public in a written summary for each auction:

- Auction settlement price.
- Registered entities with permission to participate in the auction.
- Number of allowances sold.
- Number of each vintage year of allowances sold.
- Description of how the allowances were distributed among the registered entities who submitted bids, without identifying which registered entities purchased the allowances.

Expected impact

While it specifies information that Ecology must make available to the public, we do not expect this element of the proposed rule to result in costs or benefits beyond administrative and procedural costs for Ecology. As compared to the regulatory baseline, the proposed rule would make the summary report available to the public as well.

2.3.4.16 Auction of future year allowances

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to hold parallel auctions of future vintage allowances at least twice each year.

Proposed

Under the proposed rule, Ecology would hold parallel future vintage allowance auctions according to the regulatory baseline. It specifies that these auctions would follow the same procedure as auctions for current and past vintage allowances.

At each auction of future allowances, Ecology would consign to auction 5 percent of the allowances for the year that is three years later than the auction year.

Expected impact

As compared to the regulatory baseline, the proposed rule would specify that each auction of future allowances would include 5 percent of the allowances of a vintage three years later than the auction year. This provides a benefit by allowing for additional planning by registered entities for future GHG emissions or emissions reductions. Ecology based the 5 percent value on the levels established by jurisdictions with existing cap and trade programs with which we may link. We do not expect this element of the proposed rule to result in costs beyond the costs of purchasing future vintage year allowances if entities desire them.

2.3.4.17 Allowance Price Containment Reserve Account

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to:

- Place at least two percent of allowances in an Allowance Price Containment Reserve (APCR), during 2023 – 2026.
- Adopt rules for separate auctioning allowances from the APCR when settlement prices approach the ceiling price.
- Distribute allowances from the APCR by auction when new covered or opt-in entities enter the program and the Emissions Containment Reserve (ECR) is exhausted.
- Limit auctioning of allowances from the APCR to covered and opt-in entities.
- Set the reserve auction floor price or price tiers.
- Establish the number of allowances to be placed in the APCR after the first compliance period.

Proposed

Under the proposed rule, Ecology would front load the APCR by, in 2023, placing 5 percent of the allowances from the annual allowance budgets for 2023 through 2030 in the APCR, and removing the vintage dates from those allowances such that they could be used for compliance in any year. Ecology proposes to hold separate auctions for APCR allowances when the settlement price in the preceding auction (of current and past vintage allowances) reaches the Tier 1 price for the APCR.

Ecology would also auction allowances from the APCR when new covered and opt-in entities enter the program and allowances from the ECR account are exhausted, and once each year after the final auction of current vintage allowances for the year before the compliance deadline.

Only covered and opt-in entities would be allowed to participate in APCR auctions. Purchase limits would not apply.

There would be two tiers of allowance prices at which bidders could bid:

- Tier 1: $46.05 plus five percent and the rate of inflation, for 2023.
- Tier 2: $59.17 plus five percent and the rate of inflation, for 2023.

The tier prices would increase by five percent plus the inflation rate each year. Each December, Ecology would announce the APCR tier prices for the next year, based on the inflation index through December of the current year.

The proposed rule would also set the process for:

- Order of allowance sales.
- Rejection of bids.
- Determination of maximum bid value.
- Removal of lots in the event of maximum bid value exceeding bid guarantee.

Expected impact

We expect the proposed rule to provide the benefit of maintaining allowance market success by front loading allowances into the APCR, and setting APCR tier prices. As market prices for allowances approach the allowance price ceiling, and reach the Tier 1 APCR price, it would trigger an increase in the supply of allowances released for auction, at either the Tier 1 or Tier 2 price. This would allow for maintenance of flexible prices if the market would otherwise move toward the allowance piece ceiling, allowing for an efficient balance of additional allowances auctioned with cost impacts of the Cap and Invest Program. Ecology based the APCR Tier 1 and Tier 2 prices on the California allowance market APCR price structure. This consistency facilitates potential future linkage with other jurisdictions.

2.3.4.18 Emissions Containment Reserve Account

Regulatory baseline

Chapter 70A.65 RCW required Ecology to establish an Emissions Containment Reserve (ECR).

Ecology must transfer to the ECR at least two percent of the allowance budgets in 2023 – 2026. Additional allowances that go to the ECR include:

- When allowances are unsold in auctions.
- When facilities curtail or close.

- When facilities fall below the emissions threshold. The amount of allowances withdrawn from the program budget must be proportionate to the amount of emissions such a facility was previously using.

Finally, the law specifies when allowances must be distributed from the ECR:

- By auction when new covered and opt-in entities enter the program.
- By distribution of no cost allowances for a new or expanded EITE facility with emissions in excess of 25,000 MT CO_2e during the first applicable compliance period. These must be retired by the facility.

Proposed

Under the proposed rule, the ECR account would contain:

- Two percent of the annual allowance budgets for 2023 – 2026.
- Allowances submitted by Ecology for auction that remain unsold after being offered for sale for 24 months in current and past year vintage allowance auctions and future vintage allowance auctions.
- Allowances from EITE facilities that have been curtailed or closed.
- Allowances from facilities that fall below the emissions threshold. The number of these allowances must be proportionate to the amount of emissions the facility was previously using.

Ecology would be required to distribute allowances:

- By auction when new covered and opt-in entities enter the program.
- By direct allocation at no cost to new or expanded EITE facilities with emissions greater than 25,000 MT CO_2e per year during the first applicable compliance period.

And Ecology would hold auctions of allowances from the ECR:

- When new covered and opt-in entities enter the program.
- Following processes and procedures for other auctions, except limiting participation to covered and opt-in entities.

Expected impact

We expect the proposed rule to maintain allowance market success by setting aside allowances to the ECR, as required by the regulatory baseline. We do not expect this element of the proposed rule to result in costs, as the specification of two percent of allowances being placed in the ECR (compared to at least two percent under the regulatory baseline; the rest of this element of the proposed rule matches or clarifies the regulatory baseline) is the minimum required under the statute, and retains the maximum allowances available for auction.

2.3.4.19 Price ceiling units

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to:

- Adopt an auction floor price and schedule for annual increases.
- Adopt an auction ceiling price.
- Place at least two percent of allowances in an allowance Price Containment Reserve (APCR), during 2023 – 2026.
- Adopt rules for separate auctioning allowances from the APCR when settlement prices approach the ceiling price.
- Distribute allowances from the APCR by auction when new covered or opt-in entities enter the program and the Emissions Containment Reserve (ECR) are exhausted.
- Limit auctioning of allowances from the APCR to covered and opt-in entities.
- Set the reserve auction floor price or price tiers.
- Establish the amount of allowances to be placed in the APCR after the first compliance period.

Proposed

Under the proposed rule, if no allowances remain in the APCR, Ecology would issue price ceiling units for sale at the price ceiling to covered and opt-in entities that do not have sufficient eligible compliance instruments in their holding and compliance accounts to meet their compliance obligations for that compliance deadline.

Expected impact

We expect the proposed rule to provide the benefit of maintaining allowance market success by setting an auction price ceiling, and Tier 1 and Tier 2 APCR prices, as required by the regulatory baseline, and issuing price ceiling units when the APCR is exhausted. The sale of price ceiling units would facilitate compliance by covered entities and opt-in entities when prices would otherwise be very high due to low supply relative to demand for allowances. This is intended to control the costs of the Cap and Invest Program, and resulting potential impacts to covered entities and the economy.

Since price ceiling units are not part of the total emissions program baseline, their sale increases the risk of effectively increasing the cap on emissions, reducing progress toward emissions reduction goals. Ecology is required to use proceeds from price ceiling unit sales to offset emissions increases, though because the sale of price ceiling units implies relative scarcity of other emissions reductions in Washington, the offset of price ceiling units could have lower direct environmental benefits to Washington in terms of reducing other environmental or environmental justice impacts.

Ecology chose the proposed Tier 1 and Tier 2 APCR prices and allowance price ceiling based on California's allowance price control structures, balancing the need to control program costs to covered entities, with the need to effectively reduce emissions. This consistency facilitates potential future linkage with other jurisdictions.

2.3.4.20 Price ceiling unit sales

Regulatory baseline

The regulatory baseline does not address the specifics of price ceiling unit sales.

Proposed

Under the proposed rule, Ecology would hold price ceiling unit sales between the last APCR sale before a compliance deadline and the compliance deadline itself. The units would be sold at the ceiling price, only if a covered or opt-in entity requests a price ceiling unit sale.

A request would include an accounting showing that it has insufficient compliance instruments to meet its compliance obligations for the next compliance deadline.

If Ecology agrees to sell price ceiling units, Ecology would instruct the financial services administrator to begin to accept cash payment for purchases from price ceiling sales no earlier than ten business days after the previous reserve sale and to cease accepting payments no later than seven business days thereafter.

Ecology would credit price ceiling unit purchasers accordingly to each purchaser's compliance account for retirement at the next compliance deadline.

Expected impact

We do not expect the proposed procedures for selling price ceiling units to result in costs or benefits, as these are minimal administrative costs to covered entities, and administrative costs to Ecology. We expect the costs of requests for price ceiling units to be minimal, as they should be readily demonstrable using emissions and allowance accounting under the regulatory baseline and proposed rule.

2.3.5 Compliance Instrument Transactions

2.3.5.1 General information

Regulatory baseline

The regulatory baseline does not include specific requirements for compliance instrument transfers.

Proposed

Under the proposed rule:

- A compliance instrument would authorize a covered entity to emit one MT CO_2e in one calendar year. It would not expire, and could be held or banked. Once surrendered it would be retired.
- By November 1 of the year after the end of each four-year compliance period, each covered entity and opt-in entity would need to surrender to Ecology the number of compliance instruments equal to the number of MT CO_2e they emitted during the compliance period.

- Allowances would be obtained by direct distribution of no-cost allowances from Ecology, by purchase at auction, or by purchase, trade or transfer from other parties owning allowances.
- Offset credits could be obtainable.
- Compliance instruments would be traded only among registered covered entities, opt-in entities, and general market participants.
- Covered or opt-in entities would only be able to hold compliance instruments for their own use and may not hold compliance instruments on behalf of another party.
- Only compliance instruments recorded in a holding account could be traded.
- Electric utilities could transfer no cost allowances to an electrical generating facility following a process delineated in the proposed rule (discussed below in Section 2.3.5.4).

Expected impact

We do not expect these general proposed requirements to result in costs or benefits beyond administrative costs to Ecology, as they are consistent with other elements of the regulatory baseline and proposed rule, including use of offset credits, program applicability, and allowance market structures.

2.3.5.2 Transfers among registered entities – process

Regulatory baseline

The regulatory baseline does not address specific attributes of the allowance transfer process.

Proposed

Under the proposed rule, every registered entity wishing to trade compliance instruments with another registered party would need to follow these procedures:

- To initiate the transfer, a transferor's account representative would submit a transaction request to Ecology and to all the transferor's other account representatives, and the second transferor's account representative must submit a confirmation.
- To accept the transfer, the transferee's account representative would submit a confirmation of acceptance to Ecology and to the transferor.

Ecology would transfer the compliance instruments unless:

- The transfer would result in non-compliance.
- Ecology has reasonable grounds to believe that a violation has been committed.
- The request contains errors, omissions, or is otherwise incomplete.

The proposed rule also includes a process for transfer refusal.

Expected impact

Transaction costs, such as transfer requests, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG

emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases. In the case of transfer requests, however, we expect the proposed rule to result in minimal transfer request and confirmation costs, as this will be facilitated by the electronic accounting structure contracted by Ecology.

2.3.5.3 Transaction requests – information required by Ecology

Regulatory baseline

The regulatory baseline does not address specific attributes of the transaction request process.

Proposed

Under the proposed rule, each transaction request must contain:

- Transferor holding account number.
- Transferee holding account number.
- Quantity, type and vintage of the compliance instruments to be traded.
- Settlement price of each type and vintage of compliance instruments.
- Method used to determine the settlement price.
- Type of trading agreement.
- Date of signing of the agreement.
- Trading date.
- Attestation statement.

Expected impact

Transaction costs, such as transfer requests, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases. In the case of transfer requests, however, we expect the proposed rule to result in minimal transfer request and confirmation costs, as this will be facilitated by the electronic accounting structure contracted by Ecology.

2.3.5.4 Transfers to Ecology – process

Regulatory baseline

The regulatory baseline does not address specific attributes of the allowance transfer process.

Proposed

Under the proposed rule, every registered entity wishing to transfer compliance instruments from its holding account to its compliance account would need to send Ecology a request including:

- Holding account number and compliance account number.
- Quantity, type, and vintage of the compliance instruments to be transferred.

To initiate a transfer to Ecology, an account representative from the registered entity would submit the transfer request to Ecology and to all the registered entity's other account representatives. One of the other account representatives would need to confirm the request.

Ecology would transfer the compliance instruments from the registered entity's holding account to its compliance account.

Expected impact

Transaction costs, such as transfer requests, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases. In the case of transfer requests, however, we expect the proposed rule to result in minimal transfer request and confirmation costs, as this will be facilitated by the electronic accounting structure contracted by Ecology.

2.3.5.5 Transfers of no cost allowances from an electric utility to an electrical generating facility or federal power marketing administration

Regulatory baseline

The regulatory baseline does not address specific attributes of the allowance transfer process.

Proposed

Under the proposed rule, an electric utility wishing to transfer no cost allowances to the compliance account of an electrical generating facility or federal power marketing administration would submit a request to Ecology asking for the transfer and providing the following information:

- Electric utility holding account number.
- Electrical generating facility or federal power marketing administration compliance account number.
- Quantity and vintage of no cost allowances to be transferred.
- Relationship between the electric utility and the electric generating facility or federal power marketing association.

Ecology would be allowed to transfer the allowances only if:

- The electric generating facility is operated by the electric utility.
- The electric utility has an agreement to purchase imported electricity or a power purchase agreement, including a custom product contract from the electric generating facility or federal power marketing administration.

- The transfer will not violate the electricity generating facility's or federal power marketing administration's holding limit.

Expected impact

Transaction costs, such as transfer requests, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases. In the case of transfer requests, however, we expect the proposed rule to result in minimal transfer request and confirmation costs, as this will be facilitated by the electronic accounting structure contracted by Ecology.

2.3.5.6 Transfers of no cost allowances from a utility's holding account to its limited use holding account for consignment to auction

Regulatory baseline

The regulatory baseline does not address specific attributes of the allowance transfer process.

Proposed

Under the proposed rule, utilities wishing to consign no cost allowances to auction must transfer those no cost allowances from their holding account to their limited use holding account by submitting a request to Ecology asking for the transfer and providing the following information:

- The utility's holding account number.
- The utility's limited use holding account number.
- The quantity and vintage of no cost allowances to be transferred.

Expected impact

Transaction costs, such as transfer requests, would be a part of overall private costs associated with Cap and Invest Program participation, and would underlie willingness to pay for GHG emission allowances. This means allowance market prices in the Cap and Invest Program will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of allowance purchases. In the case of transfer requests, however, we expect the proposed rule to result in minimal transfer request and confirmation costs, as this will be facilitated by the electronic accounting structure contracted by Ecology.

2.3.5.7 Compliance instrument transactions – Prohibited actions

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt provisions to guard against bidder collusion and minimize the potential for market manipulation. The Act prohibits registered entities from releasing or disclosing any bidding information, including:

- Intent to participate or refrain from participation.
- Auction approval status.

- Intent to bid.
- Bidding strategy.
- Bid price or bid quantity.
- Information on the bid guarantee provided to the financial services administrator.

Ecology may cancel or restrict a previously approved auction participation application or reject a new application if the department determines that a registered entity has:

- Provided false or misleading facts.
- Withheld material information that could influence a decision by the department.
- Violated any part of the auction rules.
- Violated registration requirements.
- Violated any of the rules regarding the conduct of the auction.

Proposed

Consistent with the regulatory baseline, the proposed rule would establish the following prohibited actions:

- Other than the account representatives directly involved in a transaction, no party holding privileged information on a compliance instrument may trade that compliance instrument, disclose the information or recommend that another party trade the compliance instrument, except if the party has reason to believe that the information is known to the public or to the other party in the transaction. However, the party may disclose the information or recommend that another party trade the compliance instrument if the party is required to disclose the information in the course of business, and if nothing leads the person to believe that the information will be used or disclosed in contravention of this section.
- No party prevented from trading compliance instruments due to prohibited disclosure may use the privileged information in any other way, unless the party has reason to believe that the information is known to the public.
- A party with knowledge of material order information may not carry out or recommend that another party carry out a transaction involving a compliance instrument, or disclose the information to any other party except if:
    - The party has reason to believe the other party is already aware of the information;
    - The party must disclose the information in the course of business, and nothing leads the party to believe that it will be used or disclosed in contravention of this section;

    - The party carries out a transaction involving the compliance instrument concerned by the information in order to perform a written obligation that the party contracted before becoming aware of the information; and
    - For the purposes of this section, material order information is any information concerning an order to buy or an order to sell a compliance instrument that could have a major impact on the price of a compliance instrument.

The proposed rule would also prohibit false and misleading information:

- No party may disclose false or misleading information or information that must be filed under the rule before it is filed, in order to carry out a transaction, in particular when it could influence the price of a compliance instrument.
- False or misleading information is any information likely to mislead on an important fact, as well as the simple omission of an important fact.
- An important fact is any fact that may reasonably be believed to have a significant impact on the price or value of a compliance instrument.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond the benefit of guarding against bidder collusion and market manipulation.

2.3.6 Offsets

2.3.6.1 General requirements for offset credits and registry offset credits

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt protocols for establishing offset projects and securing offset credits that may be used to meet a portion of a covered or opt-in entity's compliance obligation. The protocols must align with RCW 70A.45.090 (Forests and forest products sector—Climate response) and RCW 70A.45.100 (Carbon sequestration).

Under this law, offset projects must:

- Provide direct environmental benefits to Washington or be located in a jurisdiction with which Washington has entered into a linkage agreement.
- Result in greenhouse gas reductions or removals that:
    - Are real, permanent, quantifiable, verifiable, and enforceable.
    - Are in addition to greenhouse gas emission reductions or removals otherwise required by law and other greenhouse gas emission reductions or removals that would otherwise occur.
    - Have been certified by a recognized registry after July 25, 2021, or within two years prior to July 25, 2021.

The law limits the amount of a covered or opt-in entity's compliance obligation can be met using offsets:

- Five percent during the first compliance period, with at least half of the offset credits sourced from offset projects that provide direct environmental benefits in Washington.
- Four percent during the second compliance period, with at least 75 percent sourced from projects that provide direct environmental benefits in Washington.

These limits are adjustable by Ecology, depending on offset availability and whether a specific covered or opt-in entity has or is likely to:

- Contribute substantively to cumulative air pollution burden in an overburdened community.
- Violate any permits required by any federal, state, or local air pollution control agency where the violation may result in an increase in emissions.

An offset project on federally recognized tribal land does not count against the offset credit limits. No more than three percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the first compliance period. No more than two percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the second compliance period.

The law requires Ecology to:

- Take into consideration standards, rules, or protocols for offset projects and offset credits established by other states, provinces, and countries with programs comparable to the program established in this law.
- Encourage opportunities for the development of offset projects in this state by adopting offset protocols that may include, but need not be limited to, protocols that make use of aggregation or other mechanisms to reduce transaction costs related to the development of offset projects and that support the development of carbon dioxide removal projects.
- Adopt a process for monitoring and invalidating offset credits as necessary to ensure the credit reflects emission reductions or removals that continue to meet the standards required by this law.
- Make use of aggregation or other mechanisms, including cost-effective inventory and monitoring provisions, to increase the development of offset and carbon removal projects by landowners across the broadest possible variety of types and sizes of lands, including lands owned by small forestland owners.

Finally, the law specifies that offset credits used may not be in addition to or allow for an increase in the emissions limits established under RCW 70A.45.020, as reflected in annual allowance budgets for the Cap and Invest Program.

Proposed

Under the proposed rule, an offset project operator or authorized project designee must ensure the requirements for Ecology offset credits and registry offset credits are met:

- A registry offset credit must:
    - Represent a GHG emission reduction or GHG removal enhancement that is real, quantifiable, permanent, verifiable, enforceable, and additional to GHG reductions or removals otherwise required by law and other GHG reductions or removals that would otherwise occur.
    - Result from the use of a Compliance Offset Protocol that meets the requirements of WAC 173-446-505.
    - Result from an offset project that is listed in accordance with WAC 173-446-520.
    - Result from an offset project that complies with the monitoring, reporting and record retention requirements of WAC 173-446-525.
    - Result from an offset project that is verified pursuant to the requirements of WAC 173-446-530.
    - Be issued by an Offset Project Registry approved pursuant to the requirements of WAC 173-446-590.
- An Ecology offset credit must meet the requirements of this section and:
    - Be issued pursuant to WAC 173-446-555.
    - Be registered pursuant to WAC 173-446-565.
    - Provide direct environmental benefits to the state pursuant to WAC 173-446-595.
    - When used for compliance be subject to the quantitative usage limits set forth in WAC 173-446-600(6).

The proposed rule also specifies that:

- For the first compliance period:
    - No more than 5 percent of a compliance obligation may be satisfied by offset credits.
    - In addition to, but separate from the above limit, a covered entity or opt-in entity may satisfy up to 3 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land.
- For the second compliance period:
    - No more than 4 percent of a compliance obligation may be satisfied by offset credits.
    - In addition to, but separate from the above limit, a covered entity or opt-in entity may satisfy up to 2 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land.

- For the third and subsequent compliance periods:
    - No more than 4 percent of a compliance obligation may be satisfied by offset credits.
    - A covered entity or opt-in entity may satisfy an additional 2 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land, but may also use offset credits generated from offset projects on federally recognized tribal land to fulfill any portion of the 4 percent limit.

Expected impact

We expect the proposed rule to result in costs of offset purchases by GHG emitters (reflecting underlying costs associated with offset project development, registration, and verification). We also expect it to result in benefits of GHG emissions reductions and removals to the public, environment, and economy, as well as ancillary benefits of some types of offset projects, including reduced impacts of other pollutants and habitat preservation. The proposed rule does not differ from the statute in terms of offset credit use, but specifies protocols and procedures for their use.

Finally, the proposed rule adds more flexibility to the regulatory baseline, in its allowable use of offset credits generated from offset projects on federally recognized tribal land.

2.3.6.2 Requirements for compliance offset protocols

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt protocols for establishing offset projects and securing offset credits that may be used to meet a portion of a covered or opt-in entity's compliance obligation. The protocols must align with RCW 70A.45.090 (Forests and forest products sector—Climate response) and RCW 70A.45.100 (Carbon sequestration).

Under this law, offset projects must:

- Provide direct environmental benefits to Washington or be located in a jurisdiction with which Washington has entered into a linkage agreement.[4]
- Result in greenhouse gas reductions or removals that:
    - Are real, permanent, quantifiable, verifiable, and enforceable.
    - Are in addition to greenhouse gas emission reductions or removals otherwise required by law and other greenhouse gas emission reductions or removals that would otherwise occur.

[4] The requirement for offsets to provide direct environmental benefits to Washington or be located in a linked jurisdiction supersedes other listed offset limits.

- Have been certified by a recognized registry after July 25, 2021, or within two years prior to July 25, 2021.

The law limits the amount of a covered or opt-in entity's compliance obligation can be met using offsets:[5]

- Five percent during the first compliance period, with at least half of the offset credits sourced from offset projects that provide direct environmental benefits in Washington.
- Four percent during the second compliance period, with at least 75 percent sourced from projects that provide direct environmental benefits in Washington.

These limits are adjustable by Ecology, depending on offset availability and whether a specific covered or opt-in entity has or is likely to:

- Contribute substantively to cumulative air pollution burden in an overburdened community.
- Violate any permits required by any federal, state, or local air pollution control agency where the violation may result in an increase in emissions.

An offset project on federally recognized tribal land does not count against the offset credit limits. No more than three percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the first compliance period. No more than two percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the second compliance period.

The law requires Ecology to:

- Take into consideration standards, rules, or protocols for offset projects and offset credits established by other states, provinces, and countries with programs comparable to the program established in this law.
- Encourage opportunities for the development of offset projects in this state by adopting offset protocols that may include, but need not be limited to, protocols that make use of aggregation or other mechanisms to reduce transaction costs related to the development of offset projects and that support the development of carbon dioxide removal projects.
- Adopt a process for monitoring and invalidating offset credits as necessary to ensure the credit reflects emission reductions or removals that continue to meet the standards required by this law.
- Make use of aggregation or other mechanisms, including cost-effective inventory and monitoring provisions, to increase the development of offset and carbon removal

[5] All offset projects must provide direct environmental benefits to Washington unless they are from a linked jurisdiction.

projects by landowners across the broadest possible variety of types and sizes of lands, including lands owned by small forestland owners.

Finally, the law specifies that offset credits used may not be in addition to or allow for an increase in the emissions limits established under RCW 70A.45.020, as reflected in annual allowance budgets for the Cap and Invest Program.

Proposed

The proposed rule would set detailed requirements for a compliance offset protocol, including:

- Accurately determining the extent to which GHG emission reductions and GHG removal enhancements are achieved by the offset project type.
- Establishing data collection and monitoring procedures relevant to the type of GHG emissions sources, GHG sinks, and GHG reservoirs for that offset project type.
- Establishing a project baseline that reflects an estimate of business-as-usual performance or practices for comparison against the GHG emission reductions and/or GHG removal enhancements to be achieved by the offset project type.
- Accounting for activity-shifting leakage and market-shifting leakage for the offset project type, unless the offset protocol stipulates eligibility conditions limiting the use of the offset protocol that eliminate the risk of activity-shifting and/or market-shifting leakage.
- Accounting for any uncertainty in quantification factors for the offset project type.
- Ensuring GHG emission reductions and GHG removal enhancements are permanent.
- Including a mechanism to ensure permanence of GHG removal enhancements for sequestration offset project types.
- Establishing the length of the crediting period for the offset project type.
- Establishing the eligibility and additionality of the offset project type, and quantify GHG emission reductions and GHG removal enhancements using standardized baseline assumptions, emission factors, and monitoring methods.
- Specify the geographic area(s) where the protocol is applicable.

It would also limit crediting periods for non-sequestration offset projects to 7 – 10 years, and for sequestration projects to 10 – 30 years.

The proposed rule also specifies that:

- For the first compliance period:
    - No more than 5 percent of a compliance obligation may be satisfied by offset credits.
    - In addition to, but separate from the above limit, a covered entity or opt-in entity may satisfy up to 3 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land.

- For the second compliance period:
    - No more than 4 percent of a compliance obligation may be satisfied by offset credits.
    - In addition to, but separate from the above limit, a covered entity or opt-in entity may satisfy up to 2 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land.
- For the third and subsequent compliance periods:
    - No more than 4 percent of a compliance obligation may be satisfied by offset credits.
    - A covered entity or opt-in entity may satisfy an additional 2 percent of its compliance obligation using offset credits generated from offset projects on federally recognized tribal land, but may also use offset credits generated from offset projects on federally recognized tribal land to fulfill any portion of the 4 percent limit.

Expected impact

We expect the proposed rule to result in costs of offset purchases by GHG emitters (reflecting underlying costs associated with offset project development, registration, and verification). We also expect it to result in benefits of GHG emissions reductions and removals to the public, environment, and economy, as well as ancillary benefits of some types of offset projects, including reduced impacts of other pollutants or habitat preservation. The proposed rule does not differ from the regulatory baseline in terms of offset credit use, but specifies protocols and procedures for their use, and is therefore not possible to analytically separate from the regulatory baseline.

Finally, the proposed rule adds more flexibility to the regulatory baseline, in its allowable use of offset credits generated from offset projects on federally recognized tribal land.

2.3.6.3 Requirements for offset projects using Ecology compliance offset protocols

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt protocols for establishing offset projects and securing offset credits that may be used to meet a portion of a covered or opt-in entity's compliance obligation. The protocols must align with RCW 70A.45.090 (Forests and forest products sector—Climate response) and RCW 70A.45.100 (Carbon sequestration).

Under this law, offset projects must:

- Provide direct environmental benefits to Washington or be located in a jurisdiction with which Washington has entered into a linkage agreement. [6]

[6] The requirement for offsets to provide direct environmental benefits to Washington or be located in a linked jurisdiction supersedes other listed offset limits.

- Result in greenhouse gas reductions or removals that:
    - Are real, permanent, quantifiable, verifiable, and enforceable.
    - Are in addition to greenhouse gas emission reductions or removals otherwise required by law and other greenhouse gas emission reductions or removals that would otherwise occur.
    - Have been certified by a recognized registry after July 25, 2021, or within two years prior to July 25, 2021.

The law limits the amount of a covered or opt-in entity's compliance obligation can be met using offsets: [7]

- Five percent during the first compliance period, with at least half of the offset credits sourced from offset projects that provide direct environmental benefits in Washington.
- For percent during the second compliance period, with at least 75 percent sourced from projects that provide direct environmental benefits in Washington.

These limits are adjustable by Ecology, depending on offset availability and whether a specific covered or opt-in entity has or is likely to:

- Contribute substantively to cumulative air pollution burden in an overburdened community.
- Violate any permits required by any federal, state, or local air pollution control agency where the violation may result in an increase in emissions.

An offset project on federally recognized tribal land does not count against the offset credit limits. No more than three percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the first compliance period. No more than two percent of a covered or opt-in entity's compliance obligation may be met by transferring offset credits from projects on federally recognized tribal land during the second compliance period.

The law requires Ecology to:

- Take into consideration standards, rules, or protocols for offset projects and offset credits established by other states, provinces, and countries with programs comparable to the program established in this law.
- Encourage opportunities for the development of offset projects in this state by adopting offset protocols that may include, but need not be limited to, protocols that make use of aggregation or other mechanisms to reduce transaction costs related to the development of offset projects and that support the development of carbon dioxide removal projects.

[7] All offset projects must provide direct environmental benefits to Washington unless they are from a linked jurisdiction.

- Adopt a process for monitoring and invalidating offset credits as necessary to ensure the credit reflects emission reductions or removals that continue to meet the standards required by this law.
- Make use of aggregation or other mechanisms, including cost-effective inventory and monitoring provisions, to increase the development of offset and carbon removal projects by landowners across the broadest possible variety of types and sizes of lands, including lands owned by small forestland owners.

Finally, the law specifies that offset credits used may not be in addition to or allow for an increase in the emissions limits established under RCW 70A.45.020, as reflected in annual allowance budgets for the Cap and Invest Program.

Proposed

The proposed rule would set requirements for offset project operators and authorized project designees to:

- Ensure offset projects meet compliance offset protocol requirements and additionality requirements. These also include transitioning to applicable versions of specific compliance offset protocols for livestock, urban forest, and US forest projects.
- Fulfill all local, regional, state, and national requirement on environmental impact assessments that apply based on project location.

Expected impact

We expect the proposed rule to result in costs of offset purchases by GHG emitters (reflecting underlying costs associated with offset project development, registration, and verification). We also expect it to result in benefits of GHG emissions reductions and removals to the public, environment, and economy, as well as ancillary benefits of some types of offset projects, including reduced impacts of other pollutants and habitat preservation. The proposed rule does not differ from the regulatory baseline in terms of offset credit use, but specifies protocols and procedures for their use, and is therefore not possible to analytically separate from the regulatory baseline.

2.3.6.4 Authorized project designee

Regulatory baseline

The regulatory baseline does not specify requirements for authorized project designees.

Proposed

Under the proposed rule, an offset project operator may designate a party as an authorized project designee at the time of offset project listing or any time after offset project listing as long as it meets certain requirements. This designation may be modified once within each year after the offset project has been listed by Ecology or an offset project registry.

Expected impact

We expect the proposed rule to result in designation costs as well as benefits of full information about authorized project designees, and security and quality assurance of offset activities. The proposed rule would allow offset project operators to designate an authorized project designee. Transaction costs, such as representative designation, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.5 Listing of offset projects using Ecology compliance offset protocols

Regulatory baseline

The regulatory baseline does not specify requirements for listing offset projects using Ecology compliance offset protocols.

Proposed

Under the proposed rule, before an offset project can be listed by Ecology or an offset project registry, the offset project operator and its authorized project designee would be required to:

- Register with Ecology.
- Not be subject to any holding account restrictions.

Offset project operators and any authorized project designees would be required to submit specific attestations. They would also be required to provide required documentation and disclosures, and provide listing information per the most reason of a compliance offset protocol for the project type. For offset projects located on land over which Washington does not have jurisdiction, they would be required to demonstrate consent of the landowner(s) to being regulated by Ecology under the Cap and Invest Program, including consent to the jurisdiction of Washington courts and administrative tribunals with respect to actions taken by Ecology to enforce applicable requirements of the program.

The proposed rule also sets out timing and notice requirements for listing during initial and renewed crediting periods.

Expected impact

We expect the proposed rule to result in registration costs as well as benefits of full information about offset projects. The proposed rule would require offset project operators to submit information and documentation to Ecology. Transaction costs, such as registration and documentation costs, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.6 Monitoring, reporting, and record retention requirements for offset projects

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to:

- Adopt a process for monitoring and invalidating offset credits as necessary to ensure the credit reflects emission reductions or removals that continue to meet the standards required by this law.
- Make use of aggregation or other mechanisms, including cost-effective inventory and monitoring provisions, to increase the development of offset and carbon removal projects by landowners across the broadest possible variety of types and sizes of lands, including lands owned by small forestland owners.

Proposed

The proposed rule would require offset project operators or authorized project designees to use the procedures in the adopted offset protocols for monitoring measurements and project performance for offset projects. This includes maintenance and calibration.

The proposed rule would also require offset project operators or authorized project designees to submit an offset project data report to Ecology or an offset project registry for each reporting period. It specifies the timing and contents of offset project data reports, as well as procedures for requesting alternative methods or reporting periods.

Expected impact

We expect the proposed rule to result in monitoring, reporting, and recordkeeping costs as well as benefits of guaranteeing accurate accounting and understanding of offset project effectiveness. Monitoring, reporting, and recordkeeping costs would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect these costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.7 Verification of GHG emissions reductions and GHG removal enhancements from offset projects

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt protocols for establishing offset projects and securing offset credits that may be used to meet a portion of a covered or opt-in entity's compliance obligation. The protocols must align with RCW 70A.45.090 (Forests and forest products sector—Climate response) and RCW 70A.45.100 (Carbon sequestration).

Under this law, offset projects must:

- Provide direct environmental benefits to Washington or be located in a jurisdiction with which Washington has entered into a linkage agreement.
- Result in greenhouse gas reductions or removals that:
    - Are real, permanent, quantifiable, verifiable, and enforceable.
    - Are in addition to greenhouse gas emission reductions or removals otherwise required by law and other greenhouse gas emission reductions or removals that would otherwise occur.

- Have been certified by a recognized registry after July 25, 2021, or within two years prior to July 25, 2021.

The law requires Ecology to:

- Adopt a process for monitoring and invalidating offset credits as necessary to ensure the credit reflects emission reductions or removals that continue to meet the standards required by this law.

Proposed

The proposed rule would require offset project operators or authorized project designees to obtain the services of an Ecology-accredited verification body for the purposes of verifying offset project data reports. This includes:

- Timing for sequestration and non-sequestration projects.
- Timing for submittal of offset verification statements.

Expected impact

We expect the proposed rule to result in verification costs as well as benefits of guaranteeing accurate understanding of offset project effectiveness. Verification costs would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect these costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.8 Requirements for offset verification services

Regulatory baseline

The regulatory baseline does not specify requirements for offset verification services, beyond requiring offsets to result in GHG reductions that are verifiable and meet the standards of the law.

Proposed

The proposed rule would require:

- Rotation of verification bodies.
- Offset verification services that:
    - Submit a notice of offset verification services.
    - Begin offset verification services 10 calendar days after the notice for offset verification services is received.
    - Do not conduct the site visit until at least 15 calendar days after the notice for offset verification services is received, or until at least 40 days if the verification is being audited.
    - Include:
        - Offset verification plan.

- Timing of offset verification services.
- Planning meetings with the offset project operator or authorized project designee.
- Site visits for offset projects.
- Review offset project operations to identify applicable GHG emissions sources, project emissions, GHG sinks, and GHG reservoirs required to be included and quantified in the offset project data report as required by the applicable compliance offset protocol.
- Review of all information and documentation used to calculate and report project baseline and project GHG emissions, GHG reductions, and GHG removal enhancements, and other information required by the applicable compliance offset protocol.
- Sampling plan for offset project data reports.
- Data checks for offset project data reports.
- Verification the offset project data report is free of offset material misstatement.
- Issues log.
- Assessment of offset material misstatement
- Offset verification statement.

Expected impact

We expect the proposed rule's specification of requirements for offset verification services to result in costs that are passed on as part of the costs of verification services, which in turn would underlie the price of offset credits. This means offset credit prices will reflect these costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.9 Offset verifier and verification body accreditation

Regulatory baseline

The regulatory baseline does not specify requirements for offset verifier or verification body accreditation.

Proposed

The proposed rule would require an offset verifier or verification body to meet accreditation requirements to provide offset verification services. This accreditation would be separate from GHG emissions reporting verification body requirements in Chapter 173-441 WAC.

Expected impact

We expect the proposed rule's specification of requirements for offset verifier or verification body accreditation to result in costs that are passed on as part of the costs of verification services, which in turn would underlie the price of offset credits. This means offset credit prices

will reflect these costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.10 Conflict of interest requirements for verification bodies and offset verifiers for verification of offset project data reports

Regulatory baseline

Chapter 70A.65 RCW requires Ecology to adopt "provisions to guard against bidder collusion and minimize the potential for market manipulation."

Proposed

The proposed rule would apply conflict of interest provisions to verification bodies, lead verifiers, and offset verifiers accredited by Ecology to perform offset verification services for offset project operators, and authorized project designees, as well as any other member of the offset verification team and any technical consultant(s) used by the offset project operator or authorized project designee.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond the benefits of guarding against bidder collusion and market manipulation.

2.3.6.11 Issuance of registry offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for the issuance of registry offset credits.

Proposed

Under the proposed rule, one registry offset credit, which represents one MT CO_2e for a direct GHG emission reduction or direct GHG removal enhancement, would be issued only if:

- An offset project registry has listed the offset project.
- The GHG emission reductions or GHG removal enhancements were issued a positive offset or qualified positive offset verification statement.
- An offset project registry has received a positive offset or qualified positive offset verification statement issued and attested to by an Ecology-accredited verification body for the offset project data report for which registry offset credits would be issued.

An offset project registry would determine whether the GHG emission reductions and GHG removal enhancements meet the necessary requirements, the information submitted is complete, and the positive offset or qualified positive offset verification statement meets the requirements of this section within 45 calendar days of receiving it.

The proposed rule would also establish determination for timing and duration of initial crediting periods and renewed crediting periods.

Expected impact

We expect the proposed rule's specification of requirements for issuance of registry offset credits to result in costs that are passed on as part of the costs of offset project operations. Transaction costs, such as costs of registry activities, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.12 Issuance of Ecology offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for the issuance of Ecology offset credits.

Proposed

Under the proposed rule, one Ecology offset credit, which represents one MT CO_2e for a direct GHG emission reduction or direct GHG removal enhancement, would be issued only for a GHG emission reduction or GHG removal enhancement that occurs during a reporting period, and only if:

- Ecology or an offset project registry has listed the offset project.
- The GHG emission reductions and GHG removal enhancements were issued a positive offset or qualified positive offset verification statement.
- Ecology or an offset project registry has received a positive offset or qualified positive offset verification statement issued and attested to by an Ecology accredited verification body for the offset project data report for which registry offset credits were issued if the offset project was submitted for listing with an offset project registry, or for which Ecology offset credits would be issued.
- The issued Ecology offset credits would not immediately be subject to invalidation.

The proposed rule would also set out requirements for offset projects submitted through an offset project registry seeking issuance of Ecology offset credits.

Initial crediting periods would begin with the date that the first verified GHG emission reductions and GHG removal enhancements occur, according to the first positive offset or qualified positive offset verification statement that is received by Ecology, unless otherwise specified in a compliance offset protocol.

Renewed crediting periods would begin the day after the conclusion of the prior crediting period.

Expected impact

We expect the proposed rule's specification of requirements for issuance of Ecology offset credits to result in costs that are passed on as part of the costs of offset project operations. Transaction costs, such as costs of issuing offset credits, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This

means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.13 Process for issuance of Ecology offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for the process for issuance of Ecology offset credits.

Proposed

The proposed rule would establish a process for Ecology to issue offset credits, including notices, information requests, changes, and determinations.

Ecology would transfer Ecology offset credits into the holding account of the offset project operator, authorized project designee, or any other third party requested by the offset project operator to receive Ecology offset credits, within 15 business days of the offset project registry providing proof to Ecology that the registry offset credits have been permanently removed or cancelled from the registry system.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond administrative costs to Ecology.

2.3.6.14 Registration of Ecology offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for registration of Ecology offset credits.

Proposed

Under the proposed rule, an Ecology offset credit would be registered by:

- Creating a unique Ecology serial number.
- Transferring the Ecology offset credits to the holding account of the listed offset project operator, authorized project designee, or another third party as requested by the offset project operator to receive Ecology offset credits, unless otherwise required by a forestry offset reversal.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond administrative costs to Ecology.

2.3.6.15 Forestry offset reversals

Regulatory baseline

The regulatory baseline does not specify requirements for forestry offset reversals.

Proposed

Under the proposed rule, a portion of Ecology offset credits issued to a forest offset project would be placed by Ecology into the Forest Buffer Account at the time of offset credit registration. The portion would be determined by the applicable version of the compliance offset protocol.

The proposed rule details process and replacement requirements for unintentional and intentional forest reversals, in which the forestry offset project does not result in the expected GHG emissions reductions, as well as early project termination.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond the benefits of assuring that offset credits reflect real GHG reductions as required under the regulatory baseline.

2.3.6.16 Transferability of Ecology offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for transferability of Ecology offset credits.

Proposed

Under the proposed rule, an Ecology offset credit may be sold, traded, or transferred, unless:

- It has been retired, surrendered for compliance, or used to meet any GHG mitigation requirements in any voluntary or regulatory program.
- It resides in the Forest Buffer Account.
- It has been invalidated.

And may only be used:

- To meet a compliance obligation under this article, except if used by a covered entity in a program approved for linkage.
- By a general market participant for purposes of voluntary retirement.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits as compared to the regulatory baseline. Neither the regulatory baseline nor the proposed rule create a new trading structure or market for offset credits, and the proposed rule clarifies how the transferability of offset credits differs from allowances.

2.3.6.17 Invalidation of Ecology offset credits

Regulatory baseline

The regulatory baseline does not specify requirements for the invalidation of Ecology offset credits.

Proposed

The proposed rule would establish criteria for invalidation of Ecology offset credits.

Expected impact

We do not expect this element of the proposed rule to result in costs or benefits beyond the benefits of assuring that offset credits reflect real GHG reductions as required under the regulatory baseline.

2.3.6.18 Approval requirements for offset project registries

Regulatory baseline

The regulatory baseline does not specify requirements for approval of offset project registries.

Proposed

The proposed rule would establish approval requirements for all offset project registries that operate to provide registry services. These would include:

- Offset project registry approval application.
- Procedures to screen and address internal conflicts of interest.
- The applicant's primary business being operating an offset project registry for voluntary or regulatory purposes.
- Professional liability insurance.
- Attestations.
- Training and examination of at least two management staff.
- Training and examination of staff in all compliance offset protocols.
- At lest two years experience.

Expected impact

We expect the proposed rule's specification of information that must be submitted by offset project registries to result in costs that are passed on as part of the costs of offset project operations. Transaction costs, such as costs of registry activities, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.19 Offset project registry requirements

Regulatory baseline

The regulatory baseline does not specify requirements for an offset project registry.

Proposed

The proposed rule would establish requirements for offset project registries, using approved compliance offset protocols, to determine whether an offset project may be listed with the offset project registry for issuance of registry offset credits.

The registry would need to make information about the offset projects publicly available.

An offset project registry would be required to audit at least 10 percent of the annual full offset verifications developed for offset projects using a compliance offset protocol, and review each detailed verification report for completeness. It would also be required to make data readily available, and remove or cancel credits issued.

Registries would be required to provide an annual report of the previous year's offset projects, and all information submitted, and correspondence related to, listed offset projects under compliance offset protocols by the offset project registry would need to be maintained for a minimum of 15 years.

Expected impact

We expect the proposed rule's specification of offset project registry requirements to result in costs that are passed on as part of the costs of offset project operations. Transaction costs, such as costs of registry activities, would be a part of overall private costs associated with offset project operations, and would underlie the price of offset credits. This means offset credit prices will reflect transaction costs, and we do not analyze them separately (or in addition to) costs of offset credit purchases.

2.3.6.20 Direct environmental benefits in the State

Regulatory baseline

Chapter 70A.65 RCW requires offset projects to provide direct environmental benefits to Washington or be located in a jurisdiction with which Washington has entered into a linkage agreement.

Proposed

Under the proposed rule, offset projects that are located within, or that avoid GHG emissions within the State of Washington would be considered to provide direct environmental benefits in the State.

Projects located outside of Washington would be able to submit information to Ecology to enable a determination of whether the project provides direct environmental benefits in the State, based on showing that the offset project or offset project type provides for the:

- Reduction or avoidance of emissions of any air pollutant that is not credited pursuant to the applicable compliance offset protocol in the State of Washington.
- Reduction or avoidance of any pollutant that is not credited pursuant to the applicable compliance offset protocol that could have an adverse impact on waters of the State of Washington.

The proposed rule details the types of information that may be used to support such a determination.

In addition, the proposed rule provides that Ecology will accept offset credits only from offset projects that do not have significant adverse environmental impacts after mitigation.

Expected impact

We expect the proposed rule's specification of what constitutes "direct environmental benefits to the state" to create benefits of additional potential for ancillary benefits to Washington's environment and public, including emissions of pollutants other than GHGs to the air or waters.

2.4 Additional regulatory baseline information

2.4.1 Use of auction revenues

Chapter 70A.65 RCW also specifies allocations of auction revenues to various accounts. While not directly applicable to any particular section of the proposed rule, these allocations inform the types of spending, and therefore the types of benefits that could result from projects or investments made as part of the Cap and Invest Program.

- Fiscal year 2023:
    - $127,341,000 must first be deposited into the carbon emissions reduction account.
    - The remaining auction proceeds go to the climate investment account and the air quality and health disparities improvement account.
- Fiscal year 2024:
    - $356,697,000 must first be deposited into the carbon emissions reduction account
    - The remaining auction proceeds go to the climate investment account and the air quality and health disparities improvement account.
- Fiscal year 2025:
    - $366,558,000 must first be deposited into the carbon emissions reduction account.
    - The remaining auction proceeds go to the climate investment account and the air quality and health disparities improvement account.
- Fiscal years 2026 through 2037:
    - $359,117,000 per year must first be deposited into the carbon emissions reduction account.
    - The remaining auction proceeds go to the climate investment account and the air quality and health disparities improvement account.
- Fiscal years 2038 and later:
    - 50 percent of the auction proceeds go to the carbon emissions reduction account.
    - The remaining auction proceeds go to the climate investment account and the air quality and health disparities improvement account.

- Deposits into the carbon emissions reduction account must not exceed $5,200,000,000 over the first 16 years.
- Any remaining auction proceeds must be deposited into the climate investment account and the air quality and health disparities improvement account.

2.5 Analytic structure and assumptions

This section describes the structure for our analysis of likely costs and benefits of the proposed rule – the basis of cost estimation results discussed in Chapter 3, and benefits estimation results discussed in Chapter 4. It is also the structure used for analyses of alternative assumptions in sensitivity analyses discussed in the appendices.

For the CBA, we consider direct costs and benefits, but as this rulemaking potentially has broad impacts across the state economy, we also considered indirect (upstream or downstream) and induced (resulting from relative price changes) impacts that could result from changes in economic activity, including impacts to output and jobs. These results help decisionmakers, the public, and other stakeholders to understand the full implications of the proposed rule (see Chapter 7 for modeling discussion and results).

2.5.1 Likely covered entities

We began this analysis by developing an understanding of likely covered entities. Most covered entities have been reporting emissions under the GHG reporting rule (Chapter 173-441 WAC). There are 105 likely current reporters who would be covered entities, based on past GHG emissions, 104 of which would be covered by the Cap and Invest Program starting in 2023.[8] Nearly half of these entities would be EITE facilities under the EITE determination rule (Chapter 173-446A WAC).

There are also likely covered entities that do not have existing reported GHG emissions. These are electricity importers. In a recent GHG reporting rulemaking, we assumed, as supported by information from the Bonneville Power Administration,[9] that 25-30 EPEs could be likely covered entities as electricity importers. These numbers were based on half of 50 – 60 new EPE reporters under a recent GHG reporting rulemaking being likely CCA covered entities as electricity importers. Accounting for these additional covered parties, the tables below summarize information about all likely covered entities.[10]

[8] WA Department of Ecology, 2022. GHG Reporting Program Publication dataset. https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Publication/idhm-59de/data

[9] Bonneville Power Administration phone discussion with Neil Caudill and Bill Drumheller, WA Department of Ecology Air Quality Program. Summer 2021.

[10] WA Department of Ecology, 2022. GHG Reporting Program Publication dataset. https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Publication/idhm-59de/data

Table 17: Number of likely covered entities

First Year of Coverage	Number of Likely Covered Entity Existing Reporters
2023	**104**
2027	**1**
Total	**105**

Table 18: Covered entities by sector

Sector	Number of Entities	EITE
Chemicals	**3**	**Yes**
Electricity Importers	**25 – 30**	**No**
Food Production	**10**	**Yes**
Fuel Supplier – Natural Gas Distribution	**6**	**Yes**
Fuel Supplier – Transportation Fuels	**22**	**No**
Government (Universities)	**2**	**No**
Manufacturing	**7**	**Yes**
Metals	**5**	**Yes**
Minerals	**4**	**Yes**
Natural Gas Systems	**14**	**No**
Petroleum Services	**7**	**Yes**
Power Plants	**15**	**No**
Pulp and Paper	**8**	**Yes**
Waste to Energy	**1**	**No**
Total	**130 – 135**	**n/a**

2.5.2 Baseline emissions and trajectories

We estimated the likely baseline emissions for the Cap and Invest Program for each likely covered entity or group of entities.

- Emissions for likely covered entities with existing GHG reporting data were based on 2015 – 2019 emissions.[11]
- Emissions for electricity importers were based on consumption-based inventories of statewide electricity emissions.[12]

We assumed covered entity emissions would change over time under the regulatory baseline, through 2050, based on historic data and emissions forecasts from the WA Department of Commerce.[13]

[11] Ibid.
[12] WA Department of Commerce, 2021. Carbon Tax Assessment Model (CTAM). Version 4.2. Jan 11, 2021. https://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/
[13] Ibid.

We based baseline emissions on existing GHG reporting data,[14] as well as the statewide inventory of electricity sector emissions (consumption based).[15] Consumption based electricity emissions reflect both in-state consumption and electricity imports, but potentially underestimates electricity imports from power marketers.

2.5.2.1 Likely covered entities with known emissions

Based on reported GHG emissions subject to the proposed rule, we estimated the following baseline emissions, summarized by sector.

Table 19: Baseline emissions by sector[16]

Sector	Baseline Emissions (MT CO_2e)
Chemicals	**255,073**
Food Production	**530,931**
Fuel Supplier	**38,935,052**
Government	**151,448**
Manufacturing	**404,225**
Metals	**1,548,547**
Minerals	**594,487**
Natural Gas Systems	**692,231**
Petroleum Systems	**6,534,006**
Power Plants	**4,873,648**
Pulp and Paper	**1,032,952**

2.5.2.2 Electricity importers

We do not have historical GHG emissions reporting data for electricity importers. To estimate this value, we used consumption data from our statewide inventory to estimate electricity imports. Total electricity sector emissions were assumed to be the total of in-state electric generation (including independent power providers) and electricity imports.

Table 20: Total electricity sector emissions

Sub-sector	Average GHG Emissions, 2015 – 2019 (MT CO_2e)
In-State electricity generation (not IPPs)	**3.8 million**
Electricity Imports	**11.6 million**
Independent power providers (IPPs)	**1.1 million**

[14] WA Department of Ecology, 2022. GHG Reporting Program Publication dataset. https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Publication/idhm-59de/data

[15] WA Department of Commerce, 2021. Carbon Tax Assessment Model (CTAM). Version 4.2. Jan 11, 2021. https://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/

[16] This analysis uses the most recent reported emissions available for likely covered entities. We expect emissions values to change slightly with new reporting data over the course of this rulemaking, and will update the analysis accordingly for the Final Regulatory Analyses.

Sub-sector	Average GHG Emissions, 2015 – 2019 (MT CO_2e)
Total	**16.4 million**

2.5.2.3 Total baseline emissions

We based total regulatory baseline emissions in the proposed rule on total baseline emissions across all likely covered entities, as summarized in the table below.

Table 21: Baseline emissions by sector

Sector	Baseline Emissions (MT CO_2e)
Sectors covered in 2023	**n/a**
Chemicals	**255,073**
Electric Power Entities (excluding direct power plant emissions)	**12,579,903**
Food Production	**530,931**
Fuel Supplier	**38,935,052**
Government	**151,448**
Manufacturing	**404,225**
Metals	**1,548,547**
Minerals	**594,487**
Natural Gas Systems	**692,231**
Petroleum Systems	**6,534,006**
Power Plants (excluding waste-to-energy)	**4,873,648**
Pulp and Paper	**1,032,952**
Subtotal	**68,132,503**
Sectors covered in 2027	**n/a**
Power Plants (waste-to-energy)	**98,851**
Total	**68,231,354**

Based on observations in other GHG emissions allowance markets, we assumed that likely zero or very few opt-in entities would participate in the program. Opt-in entities would only choose to participate if their perceived private net benefit was positive.

The total program budget was based on total covered emissions for sectors covered starting in 2023. As seen in Table 12, this is 68,532,501 MT CO_2e.

Total program allowance budgets in each year would be set in the proposed rule. As total allowance budgets starting in 2027 are unknown (they are based on new covered sectors entering the program), we made the simplifying assumption that no new covered parties would enter the program.

We also subtracted one-third of one percent for the VRERA, 2 percent for the ECR, and 5 percent for the APCR, in each year. While not specified in the proposed rule, we assumed that the one-third of one percent allocation to the VRERA would continue throughout the program.

The proposed rule would set a total program emissions baseline of 68,132,501 MT CO_2e for the first compliance period. Future total program emissions baselines would be based on future rulemakings and methods established under the regulatory baseline and proposed rule. Since these future total program emissions baselines are unknown, and depend on additional covered sectors at the time, we conservatively assumed they would be the initial program emissions baseline plus currently known baseline emissions from covered sectors added to the program in subsequent compliance periods.

2.5.2.4 Total program allowance budgets

The proposed rule would set the total allowances in the program in each year:

- First compliance period:
    - 2023: 93 percent of total program baseline for 2023 – 2026.
    - 2024 – 2026: Decreases annually by an additional 7.0 percent of total program baseline for 2023 – 2026.
- Second compliance period:
    - 2027: The 2026 total program allowance budget plus adjustment for newly covered entities, reduced by an additional 7.0 percent of total program baseline for 2027 – 2030.
    - 2028 – 2030: Decreases annually by an additional 7.0 percent of total program baseline for 2027 – 2030.
- 2031 - 2042:
    - 2031: The 2030 total program allowance budget plus adjustment for newly covered entities, reduced by an additional 1.9 percent of total program baseline for 2031 and later.
    - 2032 – 2042: Decreases annually by an additional 1.9 percent of total program baseline for 2031 and later.
- 2043 – 2050: Decreases annually by an additional 2.5 percent of total program baseline for 2031 and later.

2.5.2.5 Reserves

Under the proposed rule, Ecology would:

- Set aside 1/3 of one percent of the total program allowance budget for each year to the VRERA.
- Place 5 percent of annual allowance budgets for the years 2023 through 2030 in the APCR, make those allowances vintageless, and make them all available for auction in 2023 and succeeding years.
- Place 2 percent of annual allowance budgets in the ECR

We subtracted 7 1/3 percent of allowances in each year for placement in the VRERA, the ECR, and the APCR.

2.5.3 Allocation of no cost allowances

For each covered entity, we estimated the allocation of no cost allowances each year. Allocations were determined by the regulatory baseline and proposed rule, based on their emissions baseline.

- EITE facilities:
    - 100 percent of baseline emissions during the first compliance period.
    - 97 percent of baseline emissions during the second compliance period.
    - 94 percent of baseline emissions during the third and subsequent compliance periods.
    - Allocation of no cost allowances after the third compliance period may be revised, but the regulatory baseline specifies that absent future determination of another allocation trajectory, the 94 percent allocation would continue.
- Electric utilities:
    - 100 percent of cost burden effect of each utility's emissions, through 2045.
    - Zero no cost emissions after 2045.
    - We assumed utilities would continue to use the same fuel mix, beyond changes required under the CETA. Under CETA – part of the regulatory baseline – electric utilities must be 80 percent clean by 2030, and 100 percent clean by 2045.
- Natural gas utilities:
    - 93 percent of baseline emissions in 2023.
    - Decreasing by 7 percent each year through 2030.
    - Decreasing by 1.9 percent each year 2031 – 2042
    - Decreasing by 2.5 percent each year 2043 - 2050.

We assumed no cost allowances would be allocated according to the requirements of the proposed rule:

- EITE facilities:
    - First compliance period: 100 percent of baseline emissions.
    - Second compliance period: 97 percent of baseline emissions.
    - Third compliance period: 94 percent of baseline emissions.
    - Fourth compliance period and later: 94 percent of baseline emissions.
- Electric utilities:

    - 100 percent of cost burden effect
    - We assumed cost burden effect was the quantity of utility emissions, based on electric utility fuel mix data reported by the WA Department of Commerce,[17] adjusted over time to match decreases in total electricity consumption emissions modeled for Washington.[18]
- Natural gas utilities:
    - 2023: 93 percent of allocation baseline.
    - 2024 – 2030: Decreases by an additional 7 percent of their allocation baseline.
    - 2031 - 2042: Decreases annually by an additional 1.9 percent of their allocation baseline.
    - 2043 – 2050: Decreases annually by an additional 2.5 percent of their allocation baseline.

Electric utilities and natural gas utilities can consign up to 100 percent of their no cost allowances to auction. There is no minimum consignment requirement for electric utilities, while natural gas utilities are required to consign at least:

- 65 percent in 2023
- 70 percent in 2024.
- 75 percent in 2025.
- 80 percent in 2026.
- 85 percent in 2027.
- 90 percent in 2028.
- 95 percent in 2029.
- 100 percent in 2030.

We conservatively assumed electric utilities would not consign any of their no cost allowances to auction, and would instead use them for compliance as needed. Similarly, we assumed natural gas utilities would consign the required minimum numbers of no cost allowances to auction, as a fraction of the no cost allowances allocated to them.

2.5.4 Offsets

Use of offset credits would reduce demand for allowances, but would require available and appropriate offset credits at prices that would be the lowest cost option available to covered

[17] WA Department of Commerce, 2020. Fuel Mix Disclosure 2020 Utility Emissions Report. Available through https://www.commerce.wa.gov/growing-the-economy/energy/fuel-mix-disclosure/
[18] WA Department of Commerce, 2021. Carbon Tax Assessment Model (CTAM). Version 4.2. Jan 11, 2021. https://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/

parties. This would depend on the development time for offset projects. Since we are uncertain of the degree and timing of offset credit use, we examined results reflecting no offset credit use, as well as results assuming maximum offset credit use.

We based the cost of using offset credits on offset price trajectories, assuming a 15 percent discount relative to allowance prices.

2.5.5 Decision to reduce emissions or purchase allowances

We did not make entity-specific or industry-specific assumptions about which entities would choose GHG emissions reductions, offset credits, or emissions allowances at different points in time or under different market or economic circumstances. This means estimated allowance demand reflects aggregate demand.

2.5.6 Emissions abatement

If emissions exceed the available auction allowances, the remainder of emissions reductions would be made using abatement options with:

- Costs below the market allowance price, by entities that would choose lower abatement costs available to them over purchasing allowances.
- Costs above the allowance market price, by entities that would have purchased additional allowances if they were available, but which must use other abatement options due to limited allowance supply (mitigated by additional allowance releases based on price controls).

We made the simplifying structural assumption that market price would reflect the break-even point of these abatement costs relative to allowance supply and demand, in terms of willingness to pay for allowances as well as volume of allowances demanded.

2.5.7 Total emissions reductions

Total actual emissions reductions are the difference between GHG emissions under the proposed rule and under the regulatory baseline:

- Under the regulatory baseline, absent the Cap and Invest Program created under the proposed rule, GHG emissions would be baseline emissions plus likely growth in emissions in each year based on doing business as usual.
- Under the proposed rule, using the Cap and Invest Program, emissions in each year would be the total allowance budget.

We note that because we could not analytically separate the proposed rule from the regulatory baseline, the analytic structure assigns responsibility for both costs and benefits of emissions reductions to the proposed rule. This means we are less likely to underestimate actual costs of the proposed rule.

2.5.8 Impacts of carbon emissions

To estimate the benefits of avoiding a metric ton of GHG emissions, Ecology uses the Social Cost of Carbon (SCC). 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."[19]

The workgroup follows up in the technical update:

> "The 2010 interagency SCC TSD [technical support document] discusses a number of important limitations for which additional research is needed. In particular, the document highlights the need to improve the quantification of both non-catastrophic and catastrophic damages, the treatment of adaptation and technological change, and the way in which inter-regional and inter-sectoral linkages are modeled. While the new version of the models discussed above offer some improvements in these areas, further work remains warranted. The 2010 TSD also discusses the need to more carefully assess the implications of risk aversion for SCC estimation as well as the inability to perfectly substitute between climate and non-climate goods at higher temperature increases, both of which have implications for the discount rate used."[20]

[19] 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

[20] 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.

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 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.[21]

In 2021, the federal government issued new interim values for the Social Cost of Carbon (SCC).[22] These included median values estimated using three discount rates, as well as a set of values reflecting highly damaging scenarios.

[21] 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).

[22] 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

Table 22: Social Cost of Carbon (2022$)

Year	Median SCC at 5% Discount Rate	Median SCC at 3% Discount Rate	Median SCC at 2.5% Discount Rate	95th Percentile SCC at 3% Discount Rate
2021	**$16.13**	**$56.93**	**$85.17**	**$168.96**
2022	**$16.68**	**$58.12**	**$86.63**	**$172.88**
2023	**$17.22**	**$59.31**	**$88.08**	**$176.79**
2024	**$17.77**	**$60.50**	**$89.54**	**$180.70**
2025	**$18.31**	**$61.69**	**$90.99**	**$184.61**
2026	**$18.86**	**$62.88**	**$92.45**	**$188.53**
2027	**$19.40**	**$64.07**	**$93.90**	**$192.44**
2028	**$19.95**	**$65.26**	**$95.36**	**$196.35**
2029	**$20.49**	**$66.45**	**$96.81**	**$200.26**
2030	**$21.03**	**$67.64**	**$98.27**	**$204.17**
2031	**$21.58**	**$68.83**	**$99.72**	**$208.09**
2032	**$22.23**	**$70.11**	**$101.24**	**$212.35**
2033	**$22.88**	**$71.38**	**$102.76**	**$216.61**
2034	**$23.53**	**$72.66**	**$104.28**	**$220.87**
2035	**$24.18**	**$73.93**	**$105.80**	**$225.13**
2036	**$24.83**	**$75.21**	**$107.32**	**$229.39**
2037	**$25.48**	**$76.48**	**$108.84**	**$233.66**
2038	**$26.13**	**$77.76**	**$110.36**	**$237.92**
2039	**$26.78**	**$79.03**	**$111.88**	**$242.18**
2040	**$27.43**	**$80.31**	**$113.40**	**$246.44**
2041	**$28.08**	**$81.58**	**$114.92**	**$250.70**
2042	**$28.80**	**$82.86**	**$116.41**	**$254.60**
2043	**$29.52**	**$84.14**	**$117.90**	**$258.50**
2044	**$30.24**	**$85.42**	**$119.38**	**$262.40**
2045	**$30.96**	**$86.69**	**$120.87**	**$266.30**
2046	**$31.68**	**$87.97**	**$122.36**	**$270.20**
2047	**$32.40**	**$89.25**	**$123.85**	**$274.10**
2048	**$33.12**	**$90.52**	**$125.34**	**$278.00**
2049	**$33.84**	**$91.80**	**$126.83**	**$281.90**
2050	**$34.56**	**$93.08**	**$128.32**	**$285.80**

2.5.8.1 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.[23] 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:[24]

> "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

[23] 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.

[24] 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

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."

- 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:[25]

> "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:[26]

> "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

[25] 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.
[26] 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.

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, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time." The same is true for any output-based scaling to state, region, county, or other geographic level.
- The IWG responded to comments in support of global SCC:[27]

  "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

[27] 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.

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

- In its response to public comments, the IWG also responded to concerns regarding domestic damages: [28]

> "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

[28] 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.

global damages of 6 to 8.7 percent based on a paper by Nordhaus (2011). One commenter stated that the methods used to estimate the domestic damages as 7 to 23 percent of global damages is too speculative for quantification of the SCC.

Response

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

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

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

- On August 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:[29]

> "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:[30]

> "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.

[29] 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.

[30] 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.

- Washington exported an estimated $69.9 billion in goods and $28.8 billion in services in 2018.[31]
- International trade, including exports and imports, supported 940,800 Washington jobs in 2018.[32]
- 140,600 people in Washington are directly employed by US affiliates of foreign multinational companies.[33]

As with the US economy as a whole, Washington is impacted directly and indirectly by economic disruptions outside the state.[34, 35] Therefore, we used the SCC in evaluating the benefits of the leakage avoided by this rule's accommodation of EITE facilities.

In 2017, authors at Carbon Brief addressed criticisms of the global SCC[36], noting:

- Scaling of global SCC to sub regions or populations:
    - Was rejected by the U.S. Seventh Circuit Court of Appeals.[37]
    - 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:

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[31] 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

[32] Ibid.

[33] 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

[34] 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

[35] 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/

[36] CarbonBrief, 2017. Q & A: The social cost of carbon. February 14, 2017. https://www.carbonbrief.org/qa-social-cost-carbon

[37] *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

- Accounting for the various uncertainties surrounding estimates of the SCC would increase the SCC value by 70 percent to 420 percent over current estimates.[38]

- The federal SCC was ruled "reasonable and the best available measure to determine the environmental cost of CO_2" in 2016.[39]

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.[40] 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.[41] 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.[42] This decision was subsequently stayed by the Fifth Circuit Court of Appeals.[43] 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 U.S. District Court for the Eastern District of Missouri denied a similar challenge to the SCC. 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.

2.5.8.2 Benefits of reduced climate change not reflected in the SCC

[38] 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

[39] *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 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

[40] 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.

[41] 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

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

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

The SCC reflects many impacts of climate change, including impacts to agricultural productivity, human health, and property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. However, at this point it does not include other important values, which include both quality of life impacts and further economic impacts. As we do not know the extent to which these environmental and human costs would be avoided under the proposed rule, we discuss them qualitatively with numeric information where possible to further illustrate them.

2.5.8.3 Wildfire risk and costs

Washington is particularly vulnerable to losing forestlands, bushlands, and other habitats including residential, commercial, or industrial areas to wildfire. We have already experienced significant wildfires, causing direct damage as well as contributing to poor or hazardous air quality throughout the region. The UN Environment Programme recently estimated that globally wildfires would increase by an additional 50 percent by 2100. As we do not know the extent to which these environmental and human costs would be avoided under the proposed rule, we discuss them qualitatively with numeric information where possible to further illustrate them.

2.5.8.4 Heat-related deaths

Recent analyses using data from the 2021 Northwest heat wave ("heat dome") indicate that existing estimates of heat-related deaths and associated costs are likely too low. As we do not know the extent to which reductions in GHG emissions would reduce the frequency or severity of heat waves, we discuss them qualitatively with numeric information where possible to further illustrate them.

A 2021 study found that the SCC also likely underrepresents the value of heat-related mortality due to climate change[44], consistent with previous studies and meta-analyses.[45,46]

2.5.8.5 Other air pollutants

Depending on how covered parties meet their GHG emission reduction pathways, there may be associated reductions in other emissions, such as criteria pollutants and toxic air pollutants. Associated emissions that might also be reduced include nitrogen oxides, sulfur oxides, fine particulates, and various toxic air pollutants. Avoiding or reducing these emissions would improve air quality and may reduce associated health endpoints, such as asthma and other lung disorders, and contributors to certain cancers.

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[44] Bressler, RD, FC Moore, K Rennert, and D Anthoff, 2021. Estimates of country level temperature-related mortality damage functions. Scientific Reports, Nature Portfolio 11:20282. https://doi.org/10.1038/s41598-021-99156-5

[45] Bressler, RD, 2021. The mortality cost of carbon. Nat. Commun. 12, 4467 (2021).

[46] Silva, RA, JJ West, JF Lamarque, DT Shindell, WJ Collins, G Faluvegi, GA Folberth, LW Horowitz, T Nagashima, V Naik, ST Rumbold, K Sudo, T Takemura, D Bergmann, P Cameron-Smith, RM Doherty, B Josse, IA MacKenzie, DS Stevenson, and G Zeng, 2017. Future global mortality from changes in air pollution attributable to climate change. Nat. Clim. Change, 7, no. 9, pp. 647-651. DOI:10.1038/nclimate3354

While estimation of actual avoided costs of associated emissions, in addition to avoided GHG emissions, would require knowledge of the methods and locations of emissions reduction activities, the estimates of health damages below illustrate the magnitude of damage per MT of certain criteria pollutants.[47]

Table 23: Value of damages from select criteria pollutants as reported in EPA rulemakings

Criteria Pollutant	Damages per MT in Current Dollars
$PM_{2.5}$	**$1.78 million – $1.97 million**
Volatile Organic Compounds (VOCs)	**$1,377 – $1,501**
Nitrogen Oxides (NOx)	**$5,751 – $6,249**

2.5.9 Environmental justice

Overburdened communities are more likely to suffer the impacts of climate change and other air pollutant emissions, and to lack healthcare and financial resources to deal with their impacts. Reducing GHG emissions and contributing to a flattening of the trajectory of climate change would provide additional benefits to the overburdened communities that otherwise disproportionately bear these costs. As we do not know the extent to which reduced climate change impacts would specifically benefit these communities, we discuss them qualitatively with numeric information where possible to further illustrate them.

The proposed rule also includes considerations specifically supporting environmental justice, including its consideration in offset decisions, as well as through no cost allowance allocations that reduce the potential cost impacts on electricity and natural gas users (either through sales or by offsetting compliance needs). While we do not know the extent to which these elements would quantifiably impact overburdened communities, we discuss energy and fuel price impacts in Chapter 7.

2.5.10 Forecast of allowance prices, volumes, and emissions

We based allowance market attributes – including price trajectories, allowance volumes, and total emissions in each year – on analysis performed by Vivid Economics and McKinsey &

[47] ICF International (2014). California's Low Carbon Fuel Standard: Compliance Outlook & Economic Impacts. In turn, this cites specifically:

- US Environmental Protection Agency (2010). Diesel Emissions Quantifier Health Benefits Methodology, EPA, EPA-420-B-10-034, August 2010.
- US Environmental Protection Agency and National Highway Traffic Safety Administration (2011). Draft Joint Technical Support Document: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-D-11-901, November 2011.

Company (referred to hereafter as "Vivid Economics"), for Ecology.[48, 49] The modeling reflected allowance market structures in the proposed rule, as well as technological assumptions about sectoral decarbonization rates, and behavioral assumptions about intertemporal optimization and financial sector attributes.

In addition to modeling for a scenario reflecting the proposed rule's contents and most-likely market attributes, Vivid Economics modeled 24 alternative scenarios to further inform the sensitivity of our results to various parameters or rule specifications. These results are discussed in the appendices to this analysis, as well as in Chapter 6 in the context of alternative rule contents considered.

The following tables and graphs summarize modeling results for our primary analysis (called "Frontload" in the Vivid Economics analysis), reflecting APCR frontloading and all price controls in the proposed rule, assuming an allowance market that is not linked with any other jurisdictions. While the proposed rule and our primary analysis do not reflect linkage, the expectation of linkage (based on regulatory baseline requirements to design a Cap and Invest Program with attributes that facilitate linkage, or other signals affecting expectation of linkage) would affect price levels.[50]

Table 24: Modeled allowance prices, primary scenario

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**58.31**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**61.21**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**64.76**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**69.96**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**76.91**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**84.01**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**92.76**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**100.23**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**92.57**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**92.63**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**96.74**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.35**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.58**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.79**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**59.72**	**94.33**	**121.21**	**40.35**	**148.08**

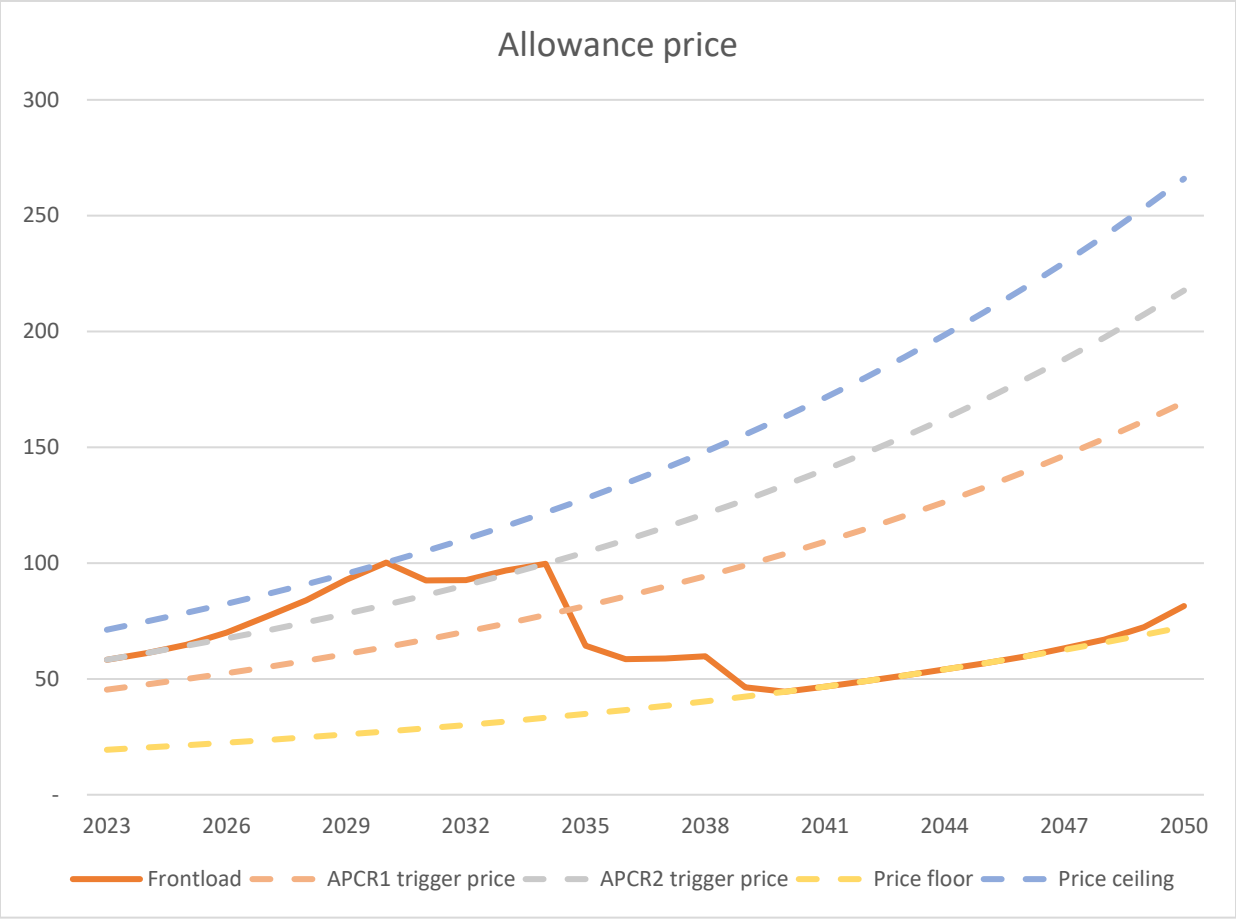
[48] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

[49] Due to the necessity of modeling based on a selected Total Program Baseline while GHG emissions reporting was ongoing, Vivid Economics modeling forecasts were based on a Total Program Baseline approximately 3% lower than the Total Program Baseline in the proposed rule. This difference is not expected to significantly affect modeled prices. Ecology will continue to receive GHG emissions reports over the course of this rulemaking, but we do not expect significant changes to aggregate emissions or covered entities.

[50] For modeling and discussion of allowance prices reflecting linkage expectations, see Appendix B. For sensitivity analysis of the timing of linkage expectations, see Appendix D.

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2039	**46.39**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.20**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.91**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.30**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.47**	**169.41**	**217.68**	**72.48**	**265.95**

Figure 1: Modeled allowance prices, primary scenario



Modeled allowance prices begin at $58.31, triggering the higher APCR price tier. They then rise until they reach the ceiling price of $100.23 in 2023. This rise is due to the rapidly increasing stringency of the emissions cap through 2030. Prices then reach a curved plateau, reflecting a lower emissions cap reduction rate after 2030, and intertemporal optimization across years within compliance periods. Subsequently, prices drop until they reach and follow the price

floor.

We note that Washington specific GHG emissions abatement costs and allowance volumes underlie these allowance prices, and they do not reflect any market linkage expectations facilitated by regulatory baseline requirements to develop a Cap and Invest Program that facilitates linkage with other jurisdictions. [51]

Table 25: Modeled emissions, primary scenario

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)
2023	**56,944,519**	**12,225,474**	**10,972,931**	**8,423,494**	**25,322,621**	**27,770,514**
2024	**52,905,144**	**11,260,997**	**9,094,768**	**8,224,713**	**24,324,667**	**24,313,109**
2025	**48,306,209**	**10,622,797**	**6,959,114**	**7,943,011**	**22,781,288**	**20,911,727**
2026	**44,062,212**	**9,993,411**	**5,353,109**	**7,145,714**	**21,569,978**	**17,863,091**
2027	**41,441,506**	**9,331,932**	**5,292,773**	**6,541,876**	**20,274,925**	**16,472,860**
2028	**38,893,574**	**8,634,916**	**5,379,086**	**5,954,099**	**18,925,473**	**15,549,870**
2029	**36,491,645**	**7,936,620**	**5,569,488**	**5,419,721**	**17,565,816**	**14,775,690**
2030	**33,801,018**	**7,230,163**	**5,256,464**	**5,100,676**	**16,213,716**	**13,379,075**
2031	**31,231,324**	**6,592,729**	**4,932,744**	**4,760,226**	**14,945,625**	**12,301,798**
2032	**28,841,787**	**6,000,788**	**4,622,529**	**4,450,556**	**13,767,914**	**11,291,038**
2033	**26,668,227**	**5,454,999**	**4,307,624**	**4,183,143**	**12,722,462**	**10,339,180**
2034	**24,523,838**	**4,941,580**	**3,987,465**	**3,897,834**	**11,696,959**	**9,414,141**
2035	**22,625,592**	**4,494,104**	**3,662,372**	**3,676,915**	**10,792,201**	**8,571,184**
2036	**20,461,573**	**4,161,655**	**3,316,312**	**3,276,765**	**9,706,842**	**7,802,783**
2037	**18,366,041**	**3,935,011**	**2,969,775**	**2,851,889**	**8,609,366**	**7,147,518**
2038	**16,267,008**	**3,714,143**	**2,617,608**	**2,421,068**	**7,514,189**	**6,491,767**
2039	**14,487,824**	**3,551,699**	**2,259,910**	**2,161,719**	**6,514,496**	**5,901,589**
2040	**12,799,423**	**3,398,850**	**1,896,681**	**1,920,519**	**5,583,374**	**5,318,133**
2041	**11,267,576**	**3,239,314**	**1,527,591**	**1,754,576**	**4,746,096**	**4,739,229**
2042	**9,776,759**	**3,074,447**	**1,153,276**	**1,577,985**	**3,971,051**	**4,156,872**
2043	**8,380,972**	**2,922,101**	**773,906**	**1,407,469**	**3,277,496**	**3,589,647**
2044	**7,078,296**	**2,780,871**	**389,463**	**1,231,213**	**2,676,750**	**3,035,493**
2045	**5,874,851**	**2,650,586**	**-**	**1,059,046**	**2,165,219**	**2,494,728**
2046	**5,146,143**	**2,535,787**	**-**	**870,178**	**1,740,178**	**2,383,640**
2047	**4,488,553**	**2,433,252**	**-**	**700,336**	**1,354,965**	**2,287,257**
2048	**3,923,159**	**2,337,644**	**-**	**560,440**	**1,025,075**	**2,197,385**
2049	**3,461,055**	**2,246,945**	**-**	**436,474**	**777,636**	**2,112,128**
2050	**3,097,227**	**2,166,721**	**-**	**333,554**	**596,952**	**2,036,717**

[51] For modeling and discussion of allowance prices reflecting linkage expectations, see Appendix B. For sensitivity analysis of the timing of linkage expectations, see Appendix D.

Figure 2: Modeled total emissions, primary scenario

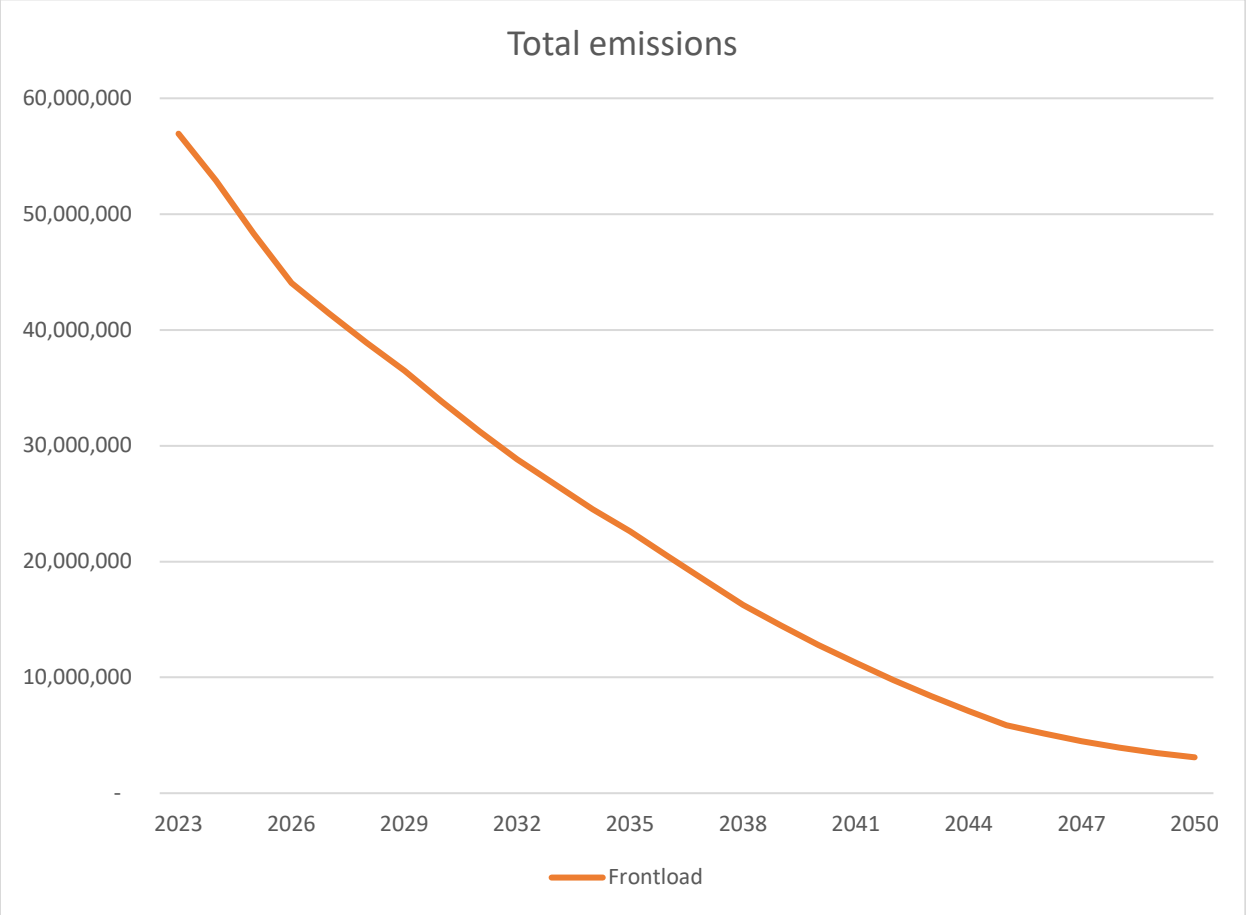


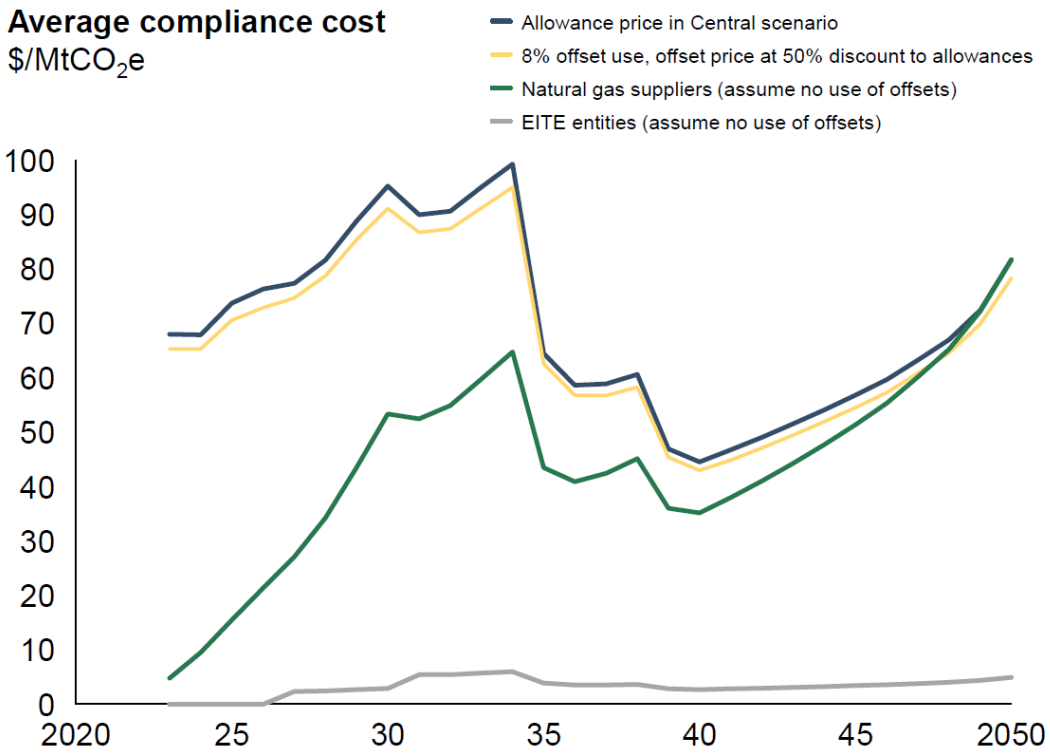
Table 26: Modeled allowance cap and price control allowance releases, primary scenario

Year	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**58,501,299**	**9,299,594**	**1,043,573**	**-**
2024	**54,097,976**	**-**	**693,049**	**-**
2025	**49,694,652**	**-**	**7,562,971**	**-**
2026	**45,291,328**	**-**	**-**	**-**
2027	**40,888,005**	**-**	**-**	**-**
2028	**36,484,681**	**-**	**-**	**-**
2029	**32,081,358**	**-**	**-**	**-**
2030	**27,678,034**	**-**	**-**	**-**
2031	**26,482,846**	**714,440**	**714,034**	**-**
2032	**25,287,658**	**682,196**	**682,602**	**-**
2033	**24,092,471**	**649,953**	**649,831**	**-**
2034	**22,897,283**	**617,710**	**269,465**	**-**
2035	**21,702,095**	**-**	**-**	**-**
2036	**20,506,907**	**-**	**-**	**-**
2037	**19,311,719**	**-**	**-**	**-**

Year	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2038	**18,116,531**	**-**	**-**	**-**
2039	**16,921,344**	**-**	**-**	**-**
2040	**15,726,156**	**-**	**-**	**- 815,017**
2041	**14,530,968**	**-**	**-**	**- 2,617,093**
2042	**13,335,780**	**-**	**-**	**- 2,527,650**
2043	**11,763,164**	**-**	**-**	**- 4,611,811**
2044	**10,190,549**	**-**	**-**	**- 3,553,613**
2045	**8,617,933**	**-**	**-**	**- 2,352,850**
2046	**7,045,318**	**-**	**-**	**- 3,028,763**
2047	**5,472,702**	**-**	**-**	**-**
2048	**3,900,087**	**-**	**-**	**-**
2049	**2,327,471**	**-**	**-**	**-**
2050	**754,855**	**-**	**-**	**-**

Vivid Economics also noted that average compliance costs would be lower for some entities, including natural gas utilities, EITE facilities, and entities using offset credits. The graph below illustrates this effect, relative to a central modeled scenario (the proposed rule without frontloading of APCR allowances), and this effect holds for all modeled scenarios.

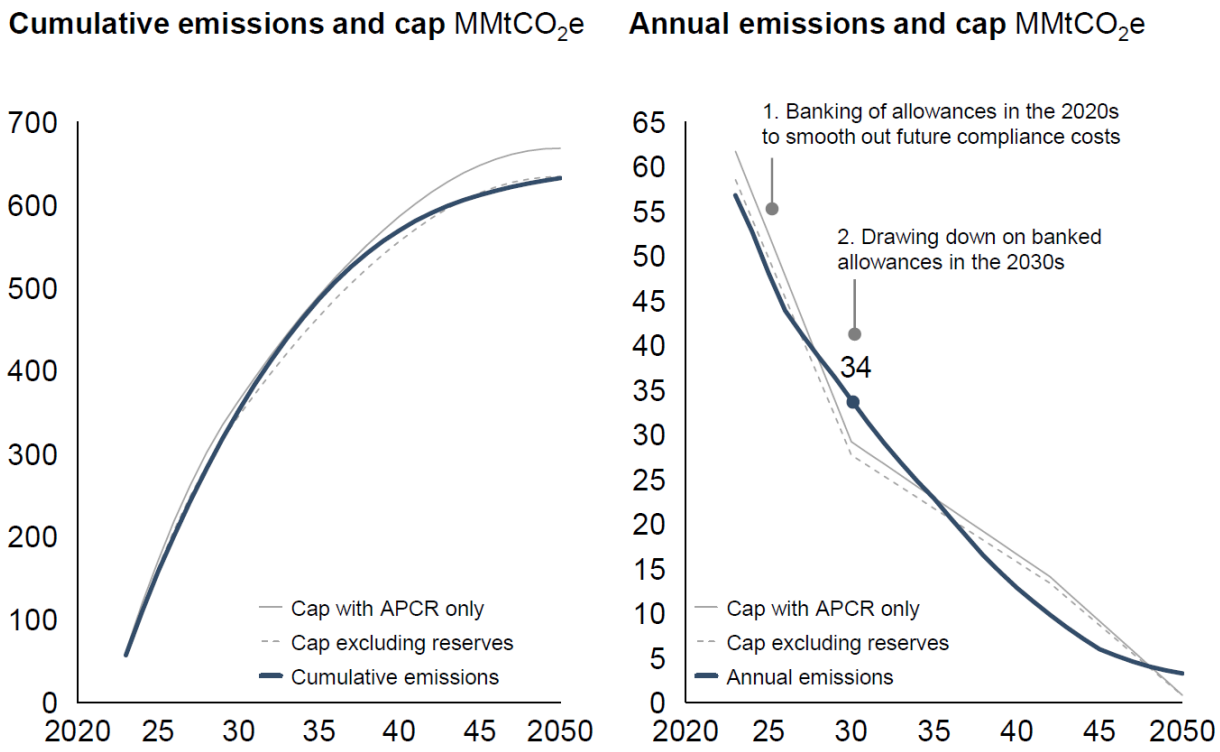
Figure 3: Average compliance costs, Central scenario



Source: Vivid Economics

Vivid Economics also noted, "Modeling suggests that banking would allow covered entities to intertemporally optimize while maintaining the cumulative 2050 emissions cap." [52] The graphs below illustrate this, reflecting cumulative emissions consistently below the statutory cap, as entities initially bank allowances and draw on them in later years.

Figure 4: Cumulative and annual emissions, and emissions cap



Source: Vivid Economics

2.5.11 Discount rates and present values

Present value calculations use real discount rates to reflect the opportunity cost of capital. The current long-run average rate of risk-free return, based on historic rates of US Treasury I Bonds, is 0.9 percent[53] and best reflects social opportunity costs. I bonds are one-year bonds, indexed to the rate of inflation, so an example I Bond return rate of 0 percent with 2 percent inflation would return 2 percent on each dollar of investment.

To maintain consistent discount rates across this analysis, we assumed the nearest available SCC discount rate (2.5 percent) as the discount rate for all present value calculations.

[52] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.
[53] US Department of the Treasury, 2022. Series I Savings Bonds Rates & Terms: Calculating Interest Rates. https://www.treasurydirect.gov/indiv/research/indepth/ibonds/res_ibonds_iratesandterms.htm Historic I bond rates 1998 – present.

Ecology reflects flows of costs and benefits over time using present values. A present value is a discounted sum of impacts over time, accounting for inflation as well as the opportunity cost of having money later versus now (the opportunity cost of capital). For example, the opportunity cost of having one dollar in five years instead of immediately is the lost five years of interest and coverage against inflation a person could get by investing a dollar now for five years. We used 2023 as the base year for present value calculations.

Ecology typically analyzes the impacts of rules for 20 years, which would cover the proposed rule's Cap and Invest Program through 2043. Since the regulatory baseline defines the program through 2050, we chose to extend the timeframe of this analysis to 2050.

2.5.12 Spending of market revenues

Market revenues to Washington have required allocations to specified accounts under the regulatory baseline. These were further informed by the transportation funding bill in the 2022 legislative session[54], which would fund multiple transportation projects using Cap and Invest Program revenues:

- The total $12.8 billion package includes $5.4 billion from the Cap and Invest Program.
- The package would fund multiple transportation infrastructure improvements:
    - $3.1 billion on transit.
    - $3.0 billion on highways.
    - $2.6 billion on culvert replacement.
    - $1.3 billion on electrification of the ferry system.
    - $1.2 billion on infrastructure improvements supporting walking and biking.
    - Free public transit for school-age children.

Market revenues to natural gas utilities, from sale of consigned allowances, are required to be used to offset cost impacts on consumers.

2.5.13 Sensitivity analyses

While we estimated ranges of costs and benefits for the primary scenario consistent with the requirements of the APA, we also investigated the significance of our assumptions, including:

- Impacts of linkage expectations – Appendix B.
- Impacts of complementary policies, including rulemakings currently in progress – Appendix C.

[54] Engrossed Substitute Senate Bill 5689. 2022 Regular Session. https://lawfilesext.leg.wa.gov/biennium/2021-22/Pdf/Bills/Senate%20Passed%20Legislature/5689-S.PL.pdf

- Sensitivity analysis of linkage expectation timing – Appendix D.
- Sensitivity analysis of behavioral assumptions – Appendix E.
- Sensitivity analysis of technology assumptions – Appendix F.
- Alternative macroeconomic modelling assumptions – Appendix G.
- Alternative specifications of APCR frontloading and price controls – Chapter 6.

Chapter 3: Likely Costs of the Proposed Rule

3.1 Introduction

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

3.2 Combined Cap and Invest Program costs

The various requirements in the proposed rule would interact to run the Cap and Invest Program. To estimate the costs resulting from the proposed rule, we estimated the costs of the combined requirements. These include combined costs of:

- Allowance purchases.
- Offsets.
- Emissions reductions.

Recall (see discussion in Chapter 2) that allowance prices account for various transaction costs of being a covered entity under the proposed rule and allowance auction participation.

See Section 2.5 for discussion of our overall analytic structure and assumptions, including underlying estimates of allowance market prices, allowance volumes, and emissions levels.

Table 27: Estimated costs, primary scenario, no offsets

Year	Allowance Purchases (billions of $)	Abatement Costs (billions of $)	Total Costs (billions of $)
2030	**$2.77**	**$0.88**	**$3.65**
2040	**$0.66**	**$0.44**	**$1.10**
2050	**$0.06**	**$0.54**	**$0.60**
Present Value (including interim years) through 2050	**$37.45**	**$11.11**	**$48.56**

We also estimated total costs with maximum allowed use of offset credits.

Table 28: Estimated costs, primary scenario, with offsets

Year	Allowance Purchases (billions of $)	Offset Purchases (billions of $)	Abatement Costs (billions of $)	Total Costs (billions of $)
2030	**$2.50**	**$0.23**	**$0.88**	**$3.61**
2040	**$0.62**	**$0.04**	**$0.44**	**$1.10**
2050	**$0.04**	**$0.02**	**$0.54**	**$0.60**

Year	Allowance Purchases (billions of $)	Offset Purchases (billions of $)	Abatement Costs (billions of $)	Total Costs (billions of $)
Present Value (including interim years) through 2050	**$34.44**	**$2.56**	**$11.11**	**$48.11**

We note that maximum use of offsets reduces average compliance costs, but has only minor impact on costs. We have therefore made the simplifying assumption of no offset use in sensitivity and alternatives analyses, which also conservatively estimates the high end of potential costs for relevant scenarios.

The costs in the tables above are maximum costs for each scenario, since abatement calculations assume a unit cost equivalent to the allowance market price. In reality, covered entities with emissions abatement options available to them at costs below the allowance price would first choose to reduce emissions before using allowances. The inverse holds for entities with high marginal abatement costs, which would inform their greater demand for allowances, which is in turn reflected by higher allowance market prices.

For the CBA, we consider direct costs summarized above, but as this rulemaking potentially has broad impacts across the state economy, we also considered indirect (upstream or downstream) and induced (resulting from relative price changes and substitution across goods and services markets) impacts that could result from changes in economic activity, including impacts to output and jobs. These results help decisionmakers, the public, and other stakeholders to understand the full implications of the proposed rule (see Chapter 7 for modeling discussion and results).

Chapter 4: Likely Benefits of the Proposed Rule

4.1 Introduction

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

4.2 Combined Cap and Invest Program benefits

The various requirements in the proposed rule would interact to run the Cap and Invest Program. To estimate the benefits resulting from the proposed rule, we estimated the benefits of the combined requirements. These include benefits of:

- Reduced GHG emissions, including avoided Social Cost of Carbon (SCC) and other benefits of reduced climate change impacts.
- Revenue from sales of no cost allowances by natural gas utilities.
- Market revenues.
- Revenue from sales of offset credits.
- Environmental justice improvements.
- Ancillary emissions reductions, including reduced or avoided costs of health impacts.

Recall (see discussion in Chapter 2) that allowance prices account for various transaction costs of being a covered entity under the proposed rule and allowance auction participation.

See Section 2.5 for discussion of our overall analytic structure and assumptions, and particularly Section 2.5.10 for underlying estimates of allowance market prices, allowance volumes, and emissions levels.

For the CBA, we consider direct benefits, but as this rulemaking potentially has broad impacts across the state economy, we also considered indirect (upstream or downstream) and induced (resulting from relative price changes and substitution across goods and services markets) impacts that could result from changes in economic activity, including impacts to output and jobs. These results help decisionmakers, the public, and other stakeholders to understand the full implications of the proposed rule (see Chapter 7 for modeling discussion and results).

4.3.1 Benefits of reduced GHG emissions

Table 29: Avoided emissions and social cost

Year	Total Emissions Reduction (millions of MT CO_2e)	Total Avoided Social Cost (billions of $)
2030	**8.75**	**$0.87**
2040	**9.91**	**$1.14**
2050	**6.62**	**$0.86**

Year	Total Emissions Reduction (millions of MT CO_2e)	Total Avoided Social Cost (billions of $)
Present Value (including interim years) through 2050	**n/a**	**$17.27**

Emissions reductions compared to business-as-usual emissions remain the same, regardless of whether compliance obligations are met using allowances or offsets.

Values not included in SCC

While the SCC includes values of economic activity and some health impacts, it is not all-inclusive. Estimates exclude the values of other impacts of climate change, which affect quality of life as well as economic activity. Values not included in SCC estimates include:

- Health:
  - Respiratory illness
  - Lyme disease
  - Death, injuries, and illnesses from omitted natural disaster and migration
  - Water, food, sanitation, shelter
- Agriculture:
  - Weeds, pests, pathogens
  - Food price spikes
  - Heat and precipitation extremes
- Oceans:
  - Acidification, temperature, and extreme weather impacts on fisheries, extinction, reefs
  - Storm surge interaction with sea level rise
- Forests:
  - Pest infestations
  - Pathogens
  - Species invasion and migration
  - Flooding and soil erosion
- Wildfire:
  - Burned acreage
  - Public health
  - Property losses
  - Fire management costs
- Ecosystems:
  - Biodiversity
  - Habitat
  - Species extinction
  - Outdoor recreation and tourism
  - Ecosystem services
  - Rising value of ecosystems due to increased scarcity
  - Accelerated decline due to mass migration

- Productivity and economic growth:
    - Labor productivity and supply, public health
    - Infrastructure impacts from sever events
    - Diversion of resources to climate adaptation
- Water:
    - Availability and competing needs
    - Flooding
- Transportation:
    - Changes to land and ocean transportation
- Energy:
    - Energy supply disruptions
- Catastrophic impacts and tipping points:
    - Rapid sea level rise
    - Methane releases from permafrost
    - Damages at very high temperatures
    - Unknown catastrophic events
- Inter- and intra-regional conflict:
    - National security
    - Increased violent conflicts

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.[55] 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 Washington[56], this would be **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.

[55] United Nations Environment Programme, 2022. Spreading like Wildfire – The Rising Threat of Extraordinary Landscape Fires. A UNEP Rapid Response Assessment. Nairobi.
[56] US Census Bureau, 2022. QuickFacts: Washington. https://www.census.gov/quickfacts/WA

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.[57] A study of the impact of the 2020 Labor Day wildfires in 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.[58] That reflects a **91.3 percent value loss of managed timber lands**. The same study found that private forest owners would 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.[59] That same year they incurred **direct costs of over $12.5 million** responding to wildfire incidents in 2020, and estimated additional damages of:[60]

- **$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.[61] 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,[62] 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**

[57] 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.
[58] Oregon Forest Resources Institute, 2021. Economic Impacts to Oregon's Forest Sector – 2020 Labor Day Fires. September 2021.
[59] 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.
[60] Ibid.
[61] 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
[62] US Environmental Protection Agency, 2022. Mortality Risk Valuation. https://www.epa.gov/environmental-economics/mortality-risk-valuation

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.[63] Particularly in times of overburdened or overwhelmed 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.**[64]

Ongoing drought and the 2021 heat dome also affected harvests:

- At least **30 percent impact to raspberries**: The aggregate Whatcom County raspberry harvest fell 30 to 40 percent, with individual growers experiencing losses between 15 and 75 percent.[65]
- At least **ten percent impact to cherries**: The overall cherry harvest, largely in the Yakima Valley, fell at least 10 percent.[66]
- **$85 million impact to blueberries**: The Washington Blueberry Commission estimated $85 million in yield loss and quality impacts.[67]
- Wheat harvests:
    - A **34-fold increase in the share of "poor" or "very poor" condition spring wheat.**[68]
    - A **6-fold increase in the share of "poor" or "very poor" condition winter wheat**.[69]
- Shellfish harvests:
    - **40 percent losses of seeded oysters.**

[63] Schramm, PJ, A Vaidyanathan, L Radhakrishnan, A Gates, K Harnett, and P Breysse, 2021. Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021. US Centers for Disease Control and Prevention. Weekly 70(90), pp. 1020-2021. July 23, 2021. https://www.cdc.gov/mmwr/volumes/70/wr/mm7029e1.htm

[64] 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.

[65] Bratt, C, 2021. June 'heat dome' cut raspberry volume 30%. Lynden Tribune. December 10, 2021.

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

[67] Ibid.

[68] Ingwersen, J, 2021. 'Wither away and die:' US Pacific Northwest heat wave bakes wheat, fruit crops. Reuters. July 12, 2021.

[69] Ibid.

- A **56 percent increase in vibriosis cases**.[70] 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.[71]
- **5 – 30 percent oyster mortality** in the Salish Sea.[72]
- Higher losses among shellfish species in smaller, sheltered waters, and those that live nearer the surface, such as cockles.[73]

4.3.2 Benefits of revenue from sales of no cost allowances – natural gas utilities

We estimated revenues to natural gas utilities from sale of no cost allowances based on the natural gas share of baseline emissions (11 percent) and percentage of no cost allowances required to be consigned to auction in each year (65 percent in 2023, increasing by 5 percent each year to 100 percent). This scaling factor was applied to total estimated market revenues for the primary market scenario, equal to total spending on allowances (see Section 3.2).[74]

Table 30: No cost allowance auction revenues to natural gas utilities

Year	Revenues, no offset use (billions of $)	Revenues, with offset use (billions of $)
2030	**$0.31**	**$0.28**
2040	**$0.07**	**$0.07**
2050	**$0.01**	**$0.00**
Present Value (including interim years) through 2050	**$3.62**	**$3.32**

4.3.3 Benefits of market revenues

We estimated revenues to Washington from allowance sales based on the assumption that the share of total allowance purchase revenues not going to natural gas utilities would go to the State, in each year.

[70] Hagenbuch, B, 2021. In hot water: Heat dome recovery looks bleak for small-scale shellfish farms. National Fisherman. August 17, 2021.
[71] https://www.cdc.gov/vibrio/faq.html
[72] Royal, T, 2022. Heat dome found to be deadly for some shellfish species, but not for others. Northwest Treaty Tribes. January 10, 2022.
[73] Ibid.
[74] We note that this scaling assumption may overestimate or underestimate natural gas utility revenues in a given year, but total market revenues (allowance price multiplied by allowance volume) would not be affected. Over or underestimated values in natural gas revenues would be offset by under or overestimated values in market revenues.

Table 31: Auction revenues to Washington, no offset use

Year	Revenues, no offset use (billions of $)	Revenues, with offset use (billions of $)
2030	**$2.47**	**$2.23**
2040	**$0.59**	**$0.55**
2050	**$0.05**	**$0.04**
Present Value (including interim years)	**$33.83**	**$31.12**

4.3.4 Benefits of offset revenues

We estimated revenues to sellers of offset credits for the primary scenario, assuming maximum use of offset credits for compliance.

Table 32: Revenues to sellers of offset credits, maximum offset use

Year	Revenues, no offset use (billions of $)
2030	**$0.23**
2040	**$0.04**
2050	**$0.02**
Present Value (including interim years) through 2050	**$2.56**

4.3.5 Environmental justice improvements

Wildfires and air quality

As noted in Section 4.3.1, **wildfires accounted for 25 – 50 percent of fine particulate matter** in the US in recent years, with **higher levels in the western states**,[75] and are expected to increase in frequency and severity. Even when wildfire smoke is ubiquitous, it impacts overburdened communities more severely, as they may not have good access to air filtration or non-emergency healthcare, and may need to spend more time outside during high heat events that often coincide, since they may have limited access to air conditioning and other cooling options. They are also more likely to reside in areas that absorb more heat and retain it longer, due to reduced greenspace and tree canopy, proximity to industrial activity, and more paved area.[76]

Heat-related mortality

[75] Burke, M, A Driscoll, S Heft-Neal, J Xue, J Burney, and M Wara, 2020. The changing risk and burden of wildfire in the United States. PNAS 118(2). https://doi.org/10.1073/pnas.2011048118

[76] King County, 2021. Results of heat mapping project show inequitable impact of hotter summers. https://kingcounty.gov/elected/executive/constantine/news/release/2021/June/23-heat-mapping-results.aspx. Results: https://www.arcgis.com/apps/webappviewer/index.html?id=84709c65c08a40bbb47d0723ef1c797a&extent=-13604644.7965%2C6019787.1095%2C-13561266.7829%2C6046616.5065%2C102100

The **heat-related death risk also disproportionately affects overburdened communities.** A study in British Columbia found that heat deaths in the greater Vancouver area were **strongly tied to individuals' "material and social deprivation" as well as age, sex, and neighborhood greenness**,[77] meaning that deaths were more likely to occur in populations that:

- Had lower income.
- Had less shade and more impervious or paved surfaces.
- Were unsheltered or had inadequate housing.
- Had less education.
- Lived alone.
- Were elderly.
- Lacked transportation.
- Lacked recreational spaces.
- Experienced more job or income insecurity.

In short, heat deaths are more likely to occur among overburdened communities whose historically lower resource access puts them more at risk of being in one or more of the categories above. And particularly during a time of high numbers of people living unsheltered or without consistent shelter, climate change is poised to harm or kill the most vulnerable among us.

Other pollutants

Overburdened communities tend to be located in areas that expose them to higher historic or current pollutants. Whether in their homes, outdoors, at school, or at work, overburdened populations are more likely to interact with air emissions from vehicles or heavy-duty vehicles, contaminated nonpotable and even potable waters, or soils and shorelines contaminated by historical activities or land uses. This means if covered parties reduce or offset GHG emissions in ways that also reduce other emissions (note that this is part of the regulatory baseline and proposed rule's definition of providing direct benefits to the state), the proposed rule would provide additional benefits to those populations.

Changes in transportation fuels and infrastructure would also particularly benefit overburdened populations. The Washington State Department of Transportation notes:[78]

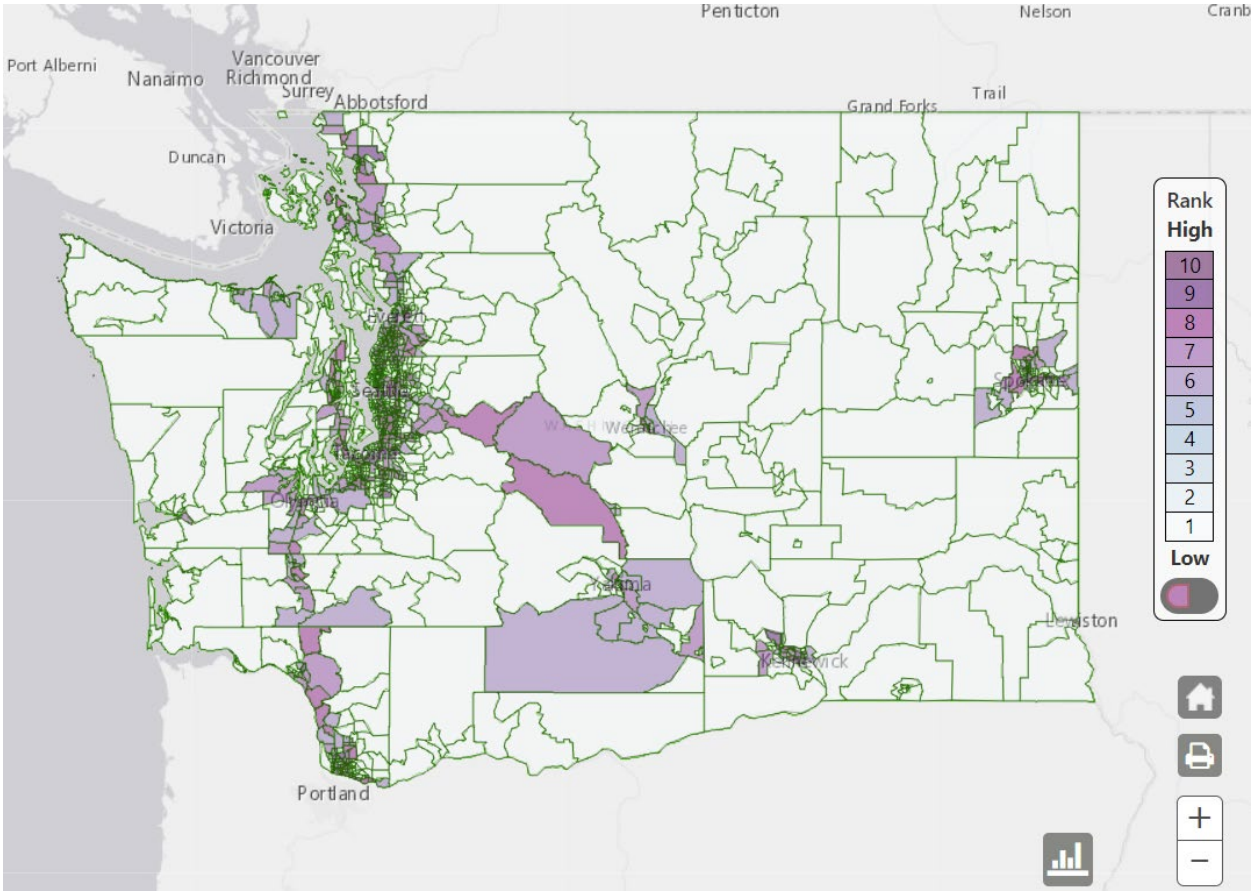
- In Washington about 1 in 7 (900,000) people live within 1/4 mile of heavy traffic roadways. These people breathe more air pollution from diesel and gasoline exhaust.

[77] Henderson, SB, KE McLean, MJ Lee, and T Kosatsky, 2022. Analysis of community deaths during the catastrophic 2021 heat dome. Environmental Epidemiology (2022) 6:e189. DOI: 10.1097/EE9.0000000000000189.
[78] WA Department of Health, 2022. Traffic Air Pollution Data. https://doh.wa.gov/data-statistical-reports/washington-tracking-network-wtn/traffic-air-pollution

- People with an underlying health condition like asthma or heart disease, may be especially sensitive to traffic-related air pollution, as are children and adults age 65 and older.
- Traffic air pollution is linked to adverse birth outcomes such as low birth weight and premature births.

The Washington State Department of Health Environmental Health Disparities map[79] identifies areas across the state that live near highways. Many of them are in urban areas around Puget Sound, but others are along interstate or state highways to the south and east.

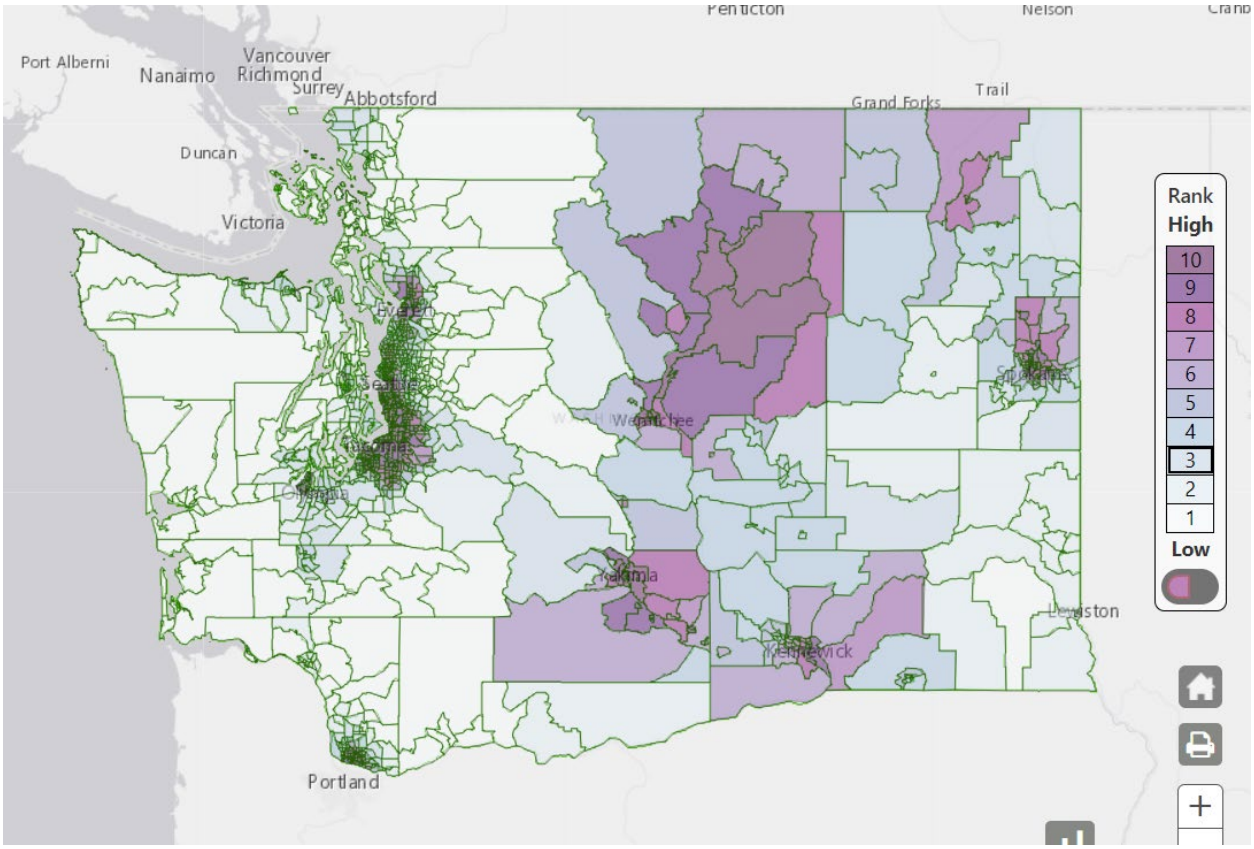
Figure 5: Populations living near high-traffic roadways



[79] WA Department of Health, 2022a. Washington Tracking Network, Environmental Health Disparities Map. https://fortress.wa.gov/doh/wtnibl/WTNIBL/

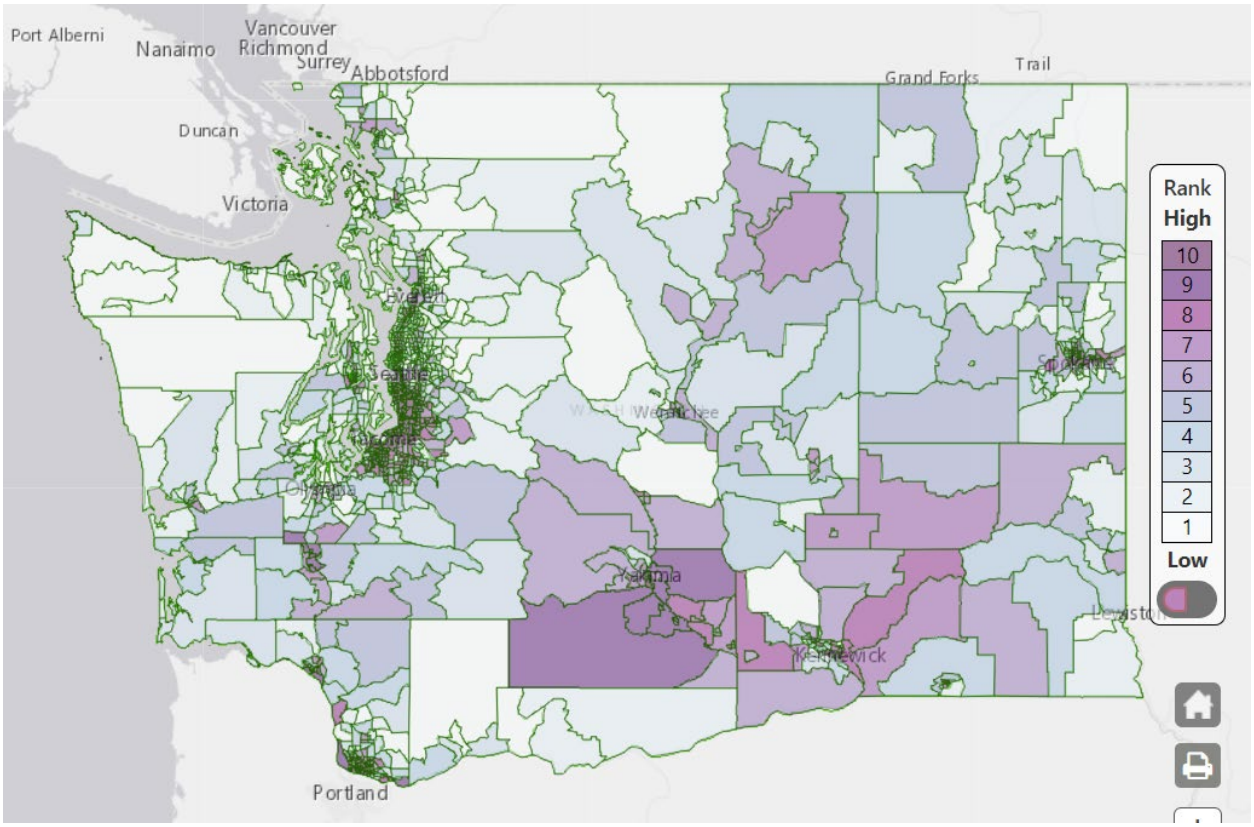
These populations overlap in many ways with areas that experience high levels of fine particulate matter. Other areas that see high particulate matter are those impacted regularly by wildfires.

Figure 6: Populations with high exposure to fine particulate matter



There are many measures of environmental health disparities, and the Health Disparities Map combines them into an overall ranking for each census tract in the state. We note that Health Disparities rankings overlap significantly with areas near roadways and/or with high fine particulate matter.

Figure 7: Environmental Health Disparities rankings



4.3.5 Benefits of ancillary emissions reductions

As we discuss in Section 2.5.2.15, the US EPA has used various values to reflect the damages caused by a metric ton of particulate matter, volatile organic compounds, and nitrogen oxides. Similar to our uncertainty about how often the proposed rule would result in reduced emissions of these pollutants, we cannot be certain about the relationship between their emissions and GHG emissions. This relationship would vary by technology, fuels, and processes. But we can connect some of the values available to us[80], to illustrate how important reductions in these

[80] ICF International (2014). California's Low Carbon Fuel Standard: Compliance Outlook & Economic Impacts. In turn, this cites specifically:

- US Environmental Protection Agency (2010). Diesel Emissions Quantifier Health Benefits Methodology, EPA, EPA-420-B-10-034, August 2010.
- US Environmental Protection Agency and National Highway Traffic Safety Administration (2011). Draft Joint Technical Support Document: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse

pollutants would be. And these damages would be more likely to occur in overburdened communities, so reducing them would generate benefits more focused in those communities.

Table 33: Value of damages from select criteria pollutants as reported in EPA rulemakings

Criteria Pollutant	Damages per MT in Current Dollars	Equivalent Mortality Risk (based on VSL)
$PM_{2.5}$	**$1.74 – 1.92 million**	**16 – 18 percent or 1 in 6**
Volatile Organic Compounds (VOCs)	**$1,347 - 1,468**	**0.01 percent or 1 in 10,000**
Nitrogen Oxides (NOx)	**$5,624 – 6,111**	**0.005 percent or 1 in 2,000**

Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-D-11-901, November 2011.

Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Summary of costs and benefits of the proposed rule

5.1.1 Costs

We estimated annual and total present value costs of allowance purchases, emissions abatement, and offset credit purchases in Chapter 3. Here, we summarize total present value costs with and without offset use.

Table 34: Total present value costs

Cost Category	Present Value through 2050, no offset use (billions of $)	Present Value through 2050, maximum offset use (billions of $)
Allowance purchases	**$37.45**	**$34.44**
Offset credit purchases	**$0.00**	**$2.56**
Emissions abatement	**$11.11**	**$11.11**
Total	**$48.56**	**$48.11**

5.1.2 Benefits

5.1.2.1 Quantifiable benefits

We estimated annual and total present value benefits of emissions reductions, natural gas revenues, market revenues to the State, and sales of offset credits in Chapter 4. Here we summarize total quantifiable present value benefits, with and without offset use. Quantifiable benefits should be considered in conjunction with benefits discussed qualitatively or partially quantified, in Section 2.5.2.2.

Table 35: Total present value benefits

Cost Category	Present Value through 2050, no offset use (billions of $)	Present Value through 2050, maximum offset use (billions of $)
Revenues to Washington	**$33.83**	**$31.12**
Revenues to natural gas utilities	**$3.62**	**$3.32**
Avoided Social Cost of Carbon	**$17.27**	**$17.27**
Revenues to sellers of offset credits	**$0.00**	**$2.56**
Total	**$54.72**	**$54.27**

5.1.2.2 Qualitative and partially quantifiable benefits

Costs resulting from climate change not fully reflected in the SCC

Additional avoided impacts of climate change not included in the SCC:

- Health:
  - Respiratory illness
  - Lyme disease
  - Death, injuries, and illnesses from omitted natural disaster and migration
  - Water, food, sanitation, shelter
- Agriculture:
  - Weeds, pests, pathogens
  - Food price spikes
  - Heat and precipitation extremes
- Oceans:
  - Acidification, temperature, and extreme weather impacts on fisheries, extinction, reefs
  - Storm surge interaction with sea level rise
- Forests:
  - Pest infestations
  - Pathogens
  - Species invasion and migration
  - Flooding and soil erosion
- Wildfire:
  - Burned acreage
  - Public health
  - Property losses
  - Fire management costs
- Ecosystems:
  - Biodiversity
  - Habitat
  - Species extinction
  - Outdoor recreation and tourism
  - Ecosystem services
  - Rising value of ecosystems due to increased scarcity
  - Accelerated decline due to mass migration
- Productivity and economic growth:
  - Labor productivity and supply, public health
  - Infrastructure impacts from sever events
  - Diversion of resources to climate adaptation
- Water:
  - Availability and competing needs
  - Flooding
- Transportation:
  - Changes to land and ocean transportation

- Energy:
    - Energy supply disruptions
- Catastrophic impacts and tipping points:
    - Rapid sea level rise
    - Methane releases from permafrost
    - Damages at very high temperatures
    - Unknown catastrophic events
- Inter- and intra-regional conflict:
    - National security
    - Increased violent conflicts

Wildfires

- Based on a national average of comprehensive wildfire impacts, **wildfires cost Washingtonians at least $1.6 to $8 billion each year.**
- In 2020, Washington spent an estimated **$20 million on aviation readiness and support** for large fires.
- The WA Department of Natural Resources incurred **direct costs of over $12.5 million** responding to wildfire incidents in 2020, and estimated additional damages of:
    - **$20 million** to utilities.
    - **$15 million** to state agency infrastructure.
    - **$10 million** to other government infrastructure.
- During a severe wildfire season, which are forecast to increase due to climate change, **burned managed (working) forests can lose over 90 percent of the value of their timber,** even when salvage harvest is accounted for.
- Wildfires also cause **hazardous air quality** in broad regions, impacting rural as well as densely populated areas.

Heat impacts

- The 2021 heat dome event in the Pacific Northwest resulted in **at least $1.45 billion in lost lives.**
- **Extreme heat events are forecast to increase due to climate change,** corresponding to wildfire events as well.
- Even when extreme heat events do not result in death, they significantly increase burden on healthcare services. During the 2021 heat dome event, the **number of people needing emergency room services increased 70-fold.** Healthcare visits related to a high heat event **costs $12,544 per visit** on average.

Ongoing drought and the 2021 heat dome also affected harvests:

- At least **30 percent impact to raspberries**: The aggregate Whatcom County raspberry harvest fell 30 to 40 percent, with individual growers experiencing losses between 15 and 75 percent.[81]
- At least **ten percent impact to cherries**: The overall cherry harvest, largely in the Yakima Valley, fell at least 10 percent.[82]
- **$85 million impact to blueberries**: The Washington Blueberry Commission estimated $85 million in yield loss and quality impacts.[83]
- Wheat harvests:
    - A **34-fold increase in the share of "poor" or "very poor" condition spring wheat**.[84]
    - A **6-fold increase in the share of "poor" or "very poor" condition winter wheat**.[85]
- Shellfish harvests:
    - **40 percent losses of seeded oysters**.
    - A **56 percent increase in vibriosis cases**.[86] 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.[87]
    - **5 – 30 percent oyster mortality** in the Salish Sea.[88]
    - Higher losses among shellfish species in smaller, sheltered waters, and those that live nearer the surface, such as cockles.[89]

Environmental justice improvements

Wildfires account for *at least* 25 to 50 percent of fine particulate matter in Washington, compounding health and quality of life impacts for overburdened populations that are more likely to live or work outdoors near high-traffic roadways and/or in wildfire smoke prone areas.

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[81] Bratt, C, 2021. June 'heat dome' cut raspberry volume 30%. Lynden Tribune. December 10, 2021.
[82] Zhou, A, 2021. Western lawmakers seek more federal aid for farmers, ranchers hurt by extreme heat, drought. Seattle Times. July 27, 2021.
[83] Ibid.
[84] Ingwersen, J, 2021. 'Wither away and die:' US Pacific Northwest heat wave bakes wheat, fruit crops. Reuters. July 12, 2021.
[85] Ibid.
[86] Hagenbuch, B, 2021. In hot water: Heat dome recovery looks bleak for small-scale shellfish farms. National Fisherman. August 17, 2021.
[87] https://www.cdc.gov/vibrio/faq.html
[88] Royal, T, 2022. Heat dome found to be deadly for some shellfish species, but not for others. Northwest Treaty Tribes. January 10, 2022.
[89] Ibid.

Heat-related mortality is more likely to affect people who:

- Have lower income.
- Have less shade and more impervious or paved surfaces.
- Are unsheltered or had inadequate housing.
- Have less education.
- Live alone.
- Are elderly.
- Lack transportation.
- Lack recreational spaces.
- Experience more job or income insecurity.

Other pollutants

Table 36: Value of damages from select criteria pollutants as reported in EPA rulemakings[90]

Criteria Pollutant	Damages per MT in Current Dollars	Equivalent Mortality Risk (based on VSL)
$PM_{2.5}$	**$1.74 – 1.92 million**	**16 – 18 percent or 1 in 6**
Volatile Organic Compounds (VOCs)	**$1,347 - 1,468**	**0.01 percent or 1 in 10,000**
Nitrogen Oxides (NOx)	**$5,624 – 6,111**	**0.005 percent or 1 in 2,000**

5.2 Conclusion

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

[90] ICF International (2014). California's Low Carbon Fuel Standard: Compliance Outlook & Economic Impacts. In turn, this cites specifically:

- US Environmental Protection Agency (2010). Diesel Emissions Quantifier Health Benefits Methodology, EPA, EPA-420-B-10-034, August 2010.
- US Environmental Protection Agency and National Highway Traffic Safety Administration (2011). Draft Joint Technical Support Document: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-D-11-901, November 2011.

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 alternatives for proposed rule content, and determined whether they 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 proposed rule 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.65 RCW, Greenhouse Gas Emissions – Cap and Invest Program. Its goals and objectives are:

- Implementing a cap on greenhouse gas emissions from covered entities and a program to track, verify, and enforce compliance with the cap through the use of compliance instruments.
- Restoring the health of our forests and investing in wildfire prevention and preparedness.

- Positioning Washington’s economy, technology centers, financial institutions, and manufacturers to benefit from national and international efforts that must occur to reduce greenhouse gases.
- Creating climate policy that minimizes leakage by recognizing the special nature of emissions-intensive, trade-exposed industries and increased life-cycle emissions associated with product imports.
- Encouraging energy-intensive and trade-exposed industries to continue to innovate, find new ways to be more energy efficient, use lower carbon products, and be positioned to be global leaders in a low carbon economy.
- Establishing a coordinated and strategic statewide approach to climate resilience.
- Building an equitable and inclusive clean energy economy.
- Identifying overburdened communities where the highest concentrations of criteria pollutants occur, determining the sources of those emissions and pollutants, and pursuing significant reductions of emissions and pollutants in those communities.
- Preventing job loss and providing protective measures if workers are adversely impacted by the transition to a clean energy economy through transition and assistance programs, worker-support projects, and workforce development and other activities designed to grow and expand the clean manufacturing sector in communities across Washington.
- Establishing this program in a manner that contributes to a healthy environment for all of Washington's communities.
- Considering opportunities to implement the program in a manner that allows linking the state's program with those of other jurisdictions.

In 2020, the legislature updated the state's GHG emissions limits that are to be achieved by 2030, 2040, and 2050, based on current science and emissions trends, to support local and global efforts to avoid the most significant impacts from climate change. Achieving the GHG emissions reductions required by these limits will require coordinated, comprehensive, and multisectoral implementation of policies, programs, and laws, as other enacted policies are insufficient to meet the limits. Chapter 70A.65 includes a goal of ensuring that the government provides clear policy and requirements, financial tools, and other mechanisms to support achieving the GHG emissions limits.

6.3 Measures to reduce burden

Chapter 70A.65 RCW provides a detailed framework for the cap and invest program, which in some cases limits Ecology’s discretion in developing certain elements of the proposed rule. However, to the extent Ecology does have discretion to choose between alternatives in the rulemaking, Ecology took steps to minimize the burden on the regulated community. We included the following elements in the proposed rule to minimize burden.

- The proposed rule includes provisions similar to those in the existing California-Quebec cap-and-trade program. The similarity of these provisions will facilitate linkage with the California-Quebec program in the future, and will also make it simpler and reduce transaction costs for parties that already participate in the California-Quebec program by providing them with requirements they are already familiar with and have been working with for years. For example, Ecology is adopting the same compliance deadline (November 1, at 5 pm) as California and Quebec, as well as similar holding limits, corporate association disclosures, and auction process, just to name a few. This not only supports the statutory objective of implementing the program in a manner that allows for linkage, but supports reduced burden that can result from linkage (RCW 70A.65.210):
    - Mutual use and recognition of compliance instruments.
    - Broader GHG emission reduction opportunities, reducing compliance costs.
    - Broader offset project opportunities, reducing compliance costs.
    - Reduced compliance effort and administrative costs, including joint allowance auctions and a unified tracking system.
    - Enhanced market security.
    - Consistent requirements for covered entities whose operations span jurisdictional boundaries.
- This rule provides that covered entities that are already registered in Ecology's GHG reporting program are automatically registered in the cap and invest program, thus bypassing the need for them to register again and eliminating the associated transaction costs of registration.
- Ecology adjusted the dates for allocating no cost allowances to EITE facilities such that they get current vintage allowances (rather than future vintage allowances) except for the minimal number of allowances required to reconcile their allowance allocation with their actual production. This allows EITE facilities more flexibility based on their needs, for immediate use of no cost allowances for compliance, if necessary, rather than needing to purchase current vintage allowances or otherwise reduce emissions.
- Ecology is putting five percent of the annual allowance budgets for 2023 through 2030 in the Allowance Price Containment Reserve immediately instead of the minimum of two percent per year required by statute. Ecology is making the allowances in the APCR vintageless, which makes them eligible for use for compliance at any time. This will greatly increase the number of allowances available for auction from the APCR in the early years and have a moderating effect on allowance prices. It will also make more allowances available at the lower APCR prices, meaning parties would have less need to purchase price ceiling units at a higher price.
- Ecology will be holding an APCR auction each year after the 3rd quarter regular auction and before the November 1 compliance deadline, to enable covered and opt-in entities

to purchase allowances from the APCR before resorting to the purchase of price ceiling units at the higher price ceiling price.

- Ecology decided to exclude allowances needed to meet a current compliance obligation from the holding limit requirements. This approach gives registered entities more flexibility by allowing them to hold larger numbers of compliance instruments at any one time.
- Ecology is maximizing the number of allowances available for purchase at auction by including a mechanism for allowances that do not sell in a given auction to remain available for purchase at subsequent auctions for two years before being placed in the Emissions Containment Reserve.
- Ecology is exercising the option to suspend the emissions containment trigger price, which will have a moderating effect on allowance prices.

6.4 Alternatives considered and why they were excluded

We considered the following alternatives for rule content during the rule development process, and did not include those elements in the proposed rule for the reasons discussed in each subsection below.

- Setting different price controls.
- Establishing a different total allowance budget trajectory.
- Adopting additional offset protocols for additional offset project categories.
- Allowing separate bid guarantees for parallel auctions.
- Requiring covered entities to affirmatively register for the program.
- Requiring all of the no cost allowances provided to EITE facilities to be from future vintage years.
- Putting a lower amount of the annual allowance budget into the APCR. (The minimum required under the regulatory baseline is 2 percent.)
- Not including an annual APCR auction.
- Applying the holding limits to all allowances in a compliance account.
- Putting allowances not sold at a single auction directly into the ECR.
- Implementing the ECR trigger price.

6.4.1 Price controls

We considered multiple options for price controls (floor, ceiling, APCR tier prices), in conjunction with price trajectory modeling[91] results under various assumptions. Price trajectory modeling results indicated that in early compliance periods, the declining program budget and attributes of GHG emissions abatement options available and appropriate for Washington covered entities, would result in significant upward pressure on prices in the first two compliance periods. Modeling also indicated that high confidence in approaching linkage with another jurisdiction would alleviate a significant portion of that upward pressure, lowering prices and resulting compliance costs. We therefore chose Cap and Invest program attributes in line with California allowance market price controls, to increase the likelihood and confidence that linkage could be achieved early. Alternative sets of price controls, while potentially allowing for wider or narrower variation in prices, would not have met the statutory goal of program design that facilitates linkage with other jurisdictions. This, in turn, would have foregone the opportunity for lower allowance market prices than those used in this analysis.

6.4.2 Program budget trajectory

We considered an alternative trajectory and path for reductions in the total allowance budget over time. The trajectory of the allowance budget needed to be designed to achieve statutory emissions reductions by the applicable deadlines while achieving the goals and objectives of the statute in an efficient way that does not create unnecessary burden and is aligned with GHG emissions regulations and market structures in potential future linked jurisdictions.

The proposed percentage reductions in different compliance periods reflect what Ecology believes are likely achievable emissions reductions, accounting for relatively straightforward abatement options and offset projects available in the short run, and the need for technology and efficiencies to develop in the medium run. In the long run, the percentage reductions strike a balance between the need to provide flexibility in achieving the most difficult final emissions reductions, and the potential for significant technological and infrastructural advancement that will allow for a higher reduction rate that is not as high as in initial compliance periods.

The regulatory baseline sets required emissions reduction goals and timeframes, leaving Ecology no discretion in setting a less aggressive *overall* budget trajectory that would not achieve those goals. In addition, RCW 70A.65.070(2) requires Ecology to "adopt annual allowance budgets for the program on a calendar year basis that provide for progressively equivalent reductions year over year." This left Ecology with options in the timing and size of reductions in the total allowance budget within each decade:

- **Higher early reductions and low later reductions, meeting the stepwise 2030, 2040, and 2050 emissions goals.** A budget trajectory that would require very high initial reductions in GHG emissions in each decade would contribute to gaining environmental

[91] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

and human health benefits earlier, but would impose more burden on covered and opt-in entities by creating higher demand for emissions reductions before markets and technology have time to adapt. This would drive up short-run allowance prices – potentially to APCR or ceiling prices depending on the cost of available short-run emissions abatement options or offsets – resulting in inefficiencies in the market and a higher overall cost of achieving statutory GHG emissions goals.

- **Lower early reductions and high later reductions, meeting stepwise 2030, 2040, and 2050 emissions goals.** A budget trajectory that would require low emissions reductions early in each decade, followed by very high reductions toward the end of the decade, would delay gaining environmental and human health benefits as well as delaying compliance costs for covered and opt-in entities. While this would seemingly reduce the present value of compliance burden by delaying costs, overall lower costs might not manifest due to risks of:
    - Reduced supply of emissions reduction options in later years due to:
        - Less market incentive for technologies to develop over time in Washington.
        - Insufficient quantity of affordable emissions reduction options to meet a sudden surge in demand.
    - Allowance prices rising to very high levels – potentially to APCR or ceiling prices – in later years of each decade:
        - Outweighing cost-savings of delaying compliance costs.
        - Risking market inefficiency or failure undermining the state's ability to meet statutory emissions reduction goals in 2030, 2040, and/or 2050.

6.4.4 Additional offset project categories

The proposed rule's offset provisions are modeled after California's offset rules and protocols as a way to facilitate and accelerate the use of offset credits in our program design from the beginning of the program, while providing the needed time to develop an offset system that is more customized to Washington's unique needs. However, there are two California offset protocols that Ecology decided not to adopt by reference in the proposed rule. Because the CCA requires that offset projects provide direct environmental benefits to the state, we determined that incorporating the Rice Cultivation and Mine Methane Capture offset protocols was not necessary in to meet the goals and objectives of the authorizing statutes, as these project types are not likely to meet the requirement of providing direct environmental benefits to Washington. (These types of offset projects are highly unlikely to be located here, based on current agricultural and mining resources.)

A number of other offset protocols or offset project categories were also suggested during rule development, however, none of these other protocols were found to be appropriate for immediate adoption in Washington. Offset protocols must meet the minimum criteria established in Chapter 70A.65 RCW. However, the proposed rule does not preclude the future

adoption of additional offset protocols for other project categories, and Ecology will actively consider such future adoption as protocols develop and improve over time to meet statutory standards.

6.4.5 Separate bid guarantees for parallel auctions

Ecology initially considered requiring separate bid guarantees for parallel auctions of future vintage allowances and quarterly auctions of current-past vintage allowances. This would have imposed additional burden on allowance market participants. Instead, the proposed rule requires just one bid guarantee to cover both auctions, making it simpler and reducing transaction costs for parties participating in these auctions.

6.4.6 Registration of covered entities

Ecology initially considered following other jurisdictions in requiring covered entities to affirmatively register into the CCA program even though they are already registered into Ecology's GHG reporting program. Instead, the proposed rule makes it simpler and reduces transaction costs for covered entities by automatically registering them for the CCA program.

6.4.7 Future vintage allowances for EITE facilities

Ecology initially considered basing the initial allocation of no-cost allowances to EITE facilities on each facility's previous year's production. This approach has the advantage of using more recent production data, but has the disadvantage that the previous year's production data will not be known and verified until late in the year following the facilities' emissions. Under this scenario, the initial no cost allowances allocated to EITE facilities would have to be from vintage years later than the year in which the emissions occurred, and would not be eligible under the statute to meet compliance obligations for that vintage year. Ecology modified its initial approach, such that under the proposed rule, the initial allocation of no cost allowances that would occur in January (or February the first year) would be based on production data from two years prior, and would be of allowances from the current vintage year and thus eligible to be used for the current year's compliance obligation. Under the proposed rule, only the allowances provided in October of each year to reconcile a facility's initial allocation with the facility's actual production would be future vintage allowances.

6.4.8 Number of allowances to the APCR

Price ceiling units sell for a higher price than APCR allowances. Price ceiling units are sold only after the APCR has been exhausted. Ecology initially considered placing into the APCR only the minimum two percent of the annual allowance budget required by statute. Instead, the proposed rule requires Ecology to place five percent of the annual allowance budget into the APCR. Increasing the number of allowances placed into the APCR will make more allowances available at the lower APCR prices, meaning parties would have less need to purchase price ceiling units at a higher price.

The proposed rule also places all of the allowances that are to go into the APCR between 2023 and 2030 into the APCR in 2023, and makes those allowances vintageless. This greatly increases the number of allowances available for auction from the APCR, and makes all those allowances eligible for use for compliance starting in 2023. These measures will help moderate allowance prices. We also considered other percentages of allowances to place into the APCR. Lower percentages would result in fewer allowances available at the lower APCR prices if settlement prices begin to approach the ceiling price. Higher percentages could drive up prices and increase burden regardless of the scenario, by reducing allowance supply.

APCR allowances are also designed to return to the allowance market pool. In years that the APCR is not triggered, allowances become available, and placing more than the statutory minimum of the annual allowance budget required by statute into the APCR does not impose additional burden on covered entities.

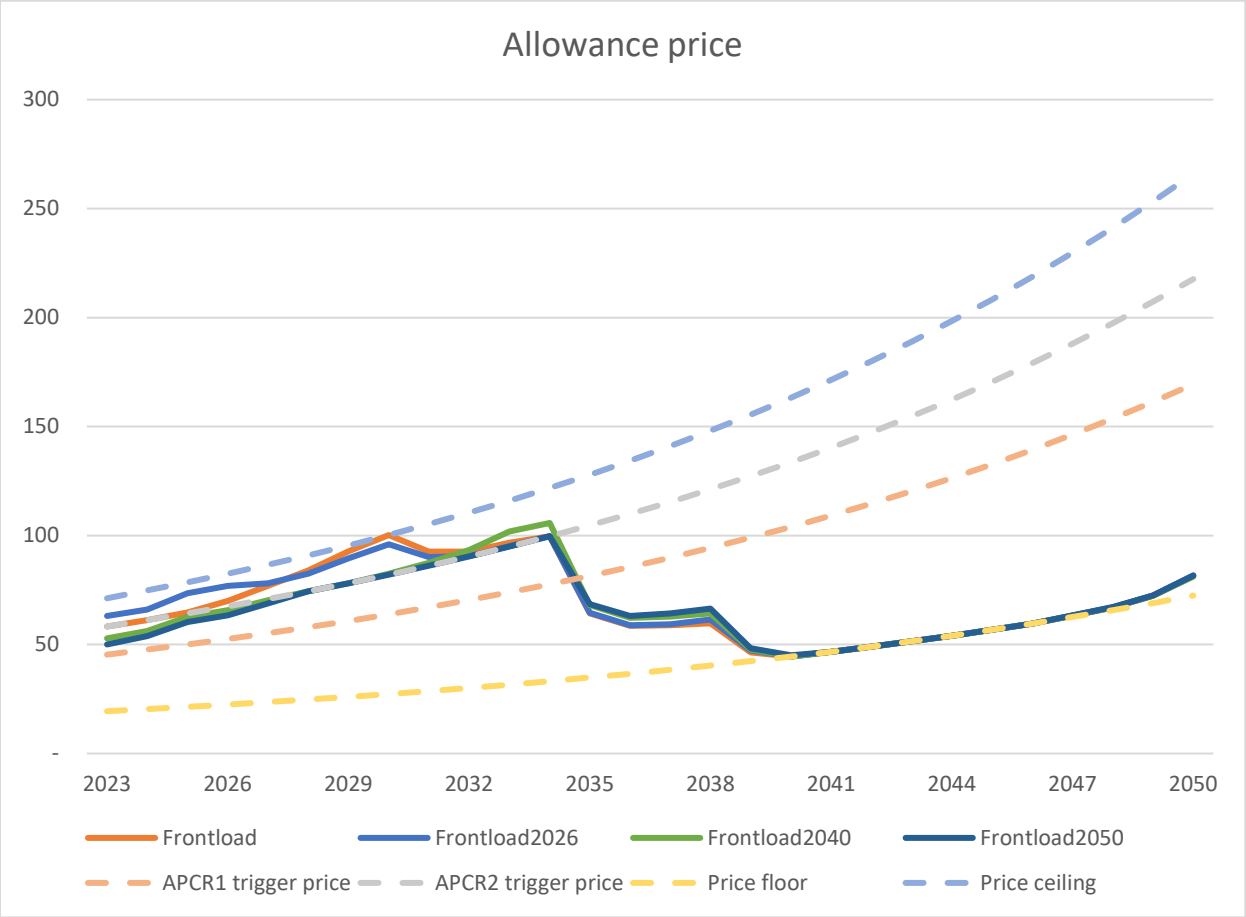
6.4.9 Vintage and vintageless APCR allowances

Modeling performed by Vivid Economics[92] indicated that in early compliance periods, the declining program budget and attributes of GHG emissions abatement options available and appropriate for Washington covered entities, would result in significant upward pressure on prices in the first to compliance periods. To mitigate this pressure, the proposed rule brings vintageless APCR allowances forward from years through 2030, increasing short-run allowance supply while maintaining a total allowance budget trajectory that meets statutory emissions goals. This element of the design of the Cap and Invest program is also consistent with California's current approach, facilitating potential future linkage with other jurisdictions, as well as creating consistent structures across jurisdictions for entities covered by multiple jurisdictions.

We also considered other frontloading periods for vintageless APCR allowances – through 2026 (the end of the first compliance period), 2040, and 2050. As illustrated in the graph below, frontloading APCR allowances through 2026 would put upward pressure on allowance prices in early years, while frontloading beyond 2030 would put downward pressure on prices.

[92] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Figure 8: Modeled price trajectories under alternative frontloading scenarios



Frontloading beyond 2030, however, would also change emissions trajectories, increasing total emissions in each year through the 2040s. This would not have met the goals of the authorizing statute, particularly jeopardizing meeting the 2030 emissions cap.

6.4.9 Annual APCR auction

Ecology initially considered holding APCR auctions only when new covered or opt-in entities enter the program and when the settlement price at a quarterly auction of current vintage allowances approaches the ceiling price, which is the minimum statutory requirement. Instead, the proposed rule requires Ecology to offer an APCR auction once a year immediately preceding each compliance deadline. Making APCR allowances available for purchase at auction at this time provides an opportunity for covered and opt in entities that have not acquired sufficient compliance instruments to cover their compliance obligations to acquire allowances from an APCR auction before the compliance deadline. Since price ceiling units are sold only after the APCR has been exhausted, the annual APCR auction provides a means of exhausting the APCR to make price ceiling units available. Holding less frequent APCR auctions would not provide this benefit in all years. Holding more frequent APCR auctions would not be necessary to meet the goals of an efficient market facilitating compliance with statutory GHG emissions limits,

since covered and opt-in entities would not necessarily need or want to buy allowances at APCR prices while they had potential access to lower market prices.

6.4.10 Exception to holding limit

Ecology initially considered applying the holding limit to all allowances in a registered entity's holding account and compliance account. Instead, the proposed rule exempts from the holding limit those compliance instruments that are needed for compliance with the next compliance deadline. This approach gives registered entities more flexibility by allowing them to hold larger numbers of compliance instruments at any one time.

6.4.11 Providing allowances for re-auction

Ecology initially considered placing all allowances that have not been sold after one auction directly into the ECR. This would limit the number of allowances available at subsequent auctions, thus likely pushing prices higher. Instead, Ecology is proposing to follow California's lead and make allowances that have not been sold after one auction available for purchase at subsequent auctions over the following two years. If after two years of auctions the allowances remain unsold, they will be placed in the ECR. This increases the number of allowances available at auction, which should have a dampening effect on allowance prices.

6.4.12 Suspending the ECR trigger price

As authorized in E2SSB 5842, Ecology has determined to suspend the ECR trigger price. The ECR trigger price is designed to raise auction prices; suspending the ECR trigger price will therefore help keep auction prices down.

6.5 Conclusion

After considering alternatives to the proposed rule's contents, within the context of the goals and objectives of the authorizing statute, we determined that the proposed rule represents the least-burdensome alternative of possible rule contents meeting the statutory 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 proposed rule. 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 proposed 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 regulatory baseline (the regulatory environment in the absence of the proposed rule, 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 Choice to develop Small Business Economic Impact Statement

The analyses required under the RFA, and their inclusion in a Small Business Economic Impact Statement, are based on whether the proposed rule would impose compliance costs on small businesses. A rule is otherwise exempt from these analyses under RCW 19.85.025(4).

Based on available information, we did not identify any small businesses that would be covered entities and therefore required to comply with the proposed rule. The average business that is likely to be a covered entity under the proposed rule employs 19,273 people. However, we do not have full information concerning all potential covered entities. For example, about half of the 50-60 expected electric power entities that would potentially start reporting under recent amendments to the GHG reporting rule[93] (Chapter 173-441 WAC), would also be covered entities. Based on the size of other covered entities, we do not expect these electric power entities to be small businesses.

While it may be reasonable to assume that electric power entities are all large businesses, we cannot be certain of all their attributes. This is particularly true for EPEs for which we have uncertainty about emissions levels. Due to uncertainty about the employment attributes of

[93] WA Department of Ecology, 2022. Rulemaking for Chapter 173-441 WAC. Administrative Order #21-07.

electric power entities, we chose to complete a Small Business Economic Impact Statement and complete work required under the RFA, to fully understand potential disproportion in the impacts of the proposed rule.

As the RFA requires analyses specifically related to employment impacts and price or output impacts (as they play into revenue and profits), we also determined this analysis would be the most appropriate space to discuss macroeconomic modeling we performed to fully understand the potential impacts of the proposed rule.

7.3 Analysis of relative compliance cost burden

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

Since there is uncertainty in the employment levels of potential small business electric power entities, we chose to examine the full range of 1 – 50 employees that defines a small business in the RFA.

Table 37: Average annual present value compliance costs per employee, through 2050

Type of cost (or total cost)	Low	High
Average small business employment	**1**	**50**
Average employment at largest ten percent of businesses	**127,498**	**127,498**
Small business cost per employee	**$266,802**	**$13,216,164**
Largest business cost per employee	**$105**	**$104**

We conclude that, **if the proposed rule does impose compliance costs on small businesses, it may disproportionately affect them**. Therefore Ecology must include elements in the proposed rule to mitigate the potential for this disproportion, as far as is legal and feasible.

7.4 Loss of sales or revenue

Businesses that would incur costs under the Cap and Invest Program could experience reduced sales or revenues if the proposed rule significantly affects 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 proposed rule 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 and population variables over time.

REMI model inputs

We used the compliance costs estimated in Chapter 3 as inputs to the REMI model, assigning costs proportionately to each sector's share of GHG emissions, less allocated no cost allowances. Proportions were based on the first year all sectors would be covered (2027, the beginning of the second compliance period).

We used the quantifiable benefits estimated in Chapter 4 as inputs as well, reflecting where the costs from Chapter 3 were spent. Compliance costs were modeled as production costs. Because avoided SCC is not a result of spending, we reflected this benefit as an input to amenity value in the REMI model. Amenity value reflects the perceived benefits of living in a region, which in turn attracts high-value labor migration into the state. Amenity value in the REMI model can be thought of as a *perceived* increase in real income, which then affects population and demographics, labor force, market demand, and prices. We examined results that did or did not include the amenity value impact.

All cost and benefit inputs were year-specific, and assumed to be real values (growing in line with inflation). As use of offset credits to meet compliance obligations did not significantly affect cost or benefits estimates, we made the simplifying assumption that no offset credits were used in the REMI model. Appendix G discusses alternative assumptions about the flows of inputs to the REMI model.

Table 38: REMI E3+ model input categories, total compliance costs

REMI E3+ Industry Aggregation	REMI E3+ Industry Aggregation
Electric power generation, transmission and distribution	***Dairy product manufacturing***
Natural gas distribution	***Animal slaughtering and processing***
Water, sewage and other systems (utilities)	***Pulp, paper, and paperboard mills***
Glass and glass product manufacturing	***Petroleum and coal products manufacturing***
Cement and concrete product manufacturing	***Basic chemical manufacturing***
Lime, gypsum, and other nonmetallic mineral product manufacturing	***Pesticide, fertilizer, and other agricultural chemical manufacturing***
Iron and Steel Mills and Ferroalloy Manufacturing	***Wholesale trade***
Alumina and aluminum production and processing	***Retail trade***
Nonferrous Metal (except Aluminum) Smelting and Refining	***Pipeline transportation***
Semiconductor and other electronic component manufacturing	***Waste management and remediation services***
Aerospace product and parts manufacturing	***Educational services***
Fruit and vegetable preserving and specialty food manufacturing	***Dairy product manufacturing***

Table 39: REMI E3+ model input categories, benefits

Benefit Category	REMI Input Variable
Abatement costs	**Firm sales: Industrial machinery; Engine, turbine, and power transmission machinery; Engineering, architectural, and related services**
State revenues	**Detailed industry sales: Transportation infrastructure**
Natural gas utility revenues	**Fuel price offset: Natural gas**
Avoided SCC	**Amenity value: Statewide**

Consumption price impacts

We ran the REMI model through 2050, assuming lagged market share response, and examined results for output and prices, both statewide and in the most affected industries. Impacts to output and prices are indicators of whether revenues and profits would be impacted. Price impacts are presented as percentages.

Table 40: Impacts to consumption price levels (direct+indirect+induced), no amenity value, percent

Year	Statewide Price Level	Motor vehicle fuels, lubricants, and fluids	Electricity	Natural Gas	Fuel Oil
2030	**0.28%**	**1.50%**	**2.80%**	**-4.20%**	**1.40%**
2040	**0.07%**	**0.40%**	**1.00%**	**0.30%**	**0.40%**
2050	**0.03%**	**0.20%**	**0.60%**	**2.00%**	**0.20%**

Percent difference from REMI reference scenario price levels

Table 41: Impacts to consumption price levels (direct+indirect+induced), SCC amenity value, percent

Year	Statewide Price Level	Motor vehicle fuels, lubricants, and fluids	Electricity	Natural Gas	Fuel Oil
2030	**0.28%**	**1.25%**	**1.91%**	**-2.78%**	**1.22%**
2040	**0.07%**	**0.32%**	**0.54%**	**0.17%**	**0.31%**
2050	**0.03%**	**0.14%**	**0.28%**	**0.87%**	**0.14%**

Percent difference from REMI reference scenario price levels

We note that potential consumption price impacts were significantly mitigated by the proposed rule's provisions enabling covered parties to use frontloaded APCR allowances and otherwise intertemporally optimize their behavior to smooth allowance price trajectories and lower overall compliance costs. They were also mitigated by the proposed rule's requirements to use consigned no cost allowance revenues to counteract impacts to consumers, and additional allowance releases of APCR allowances and price ceiling units when allowance prices reached the proposed rule's APCR trigger prices or the ceiling price.

Output Impacts

We ran the REMI model through 2050, assuming lagged market share response, and examined results for output and prices, both statewide and in the most affected industries. Impacts to

output and prices are indicators of whether revenues and profits would be impacted.

Table 42: Impacts to output, no amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-$2.25**	**-$0.29**	**-$0.41**	**-$0.88**	**-$0.12**	**$1.42**	**-$1.172**
2040	**-$2.62**	**-$0.21**	**-$0.23**	**-$0.62**	**-$0.09**	**$0.37**	**-$0.961**
2050	**-$1.47**	**-$0.10**	**-$0.15**	**-$0.31**	**-$0.05**	**$0.03**	**-$0.293**

Table 43: Impacts to output, SCC amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-$1.84**	**-$0.29**	**-$0.38**	**-$0.86**	**-$0.11**	**$1.48**	**-$1.136**
2040	**-$1.45**	**-$0.20**	**-$0.14**	**-$0.56**	**-$0.07**	**$0.48**	**-$0.859**
2050	**$0.00**	**-$0.09**	**-$0.01**	**-$0.22**	**-$0.02**	**$0.11**	**-$0.164**

Impacts to prices and output do not reflect significant structural changes to the state economy, such as local development of new or expanded green industries over time.

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.

Though the proposed rule is not analytically separable from the regulatory baseline for the purposes of this analysis, the authorizing statute does not allow Ecology to reduce, modify, or eliminate substantive requirements for any covered entities. The areas of the proposed rule reflecting these statutory requirements include rule coverage, inspections or their equivalent in verification, emissions reduction goals, compliance timetables, and fines. The areas in which Ecology exercised its discretion do not control substantive regulatory requirements or these other areas dictated in whole or in part by the statute.

Ecology simplified requirements related to recordkeeping and reporting by automatically registering covered entities (a subset of which may be small businesses, though are likely not; see Section 7.2). Automatic registration allows these businesses to avoid an element of transaction costs.

Small businesses would also inherently have fewer or no corporate associations (direct or indirect), and require fewer personnel managing or observing market and compliance activities.

For generally more burdensome alternatives that Ecology considered but did not include in the rule, see Chapter 6.

7.5 Small business and government involvement

Ecology involved small businesses and local governments in its development of the proposed rule, using:

- Four stakeholder meetings:
    - November 8, 2022
    - December 16, 2022 (morning).
    - December 16, 2022 (afternoon).
    - January 11, 2022.
- For each stakeholder meeting we sent notifications to two email distribution lists that include multiple business and local government contacts:
    - Climate Commitment Act listserv.
    - Greenhouse gas reporting listserv.
- Two Tribal rulemaking review sessions:
    - January 13, 2022.
    - January 18, 2022.
- An informal comment period from Nov. 8 – Jan. 26 (deadline extended from initial date of Jan. 18 in response to stakeholder requests).

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

The proposed rule likely impacts the following industries, with associated NAICS codes. NAICS definitions and industry hierarchies are discussed at https://www.census.gov/naics/

Table 44: Potentially impacted NAICS codes

NAICS	NAICS Title	*NAICS*	NAICS Title
1121	**Cattle Ranching and Farming**	***3274***	**Lime and Gypsum Product Manufacturing**
2123	**Nonmetallic Mineral Mining and Quarrying**	***3311***	**Iron and Steel Mills and Ferroalloy Manufacturing**
2131	**Support Activities for Mining**	***3313***	**Alumina and Aluminum Production and Processing**
2211	**Electric Power Generation, Transmission and Distribution**	***3314***	**Nonferrous Metal (except Aluminum) Production and Processing**
2212	**Natural Gas Distribution**	***3321***	**Forging and Stamping**
2213	**Water, Sewage and Other Systems**	***3344***	**Semiconductor and Other Electronic Component Manufacturing**
3112	**Grain and Oilseed Milling**	***3359***	**Other Electrical Equipment and Component Manufacturing**
3114	**Fruit and Vegetable Preserving and Specialty Food Manufacturing**	***3364***	**Aerospace Product and Parts Manufacturing**
3115	**Dairy Product Manufacturing**	***4247***	**Petroleum and Petroleum Products Merchant Wholesalers**
3116	**Animal Slaughtering and Processing**	***4251***	**Wholesale Electronic Markets and Agents and Brokers**
3119	**Other Food Manufacturing**	***4451***	**Grocery Stores**
3211	**Sawmills and Wood Preservation**	***4471***	**Gasoline Stations**
3212	**Veneer, Plywood, and Engineered Wood Product Manufacturing**	***4811***	**Scheduled Air Transportation**
3219	**Other Wood Product Manufacturing**	***4862***	**Pipeline Transportation of Natural Gas**
3221	**Pulp, Paper, and Paperboard Mills**	***4881***	**Support Activities for Air Transportation**
3222	**Converted Paper Product Manufacturing**	***4921***	**Couriers and Express Delivery Services**
3241	**Petroleum and Coal Products Manufacturing**	***4931***	**Warehousing and Storage**
3251	**Basic Chemical Manufacturing**	***5622***	**Waste Treatment and Disposal**
3253	**Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing**	***6113***	**Colleges, Universities, and Professional Schools**
3272	**Glass and Glass Product Manufacturing**	***9241***	**Administration of Environmental Quality Programs**
3273	**Cement and Concrete Product Manufacturing**	***9281***	**National Security and International Affairs**

7.7 Impact on jobs

We used the REMI E3+ model for Washington State to estimate the impact of the proposed rule

on jobs in the state, accounting for dynamic adjustments throughout the economy.

The proposed rule would result in transfers of money within and between industries, as compared to the regulatory 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. We used outputs from the same model run as described above in Section 7.5. Employment impacts are presented in thousands of full-time employee (FTE) equivalents in each year.

Table 45: Impacts to employment, no amenity value, thousands of FTEs

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**-0.28**	**-0.19**	**-2.05**	**-2.16**	**-0.77**	**8.48**	**0.352**
2040	**-5.49**	**-0.11**	**-0.87**	**-1.17**	**-0.52**	**1.86**	**-0.175**
2050	**-3.88**	**-0.04**	**-0.46**	**-0.45**	**-0.26**	**-0.08**	**0.255**

Table 46: Impacts to output, SCC amenity value, billions of $

Year	Statewide	Utilities	Retail	Wholesale (includes transportation fuels)	Transportation and Warehousing	Construction (infrastructure)	Manufacturing
2030	**1.99**	**-0.19**	**-1.92**	**-2.11**	**-0.69**	**8.88**	**0.424**
2040	**0.28**	**-0.10**	**-0.50**	**-1.05**	**-0.31**	**2.52**	**0.018**
2050	**2.64**	**-0.04**	**0.02**	**-0.31**	**0.01**	**0.38**	**0.488**

References

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.

Bratt, C, 2021. June 'heat dome' cut raspberry volume 30%. Lynden Tribune. December 10, 2021.

Bressler, RD, 2021. The mortality cost of carbon. Nat. Commun. 12, 4467 (2021).

Bressler, RD, FC Moore, K Rennert, and D Anthoff, 2021. Estimates of country level temperature-related mortality damage functions. Scientific Reports, Nature Portfolio 11:20282. https://doi.org/10.1038/s41598-021-99156-5.

Burke, M, A Driscoll, S Heft-Neal, J Xue, J Burney, and M Wara, 2020. The changing risk and burden of wildfire in the United States. PNAS 118(2). https://doi.org/10.1073/pnas.2011048118.

California Air Resources Board, 2022. Summary of Market Transfers Report. 2014 – 2021. https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/program-data/summary-market-transfers-report.

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

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.

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.

Engrossed Substitute Senate Bill 5689. 2022 Regular Session. https://lawfilesext.leg.wa.gov/biennium/2021-22/Pdf/Bills/Senate%20Passed%20Legislature/5689-S.PL.pdf.

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

Henderson, SB, KE McLean, MJ Lee, and T Kosatsky, 2022. Analysis of community deaths during the catastrophic 2021 heat dome. Environmental Epidemiology (2022) 6:e189. DOI: 10.1097/EE9.0000000000000189.

ICF International, 2014. California's Low Carbon Fuel Standard: Compliance Outlook & Economic Impacts.

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 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.

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

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.

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.

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.

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.

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.

King County, 2021. Results of heat mapping project show inequitable impact of hotter summers. https://kingcounty.gov/elected/executive/constantine/news/release/2021/June/23-heat-mapping-results.aspx. Results: https://www.arcgis.com/apps/webappviewer/index.html?id=84709c65c08a40bbb47d0723ef1c797a&extent=-13604644.7965%2C6019787.1095%2C-13561266.7829%2C6046616.5065%2C102100.

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.

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

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

Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

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

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

Schramm, PJ, A Vaidyanathan, L Radhakrishnan, A Gates, K Harnett, and P Breysse, 2021. Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021. US Centers for Disease Control and Prevention. Weekly 70(90), pp. 1020-2021. July 23, 2021. https://www.cdc.gov/mmwr/volumes/70/wr/mm7029e1.htm.

Silva, RA, JJ West, JF Lamarque, DT Shindell, WJ Collins, G Faluvegi, GA Folberth, LW Horowitz, T Nagashima, V Naik, ST Rumbold, K Sudo, T Takemura, D Bergmann, P Cameron-Smith, RM Doherty, B Josse, IA MacKenzie, DS Stevenson, and G Zeng, 2017. Future global mortality from changes in air pollution attributable to climate change. Nat. Clim. Change, 7, no. 9, pp. 647-651. DOI: 10.1038/nclimate3354.

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.

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

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.

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

US Department of the Treasury, 2022. Series I Savings Bonds Rates & Terms: Calculating Interest Rates. https://www.treasurydirect.gov/indiv/research/indepth/ibonds/res_ibonds_iratesandterms.htm.

US Environmental Protection Agency, 2010. Diesel Emissions Quantifier Health Benefits Methodology, EPA, EPA-420-B-10-034, August 2010.

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

US Environmental Protection Agency and National Highway Traffic Safety Administration, 2011. Draft Joint Technical Support Document: Proposed Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-D-11-901, November 2011.

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.

WA Department of Commerce, 2020. Fuel Mix Disclosure 2020 Utility Emissions Report. Available through https://www.commerce.wa.gov/growing-the-economy/energy/fuel-mix-disclosure/.

WA Department of Commerce, 2021. Carbon Tax Assessment Model (CTAM). Version 4.2. Jan 11, 2021. https://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/.

WA Department of Ecology, 2022. Rulemaking for Chapter 173-441 WAC. Administrative Order #21-07.

WA Department of Ecology, 2022a. GHG Reporting Program Publication dataset. https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Publication/idhm-59de/data.

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.

WA Department of Health, 2022. Traffic Air Pollution Data. https://doh.wa.gov/data-statistical-reports/washington-tracking-network-wtn/traffic-air-pollution.

WA Department of Health, 2022a. Washington Tracking Network, Environmental Health Disparities Map. https://fortress.wa.gov/doh/wtnibl/WTNIBL/.

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.

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.

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.

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

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.

In 2020, the legislature updated the state's greenhouse gas emissions limits that Washington must achieve by 2030, 2040, and 2050, based on current science and emissions trends, to support local and global efforts to avoid the most significant impacts from climate change. The Climate Commitment Act statute establishes a new cap and invest program to help Washington achieve the GHG emissions reductions needed to meet these limits, and directs Ecology to adopt rules to implement the provisions of the program (RCW 70A.65.220.) Ecology is further directed to start the program by January 1, 2023, and adopt annual allowance budgets for the first compliance period of the program by October 1, 2022 (RCW 70.65.070(1)(a)). Ecology would be in violation of the Climate Commitment Act statute if we did not pursue rulemaking on this topic. Without this rulemaking Ecology would be unable to meet its obligations under the Climate Commitment Act to implement a cap on greenhouse gas emissions from covered entities and a program to track, verify, and enforce compliance through the use of compliance instruments. 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. The requirements of this rule do not conflict with EPA reporting requirements for greenhouse gases and do not alter reporting requirements in other states.

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 compliance obligations in this rule apply to both private and public entities. WAC 173-446-230 establishes methods for allocation of no cost allowances to electric utilities. Investor-owned utilities and consumer-owned utilities have different requirements due to their inherently different organizational structure, but those differences do not impose any more stringent requirements on either type of utility.

RCW 70A.65.080(7) exempts emissions from certain activities from the program, including those from national security facilities, which are more likely to be 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.

- ☒ No. There is no federal regulation or federal statute applicable to the same activity or subject matter.
- If **yes**, the difference is justified because of the following:

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

  ☐ (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.

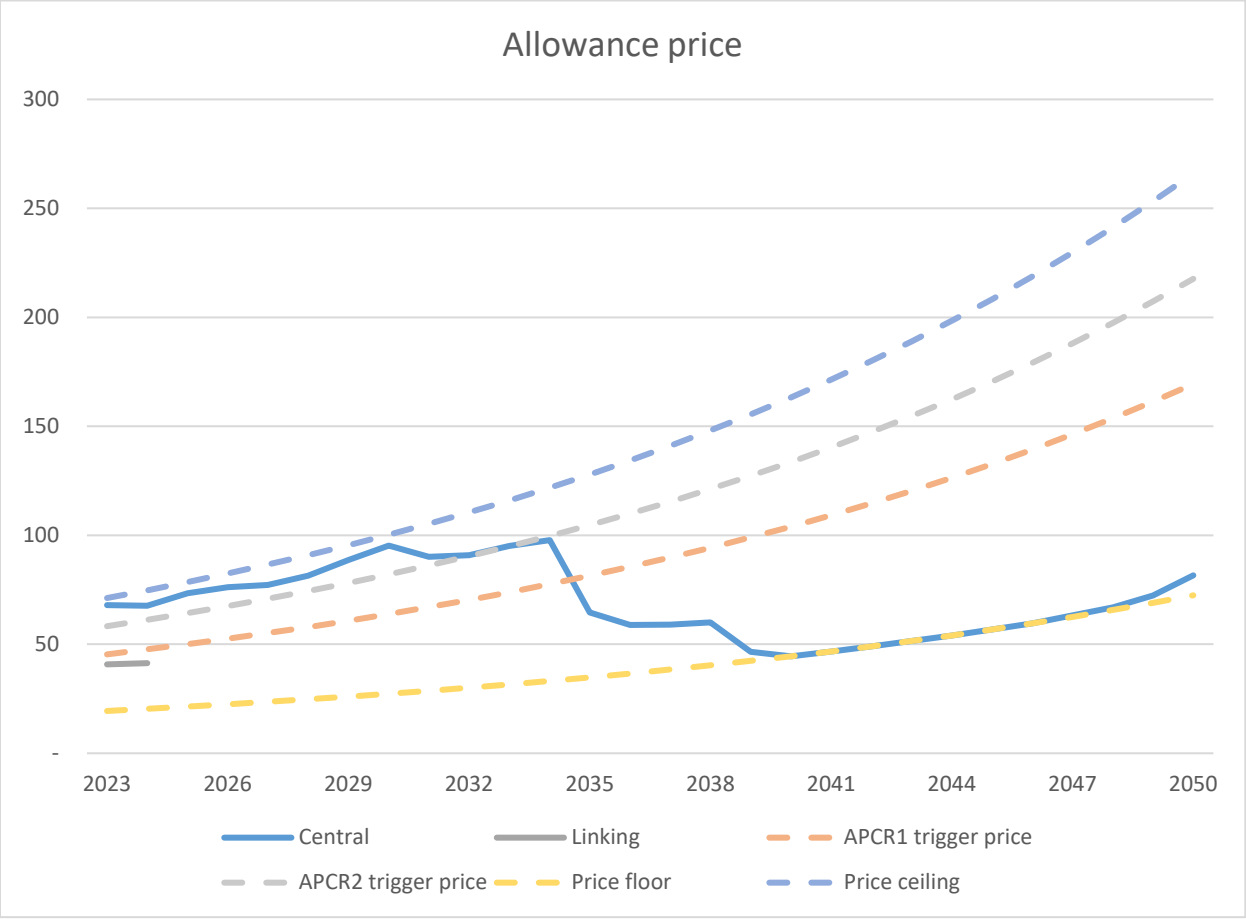
We are coordinating to the maximum extent practicable with rulemaking on the GHG Reporting Program (WAC 173-441) and on the Criteria for Emissions-Intensive, Trade-Exposed Industries (WAC 173-446A). There are overlaps in the stakeholders and Ecology staff working on these rules, which facilitates coordination. We are also coordinating this rulemaking with the requirements of RCW 19.405, the Clean Energy Transformation Act. Ecology is also working to make the rule consistent where possible with similar state law in California to facilitate potential program linkage, per RCW 70A.65.060(3).

Appendix B: Impacts of Expected Linkage

Based on an alternative scenario modeled by Vivid Economics[94], we examined the potential impact of linkage expectations on the Washington Cap and Invest Program allowance market. In this scenario, market participants would behave as though they had complete certainty that Washington would link with the California allowance market in 2025, and other attributes of the proposed rule and central assumptions were included.

The primary result of this model is a significant drop in initial Washington allowance prices, from $58.31 to $40.74 – a drop of 30 percent, or $17.57 per allowance. Low prices would persist in 2024, with an allowance price of $41.28 (32.6 percent lower than in our primary scenario). Overall compliance costs in these years would fall by similar percentages.

Figure 9: Allowance prices under the central and expected linkage scenarios



[94] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Prices were not modeled beyond 2024 for this analysis, as this model does not include full attributes of the California allowance market. Due to the relative size of the two markets, however, allowance prices are expected to track California prices in 2025 and beyond.

Appendix C: Impacts of Complementary Policies

We examined the impacts of including complementary policies on allowance price trajectories. Vivid Economics[95] modeled the allowance market for an alternative scenario that accounted for the:

- Clean Fuels Program rule (implementing a clean fuel standard), Chapter 173-455 WAC.
- Clean Vehicles Program rule (implementing zero emission vehicle requirements), Chapter 173-423 WAC.

This model did not make any additional assumptions about the Criteria for Emissions-Intensive, Trade-Exposed Industries rule (Chapter 173-446A WAC) – another rulemaking that is currently in progress – since it does not impact the allowance market.

Finally, this model differs from our primary analysis in its exclusion of frontloading APCR allowances through 2030. Despite this difference from the proposed rule, this alternative scenario illustrates the overall slight downward pressure on prices through resulting from the complementary policies. This impact is likely based in the Clean Vehicles Program requirement that 100 percent of passenger and light-duty vehicles sold be zero emissions vehicles starting in 2035.

[95] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Figure 10: Relative impact of complementary policies

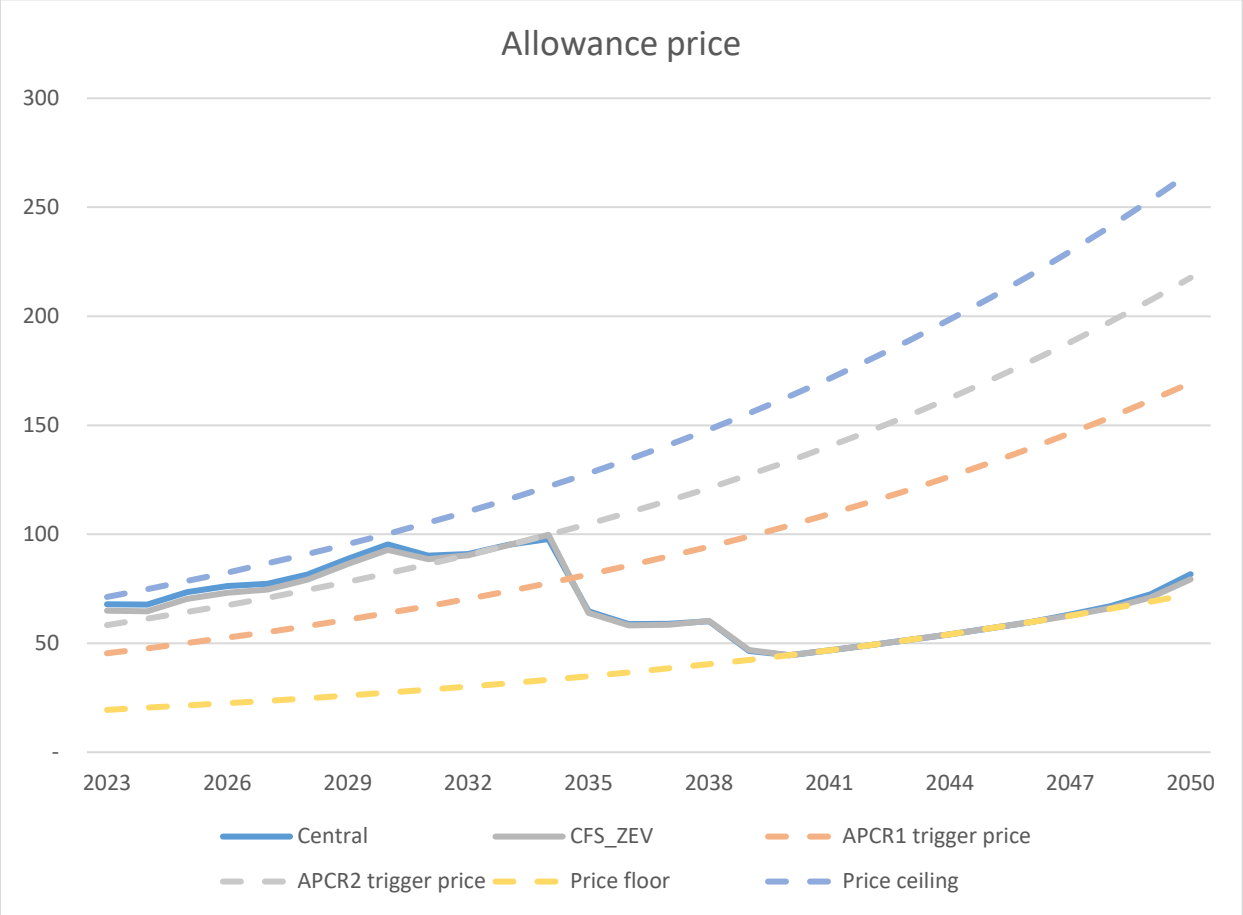


Table 47: Reduction in allowance prices due to complementary policies

Year	Price Difference
2023	**$2.93**
2024	**$3.00**
2025	**$3.09**
2026	**$3.00**
2027	**$2.59**
2028	**$2.32**
2029	**$2.36**
2030	**$2.49**
2031	**$1.63**
2032	**$0.55**
2033	**$0.23**
2034	**-$1.94**
2035	**$0.62**
2036	**$0.70**
2037	**$0.53**
2038	**-$0.20**

Year	Price Difference
2039	**-$0.38**
2040	**-**
2041	**-**
2042	**-**
2043	**-**
2044	**-**
2045	**-**
2046	**-**
2047	**$0.51**
2048	**$0.94**
2049	**$1.44**
2050	**$2.27**

Appendix D: Sensitivity Analysis of Linkage Expectations

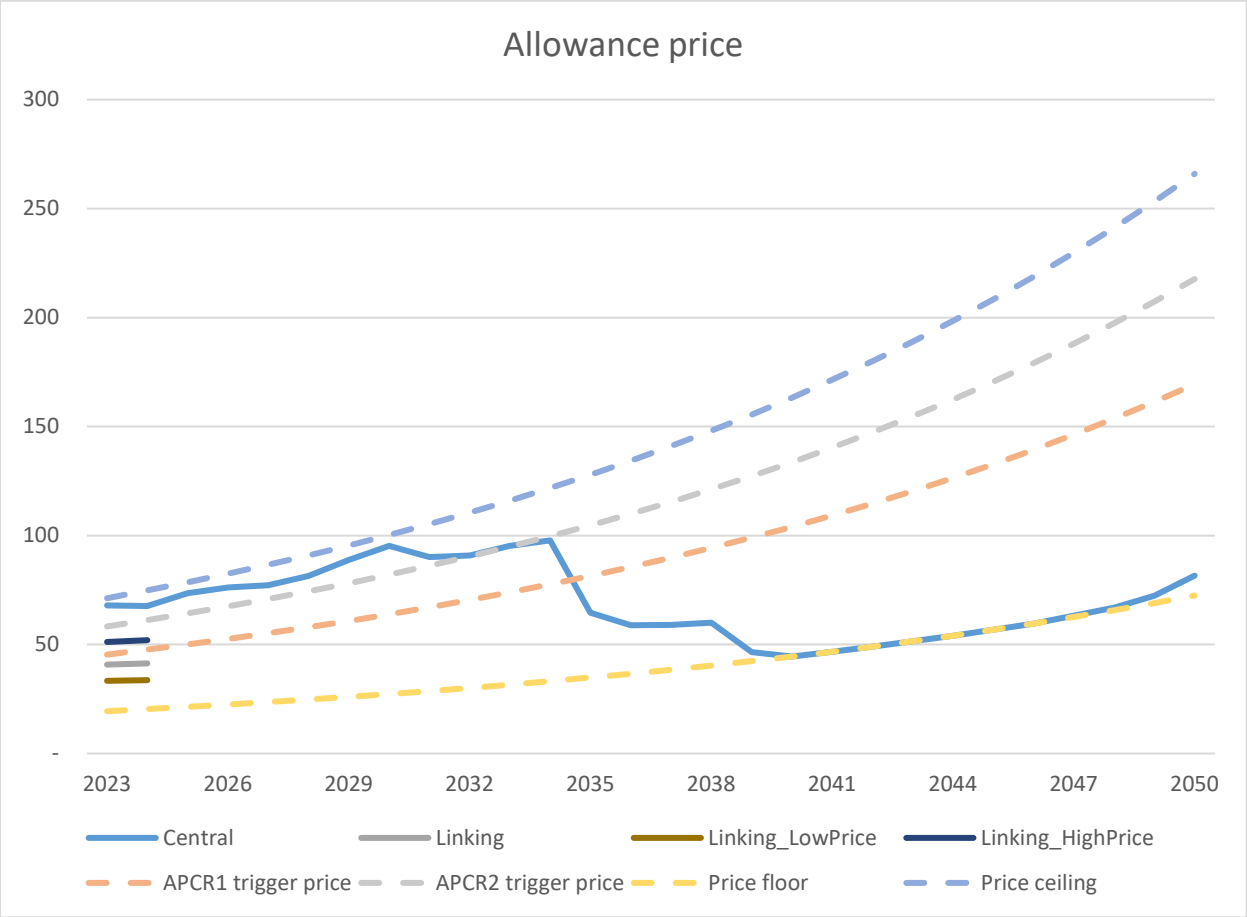
In our primary analysis, we did not include any expectation of linkage with GHG emissions allowance programs in other states. In Appendix B, we considered the impacts of market participants expecting market linkage in 2025. We also examined the impacts of later expected linkage years, based on scenarios developed by Vivid Economics[96] reflecting:

- Expected linkage in 2025 with lower California prices.
- Expected linkage in 2025 with higher California prices.
- Expected linkage in 2027.
- Expected linkage in 2030.

While the central scenario modeled for these comparisons differs from our primary analysis in that it does not include frontloading of APCR allowances through 2030, the general differences are informative to our analysis in their consistent illustration that linkage expectations reduce allowance prices, and the expected linked price levels and timing of linkage affect the magnitude of the allowance price decrease.

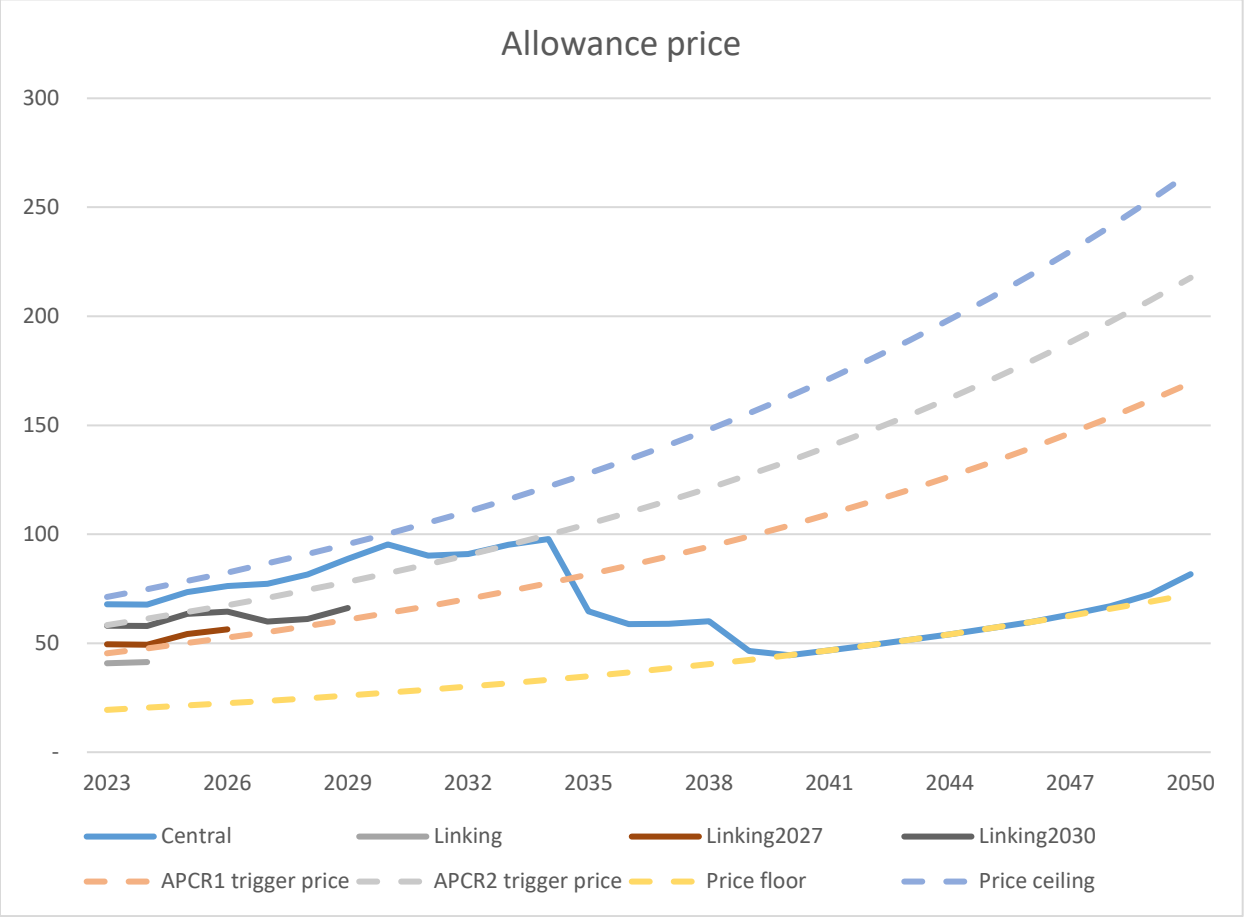
[96] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Figure 11: Allowance price differences at three levels of expected linkage prices



Higher expected prices following linkage would still reduce prices relative to the central scenario (our primary scenario without frontloading), but not by as much as expectations of average or lower prices. Similarly, lower expected prices would reduce allowance prices in the Washington market by more than the average expectation.

Figure 12: Allowance price differences at three different expected linkage years



The expected timing of linkage would also affect the degree of downward pressure on prices in the Washington allowance market. The sooner Washington is expected to link, the stronger the downward pressure on allowance prices.

Appendix E: Sensitivity Analysis of Market Behaviors

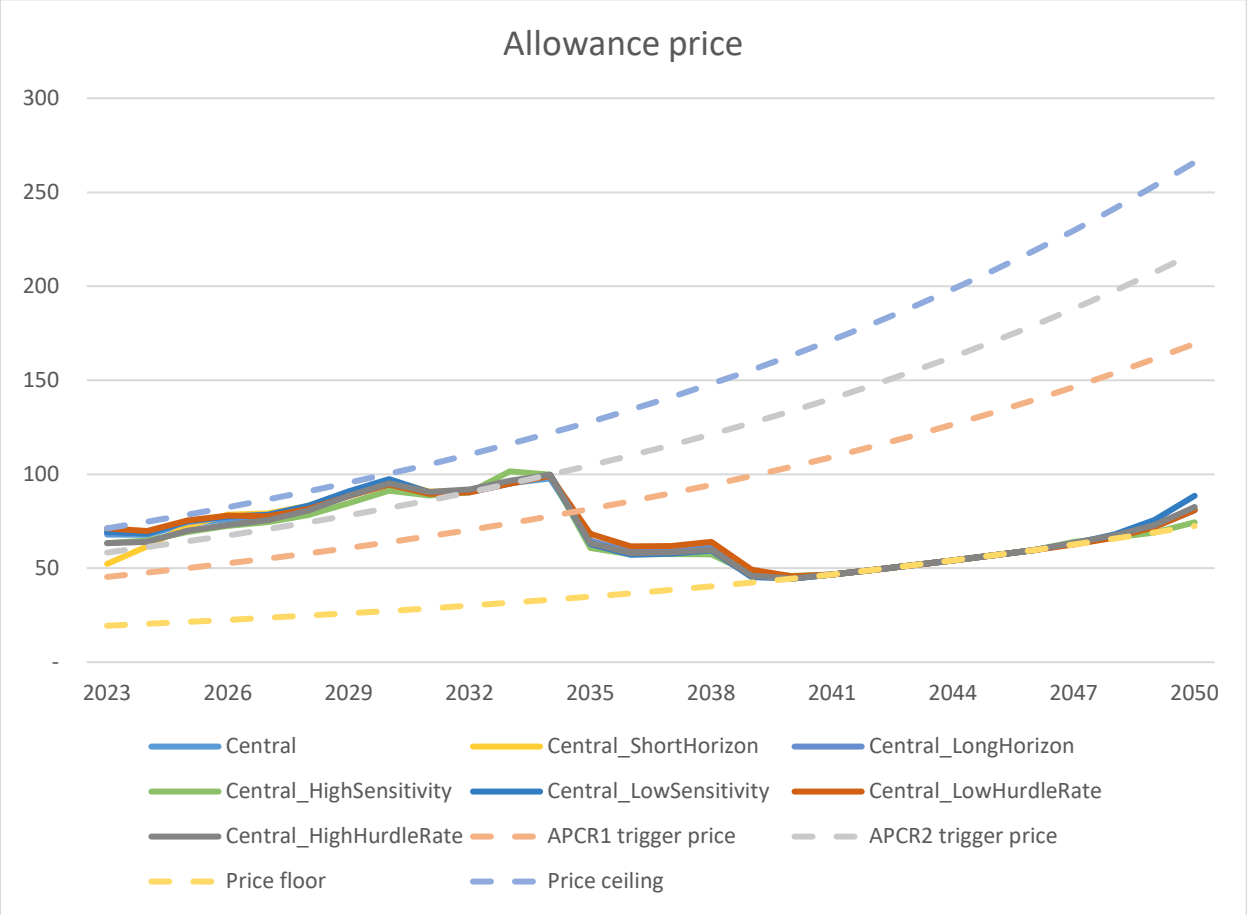
Based on a set of alternative scenarios modeled by Vivid Economics[97], we examined the potential impact of varying assumptions about the behavior of allowance market participants. These scenarios include:

- Limited foresight in the first compliance period. This reflects a period of adaptation and learning in early years of the program.
- Longer foresight across the model.
- High sensitivity to allowance prices among financial participants.
- Lower sensitivity to allowance prices among financial participants.
- A lower hurdle rate (minimum acceptable rate of return) for financial participants.
- A higher hurdle rate for financial participants.

In all sensitivity scenarios, inclusion of amenity value mitigates negative impacts.

[97] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Figure 13: Allowance prices under behavioral sensitivity scenarios



Qualitatively, the graph above shows that there are minor differences across different behavioral scenarios, which generally track one another. Differences of note are consistent with expectations, and include:

- Lower prices in the first compliance period if market participants have limited foresight in the first compliance period.
- Smoother price trajectories with a lower hurdle rate or lower sensitivity to prices.
- More variable price trajectories with a higher hurdle rate or higher sensitivity to prices.

Using the same methodology as in our primary analysis, we estimated the following for the sensitivity scenarios above. Recall that these scenarios do not include frontloading of APCR allowances through 2030, and so do not reflect the additional price smoothing and downward pressure on prices in early years that results from frontloading.

The impacts presented below further inform likely ranges of impacts around the results of our primary analysis.

- Present value costs and benefits each reflect a range of approximately $2 billion through 2050, and a range of up to approximately $200 million around present value net benefits.

- Statewide employment impacts reflect a range of approximately one thousand FTEs across paired sensitivities, with that range decreasing over time.
- Statewide output impacts reflect a range of approximately $100 million, with that range decreasing over time.
- Motor vehicle fuel price impacts reflect a range of approximately 0.2 percentage points, with that range decreasing over time.
- Electricity price impacts reflect a range of up to approximately one percentage point, with that range decreasing over time.
- Natural gas price impacts reflect a range of up to approximately 1.5 percentage points, with that range decreasing over time.

Table 48: Present value costs and benefits through 2050, billions of $

Sensitivity	Costs	Benefits	Net Benefit
Short Horizon	**$49.06**	**$55.21**	**$6.15**
Long Horizon	**$50.27**	**$56.43**	**$6.16**
High Sensitivity	**$48.36**	**$54.68**	**$6.33**
Low Sensitivity	**$50.49**	**$56.66**	**$6.17**
Low Hurdle Rate	**$50.61**	**$56.63**	**$6.02**
High Hurdle Rate	**$49.19**	**$55.42**	**$6.23**

Table 49: Employment impacts, no amenity value, thousands of FTE

Sensitivity	2030	2040	2050
Short Horizon	**-0.53**	**-5.48**	**-3.92**
Long Horizon	**-1.02**	**-5.55**	**-4.00**
High Sensitivity	**-0.78**	**-5.12**	**-3.91**
Low Sensitivity	**-0.91**	**-5.77**	**-4.00**
Low Hurdle Rate	**-1.19**	**-5.56**	**-4.02**
High Hurdle Rate	**-0.49**	**-5.36**	**-3.91**

Table 50: Employment impacts, SCC amenity value, thousands of FTE

Sensitivity	2030	2040	2050
Short Horizon	**1.77**	**0.29**	**2.60**
Long Horizon	**1.30**	**0.22**	**2.51**
High Sensitivity	**1.41**	**0.52**	**2.57**
Low Sensitivity	**1.45**	**0.04**	**2.56**
Low Hurdle Rate	**1.12**	**0.17**	**2.43**
High Hurdle Rate	**1.77**	**0.37**	**2.61**

Table 51: Output impacts, no amenity value, billions of $

Sensitivity	2030	2040	2050
Short Horizon	**-$2.37**	**-$2.63**	**-$1.49**
Long Horizon	**-$2.50**	**-$2.65**	**-$1.51**
High Sensitivity	**-$2.33**	**-$2.53**	**-$1.48**
Low Sensitivity	**-$2.51**	**-$2.66**	**-$1.52**

Sensitivity	2030	2040	2050
Low Hurdle Rate	**-$2.53**	**-$2.68**	**-$1.52**
High Hurdle Rate	**-$2.34**	**-$2.60**	**-$1.48**

Table 52: Output impacts, SCC amenity value, billions of $

Sensitivity	2030	2040	2050
Short Horizon	**-$1.96**	**-$1.46**	**-$0.02**
Long Horizon	**-$2.08**	**-$1.48**	**-$0.04**
High Sensitivity	**-$1.93**	**-$1.39**	**-$0.02**
Low Sensitivity	**-$2.08**	**-$1.49**	**-$0.04**
Low Hurdle Rate	**-$2.11**	**-$1.53**	**-$0.06**
High Hurdle Rate	**-$1.93**	**-$1.44**	**-$0.01**

Table 53: Motor vehicle fuel price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**1.26%**	**0.32%**	**0.14%**
Long Horizon	**1.40%**	**0.50%**	**0.20%**
High Sensitivity	**1.17%**	**0.34%**	**0.13%**
Low Sensitivity	**1.50%**	**0.40%**	**0.30%**
Low Hurdle Rate	**1.40%**	**0.50%**	**0.20%**
High Hurdle Rate	**1.24%**	**0.33%**	**0.15%**

Table 54: Motor vehicle fuel price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**1.26%**	**0.32%**	**0.14%**
Long Horizon	**1.40%**	**0.50%**	**0.20%**
High Sensitivity	**1.40%**	**0.50%**	**0.20%**
Low Sensitivity	**1.50%**	**0.40%**	**0.30%**
Low Hurdle Rate	**1.22%**	**0.34%**	**0.14%**
High Hurdle Rate	**1.24%**	**0.33%**	**0.15%**

Table 55: Electricity price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**1.92%**	**0.55%**	**0.27%**
Long Horizon	**2.70%**	**1.00%**	**0.60%**
High Sensitivity	**1.79%**	**0.57%**	**0.26%**
Low Sensitivity	**2.80%**	**0.90%**	**0.60%**
Low Hurdle Rate	**2.70%**	**1.00%**	**0.60%**
High Hurdle Rate	**1.89%**	**0.56%**	**0.28%**

Table 56: Electricity price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**1.92%**	**0.55%**	**0.28%**
Long Horizon	**2.70%**	**1.00%**	**0.60%**

Sensitivity	2030	2040	2050
High Sensitivity	**2.60%**	**1.00%**	**0.60%**
Low Sensitivity	**2.80%**	**0.90%**	**0.70%**
Low Hurdle Rate	**1.87%**	**0.58%**	**0.28%**
High Hurdle Rate	**1.89%**	**0.56%**	**0.28%**

Table 57: Natural gas price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**-2.94%**	**0.15%**	**0.87%**
Long Horizon	**-4.30%**	**0.30%**	**2.00%**
High Sensitivity	**-2.77%**	**0.12%**	**0.83%**
Low Sensitivity	**-4.40%**	**0.50%**	**2.20%**
Low Hurdle Rate	**-4.30%**	**0.30%**	**2.00%**
High Hurdle Rate	**-2.91%**	**0.13%**	**0.89%**

Table 58: Natural gas price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Short Horizon	**-2.94%**	**0.16%**	**0.87%**
Long Horizon	**-4.30%**	**0.30%**	**2.00%**
High Sensitivity	**-4.20%**	**0.20%**	**1.90%**
Low Sensitivity	**-4.40%**	**0.50%**	**2.20%**
Low Hurdle Rate	**-2.83%**	**0.15%**	**0.87%**
High Hurdle Rate	**-2.91%**	**0.14%**	**0.90%**

Appendix F: Sensitivity Analysis of Technology Assumptions

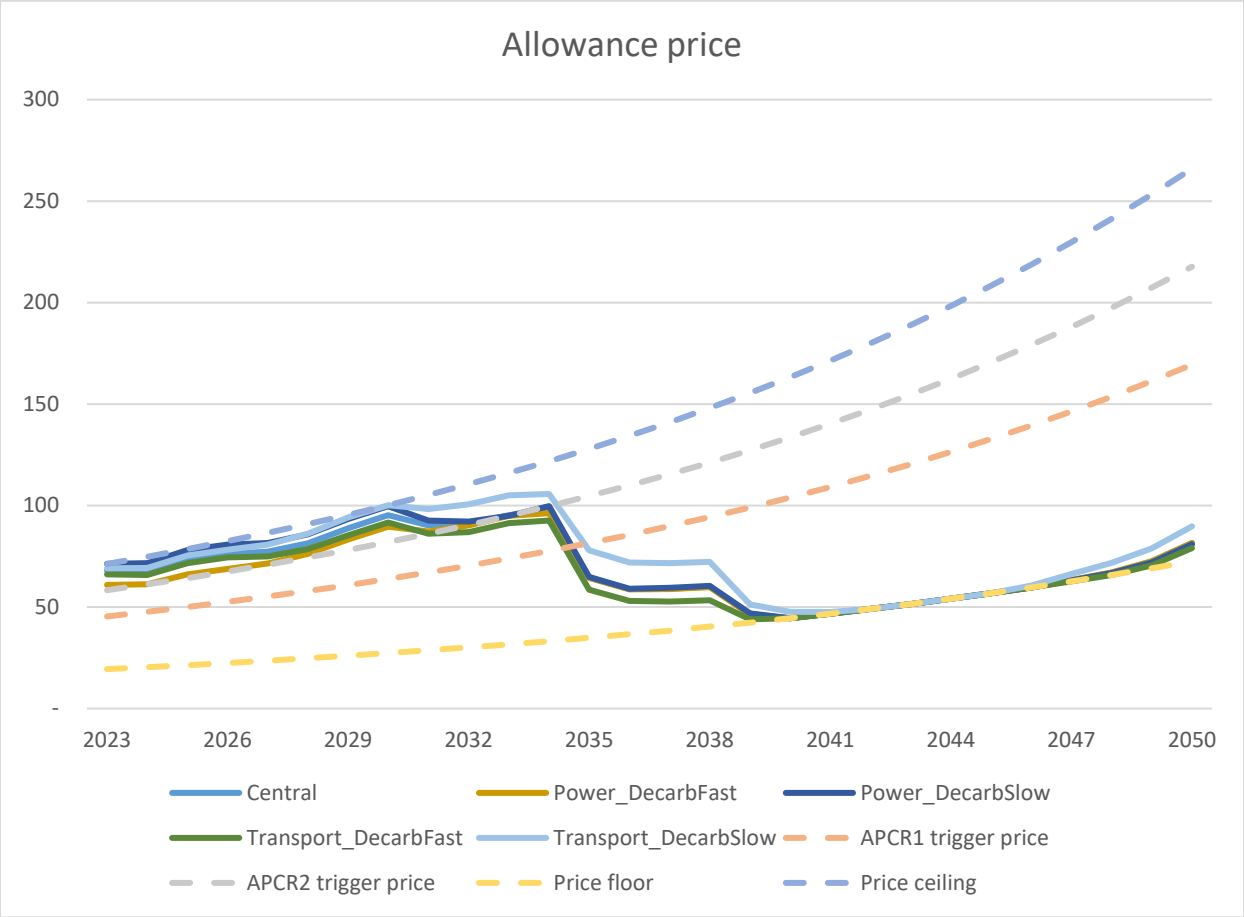
Based on a set of alternative scenarios modeled by Vivid Economics[98], we examined the potential impact of varying technology assumptions affecting decarbonization rates of the energy and transportation sectors. These scenarios include:

- 10 percent faster decarbonization in the power sector.
- 10 percent slower decarbonization in the power sector.
- Less transportation sector inertia (resistance to change) leading to faster decarbonization.
- More transportation sector inertia leading to slower decarbonization.

In all sensitivity scenarios, inclusion of amenity value mitigates negative impacts.

[98] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Figure 14: Allowance prices under technology sensitivity scenarios



Qualitatively, the graph above shows that there are potentially significant differences across different technology scenarios, although their price trajectories generally track one another. Differences of note are consistent with expectations, and include:

- Faster decarbonization in the power or transportation sector puts downward pressure on allowance prices. Faster decarbonization in the power sector reduces prices more than faster decarbonization in the transportation sector through 2031, after which faster transportation decarbonization reduces prices more until the 2040s.
- Slower decarbonization in the power or transportation sector puts upward pressure on allowance prices, more so for the power sector through 2028. After 2028, slower decarbonization in the transportation sector puts significant upward pressure on prices relative to other scenarios until the 2040s.

Using the same methodology as in our primary analysis, we estimated the following for the sensitivity scenarios above. Recall that these scenarios do not include frontloading of APCR allowances through 2030, and so do not reflect the additional price smoothing and downward pressure on prices in early years that results from frontloading.

The impacts presented below further inform likely ranges of impacts around the results of our primary analysis.

- Present value costs reflect a range of between $5 billion and $8 billion through 2050 across paired sensitivities.
- Present value benefits reflect a range of between $5 billion and $8 billion through 2050 across paired sensitivities.
- Net present value benefits reflect a range of approximately $190 million to $250 million through 2050 across paired sensitivities.
- Statewide employment impacts reflect a range of between 50 and 640 FTEs across paired sensitivities.
- Statewide output impacts reflect a range of $180 million to $430 million across paired sensitivities.
- Motor vehicle fuel price impacts reflect a range of less than 0.2 percentage points, with that range decreasing over time.
- Electricity price impacts reflect a range of up to 0.3 percentage points, with that range decreasing over time.
- Natural gas price impacts reflect a range of less than 0.2 percentage points, with that range decreasing over time.

Table 59: Present value costs and benefits through 2050, billions of $

Sensitivity	Costs	Benefits	Net Benefit
Power decarbonizes faster	**$46.82**	**$53.13**	**$6.31**
Power decarbonizes slower	**$52.22**	**$58.34**	**$6.12**
Transportation decarbonizes faster	**$46.90**	**$53.00**	**$6.10**
Transportation decarbonizes slower	**$54.82**	**$60.67**	**$5.85**

Table 60: Employment impacts, no amenity value, thousands of FTE

Sensitivity	2030	2040	2050
Power decarbonizes faster	**-0.52**	**-5.26**	**-3.84**
Power decarbonizes slower	**-1.16**	**-5.77**	**-4.10**
Transportation decarbonizes faster	**-0.92**	**-5.24**	**-3.69**
Transportation decarbonizes slower	**-0.87**	**-6.40**	**-4.55**

Table 61: Employment impacts, SCC amenity value, thousands of FTE

Sensitivity	2030	2040	2050
Power decarbonizes faster	**1.59**	**0.27**	**2.53**
Power decarbonizes slower	**1.30**	**0.21**	**2.56**
Transportation decarbonizes faster	**1.27**	**0.06**	**2.31**
Transportation decarbonizes slower	**1.58**	**-0.18**	**2.73**

Table 62: Output impacts, no amenity value, billions of $

Sensitivity	2030	2040	2050
Power decarbonizes faster	**-2.21**	**-2.52**	**-1.47**
Power decarbonizes slower	**-2.64**	**-2.73**	**-1.54**
Transportation decarbonizes faster	**-2.38**	**-2.43**	**-1.39**
Transportation decarbonizes slower	**-2.56**	**-3.03**	**-1.73**

Table 63: Output impacts, SCC amenity value, billions of $

Sensitivity	2030	2040	2050
Power decarbonizes faster	**-1.82**	**-1.41**	**-0.03**
Power decarbonizes slower	**-2.19**	**-1.52**	**-0.04**
Transportation decarbonizes faster	**-1.98**	**-1.36**	**-0.04**
Transportation decarbonizes slower	**-2.11**	**-1.78**	**-0.09**

Table 64: Motor vehicle fuel price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**1.14%**	**0.31%**	**0.14%**
Power decarbonizes slower	**1.31%**	**0.33%**	**0.15%**
Transportation decarbonizes faster	**1.17%**	**0.28%**	**0.13%**
Transportation decarbonizes slower	**1.31%**	**0.36%**	**0.19%**

Table 65: Motor vehicle fuel price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**1.14%**	**0.31%**	**0.14%**
Power decarbonizes slower	**1.31%**	**0.33%**	**0.15%**
Transportation decarbonizes faster	**1.18%**	**0.28%**	**0.13%**
Transportation decarbonizes slower	**1.31%**	**0.36%**	**0.19%**

Table 66: Electricity price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**1.74%**	**0.53%**	**0.27%**
Power decarbonizes slower	**2.00%**	**0.57%**	**0.29%**
Transportation decarbonizes faster	**1.80%**	**0.49%**	**0.26%**
Transportation decarbonizes slower	**2.01%**	**0.62%**	**0.35%**

Table 67: Electricity price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**1.75%**	**0.54%**	**0.27%**
Power decarbonizes slower	**2.00%**	**0.57%**	**0.29%**
Transportation decarbonizes faster	**1.80%**	**0.49%**	**0.26%**
Transportation decarbonizes slower	**2.01%**	**0.62%**	**0.35%**

Table 68: Natural gas price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**-2.75%**	**0.15%**	**0.86%**
Power decarbonizes slower	**-2.93%**	**0.20%**	**0.91%**
Transportation decarbonizes faster	**-2.79%**	**0.21%**	**0.81%**
Transportation decarbonizes slower	**-2.97%**	**0.21%**	**1.13%**

Table 69: Natural gas price impacts, SCC amenity value, percent

Sensitivity	2030	2040	2050
Power decarbonizes faster	**-2.75%**	**0.16%**	**0.86%**
Power decarbonizes slower	**-2.93%**	**0.21%**	**0.91%**
Transportation decarbonizes faster	**-2.79%**	**0.22%**	**0.81%**
Transportation decarbonizes slower	**-2.96%**	**0.22%**	**1.14%**

Appendix G: Sensitivity Analysis of REMI Assumptions

In our primary analysis, we made a set of assumptions about inputs for the REMI model (see Chapter 7). The present value costs and benefits of the proposed rule are the same regardless of REMI input assumptions, as the different assumptions only affect REMI results. For reference, tables below present the results of our primary REMI analysis.

Table 70: Primary REMI Model Results, No Amenity Value

Impact	2030	2040	2050
Employment impacts (thousands of FTE)	**-0.28**	**-5.49**	**-3.88**
Output impacts (billions of $)	**-$2.25**	**-$2.62**	**-$1.47**
Motor vehicle fuel price (percent)	**1.50%**	**0.40%**	**0.20%**
Electricity price (percent)	**2.80%**	**1.00%**	**0.60%**
Natural gas price (percent)	**-4.20%**	**0.30%**	**2.00%**

Table 71: Primary REMI Model Results, SCC Amenity Value

Impact	2030	2040	2050
Employment impacts (thousands of FTE)	**1.99**	**0.28**	**2.64**
Output impacts (billions of $)	**-$1.84**	**-$1.45**	**$0.00**
Motor vehicle fuel price (percent)	**1.25%**	**0.32%**	**0.14%**
Electricity price (percent)	**1.91%**	**0.54%**	**0.28%**
Natural gas price (percent)	**-2.78%**	**0.17%**	**0.87%**

We also examined alternative sets of assumptions about how costs are incurred or funds are spent, for our primary analysis reflecting the proposed rule:

- Alternative 1, with assumptions consistent with our primary analysis except:
    - Costs to wholesale transportation fuel suppliers are incurred by the petroleum industry instead of the wholesale industry group.
    - Market revenues to the State are spent in line with general state government spending instead of a focus on transportation. Note that this assumption includes the sub-variable of whether spending on state government services increases amenity value.
    - Natural gas revenues are treated as a negative production cost rather than directly affecting natural gas prices.
- Alternative 2, with assumptions consistent with our primary analysis except:
    - Costs to wholesale transportation fuel suppliers are incurred by the petroleum industry instead of the wholesale industry group.
    - Natural gas revenues are treated as a negative production cost rather than directly affecting natural gas prices.
- Alternative 3, with assumptions consistent with our primary analysis except:

- Costs to wholesale transportation fuel suppliers are incurred by the petroleum industry instead of the wholesale industry group.

Employment impacts

Table 72: Employment impacts, no amenity value, thousands of FTE

Sensitivity	2030	2040	2050
REMI alternative 1	**43.13**	**8.07**	**2.22**
REMI alternative 2	**12.79**	**-0.08**	**-0.47**
REMI alternative 3	**14.59**	**-0.12**	**-0.82**

Table 73: Employment impacts, government services amenity value, thousands of FTE

Sensitivity	2030	2040	2050
REMI alternative 1	**56.25**	**20.18**	**10.07**
REMI alternative 2	**12.79**	**-0.08**	**-0.47**
REMI alternative 3	**14.59**	**-0.12**	**-0.82**

Table 74: Employment impacts, services and SCC amenity value, thousands of FTE

Sensitivity	2030	2040	2050
REMI alternative 1	**58.54**	**25.96**	**16.56**
REMI alternative 2	**15.07**	**5.68**	**6.00**
REMI alternative 3	**16.87**	**5.64**	**5.66**

Output impacts

Table 75: Output impacts, no amenity value, billions of $

Sensitivity	2030	2040	2050
REMI alternative 1	**2.66**	**-1.86**	**-0.89**
REMI alternative 2	**-2.31**	**-3.23**	**-1.44**
REMI alternative 3	**-1.96**	**-3.16**	**-1.43**

Table 76: Output impacts, government services amenity value, billions of $

Sensitivity	2030	2040	2050
REMI alternative 1	**5.06**	**0.56**	**0.85**
REMI alternative 2	**-2.31**	**-3.23**	**-1.44**
REMI alternative 3	**-1.96**	**-3.16**	**-1.43**

Table 77: Output impacts, services and SCC amenity value, billions of $

Sensitivity	2030	2040	2050
REMI alternative 1	**5.48**	**1.73**	**2.31**
REMI alternative 2	**-1.89**	**-2.07**	**0.02**
REMI alternative 3	**-1.55**	**-2.00**	**0.03**

Price impacts

Table 78: Motor vehicle fuel price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**3.68%**	**1.04%**	**0.52%**
REMI alternative 2	**3.63%**	**1.02%**	**0.52%**
REMI alternative 3	**3.63%**	**1.02%**	**0.52%**

Table 79: Motor vehicle fuel price impacts, government services amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**3.68%**	**1.04%**	**0.53%**
REMI alternative 2	**3.63%**	**1.02%**	**0.52%**
REMI alternative 3	**3.63%**	**1.02%**	**0.52%**

Table 80: Motor vehicle fuel price impacts, services and SCC amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**3.68%**	**1.04%**	**0.53%**
REMI alternative 2	**3.63%**	**1.03%**	**0.52%**
REMI alternative 3	**3.63%**	**1.02%**	**0.52%**

Table 81: Electricity price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**2.00%**	**0.58%**	**0.29%**
REMI alternative 2	**1.96%**	**0.57%**	**0.29%**
REMI alternative 3	**1.96%**	**0.56%**	**0.29%**

Table 82: Electricity price impacts, government services amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**2.01%**	**0.58%**	**0.30%**
REMI alternative 2	**1.96%**	**0.57%**	**0.29%**
REMI alternative 3	**1.96%**	**0.56%**	**0.29%**

Table 83: Electricity price impacts, services and SCC amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**2.01%**	**0.59%**	**0.30%**
REMI alternative 2	**1.96%**	**0.57%**	**0.29%**
REMI alternative 3	**1.96%**	**0.57%**	**0.29%**

Table 84: Natural gas price impacts, no amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**-1.00%**	**0.20%**	**0.77%**
REMI alternative 2	**-1.07%**	**0.18%**	**0.77%**
REMI alternative 3	**-2.80%**	**0.16%**	**0.87%**

Table 85: Natural gas price impacts, government services amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**-0.99%**	**0.21%**	**0.78%**
REMI alternative 2	**-1.07%**	**0.18%**	**0.77%**
REMI alternative 3	**-2.80%**	**0.16%**	**0.87%**

Table 86: Natural gas price impacts, services and SCC amenity value, percent

Sensitivity	2030	2040	2050
REMI alternative 1	**-0.99%**	**0.21%**	**0.78%**
REMI alternative 2	**-1.07%**	**0.19%**	**0.77%**
REMI alternative 3	**-2.80%**	**0.17%**	**0.87%**

Discussion

All three alternative REMI model input specifications result in significantly higher employment levels than in our primary scenario. This is largely a result of lower labor intensity in the petroleum sector than the wholesale sector, as well as higher labor intensity of government services, and the ability of the natural gas sector to distribute negative production costs across price, employment, and other internal business decisions.

Alternative REMI specifications 1 and 3 reduce negative output impacts, compared to our primary scenario. This is a result of lower demand elasticity (relative responsiveness of demand to price changes) in the petroleum sector than in the wholesale sector as a whole, allowing petroleum producers to pass more costs through to their direct consumers while maintaining output levels. The wholesale industry has generally higher demand elasticity. In alternative specification 1, this effect is bolstered by increased output across multiple sectors resulting from general state government spending patterns. Alternative REMI specification 2 has a difference similar to Alternative 1 underlying the results, but lacks the output bolstering effect of state spending, while less natural gas price mitigation puts downward pressure on output across industries.

Similarly, all three alternative specifications result in higher increases in motor vehicle fuel prices, due to the lower demand elasticity faced by the petroleum sector compared to the wholesale sector. Less direct mitigation of natural gas price impact results in less decrease in price levels, bolstered in alternative specification 1 by broader government spending increasing economic activity and associated demand for fuels. In alternative specification 3, natural gas price increases are directly mitigated by allowance market revenues, but higher motor vehicle fuel prices result in substitution to natural gas and electricity. Electricity price impacts are similar across our primary scenario and alternative REMI specifications, with slight upward pressure exerted by substitution from motor vehicle fuels, and downward pressure exerted by substitution to natural gas.

Appendix H: Full Allowance Market Model Data Tables

Modeling performed by Vivid Economics[99] provided the following allowance price trajectories by scenario. These were the basis of our primary analysis and sensitivity analyses, and informed the proposed rule.

H.1 Primary analysis: The proposed rule with central assumptions (including frontloading of APCR allowances through 2030)

Table 87: Primary analysis prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**58.31**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**61.21**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**64.76**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**69.96**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**76.91**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**84.01**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**92.76**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**100.23**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**92.57**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**92.63**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**96.74**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.35**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.58**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.79**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**59.72**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.39**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**

[99] Vivid Economics with McKinsey & Company, 2022. Washington State Climate Commitment Act, Economic modeling and analysis of the proposed cap and invest program. May 6, 2022.

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.20**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.91**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.30**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.47**	**169.41**	**217.68**	**72.48**	**265.95**

Table 88: Primary analysis volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,944,519**	**12,225,474**	**10,972,931**	**8,423,494**	**25,322,621**	**27,770,514**	**58,354,932**	**58,501,299**	**9,299,594**	**1,043,573**	**-**
2024	**52,905,144**	**11,260,997**	**9,094,768**	**8,224,713**	**24,324,667**	**24,313,109**	**55,248,639**	**54,097,976**	**-**	**693,049**	**-**
2025	**48,306,209**	**10,622,797**	**6,959,114**	**7,943,011**	**22,781,288**	**20,911,727**	**51,877,213**	**49,694,652**	**-**	**7,562,971**	**-**
2026	**44,062,212**	**9,993,411**	**5,353,109**	**7,145,714**	**21,569,978**	**17,863,091**	**48,633,872**	**45,291,328**	**-**	**-**	**-**
2027	**41,441,506**	**9,331,932**	**5,292,773**	**6,541,876**	**20,274,925**	**16,472,860**	**47,114,812**	**40,888,005**	**-**	**-**	**-**
2028	**38,893,574**	**8,634,916**	**5,379,086**	**5,954,099**	**18,925,473**	**15,549,870**	**45,684,197**	**36,484,681**	**-**	**-**	**-**
2029	**36,491,645**	**7,936,620**	**5,569,488**	**5,419,721**	**17,565,816**	**14,775,690**	**44,333,454**	**32,081,358**	**-**	**-**	**-**
2030	**33,801,018**	**7,230,163**	**5,256,464**	**5,100,676**	**16,213,716**	**13,379,075**	**42,546,031**	**27,678,034**	**-**	**-**	**-**
2031	**31,231,324**	**6,592,729**	**4,932,744**	**4,760,226**	**14,945,625**	**12,301,798**	**40,737,212**	**26,482,846**	**714,440**	**714,034**	**-**
2032	**28,841,787**	**6,000,788**	**4,622,529**	**4,450,556**	**13,767,914**	**11,291,038**	**38,876,018**	**25,287,658**	**682,196**	**682,602**	**-**
2033	**26,668,227**	**5,454,999**	**4,307,624**	**4,183,143**	**12,722,462**	**10,339,180**	**37,125,878**	**24,092,471**	**649,953**	**649,831**	**-**
2034	**24,523,838**	**4,941,580**	**3,987,465**	**3,897,834**	**11,696,959**	**9,414,141**	**35,292,279**	**22,897,283**	**617,710**	**269,465**	**-**
2035	**22,625,592**	**4,494,104**	**3,662,372**	**3,676,915**	**10,792,201**	**8,571,184**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,461,573**	**4,161,655**	**3,316,312**	**3,276,765**	**9,706,842**	**7,802,783**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,366,041**	**3,935,011**	**2,969,775**	**2,851,889**	**8,609,366**	**7,147,518**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,267,008**	**3,714,143**	**2,617,608**	**2,421,068**	**7,514,189**	**6,491,767**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,487,824**	**3,551,699**	**2,259,910**	**2,161,719**	**6,514,496**	**5,901,589**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,799,423**	**3,398,850**	**1,896,681**	**1,920,519**	**5,583,374**	**5,318,133**	**22,709,819**	**15,726,156**	**-**	**-**	**-815,017**
2041	**11,267,576**	**3,239,314**	**1,527,591**	**1,754,576**	**4,746,096**	**4,739,229**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,617,093**
2042	**9,776,759**	**3,074,447**	**1,153,276**	**1,577,985**	**3,971,051**	**4,156,872**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,527,650**
2043	**8,380,972**	**2,922,101**	**773,906**	**1,407,469**	**3,277,496**	**3,589,647**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,611,811**
2044	**7,078,296**	**2,780,871**	**389,463**	**1,231,213**	**2,676,750**	**3,035,493**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,553,613**
2045	**5,874,851**	**2,650,586**	**-**	**1,059,046**	**2,165,219**	**2,494,728**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,352,850**
2046	**5,146,143**	**2,535,787**	**-**	**870,178**	**1,740,178**	**2,383,640**	**13,409,501**	**7,045,318**	**-**	**-**	**-3,028,763**
2047	**4,488,553**	**2,433,252**	**-**	**700,336**	**1,354,965**	**2,287,257**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,923,159**	**2,337,644**	**-**	**560,440**	**1,025,075**	**2,197,385**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,461,055**	**2,246,945**	**-**	**436,474**	**777,636**	**2,112,128**	**10,470,058**	**2,327,471**	**-**	**-**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2050	**3,097,227**	**2,166,721**	**-**	**333,554**	**596,952**	**2,036,717**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.2 Primary scenario with 2025 linkage expectation

Table 89: Primary scenario with 2025 linkage prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**40.74**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**41.28**	**47.65**	**61.21**	**20.39**	**74.79**

Table 90: Primary scenario with 2025 linkage volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,508,136**	**12,370,517**	**10,972,931**	**8,532,699**	**25,631,990**	**27,986,151**	**58,354,932**	**58,501,299**	**-**	**-**	**-**
2024	**54,036,766**	**11,803,144**	**9,094,768**	**8,354,694**	**24,784,160**	**24,930,248**	**55,248,639**	**54,097,976**	**-**	**-**	**-**

H.3 Central scenario (no frontloading of APCR allowances)

Table 91: Central scenario prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**67.93**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**67.68**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**73.47**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**76.18**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**77.22**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**81.47**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**88.75**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**95.25**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**90.17**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.87**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**95.21**	**73.91**	**94.98**	**31.62**	**116.03**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2034	**97.79**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.56**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.82**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.96**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**60.06**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.48**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.23**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.97**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.39**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.60**	**169.41**	**217.68**	**72.48**	**265.95**

Table 92: Central scenario volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,768,478**	**12,176,502**	**10,972,931**	**8,388,668**	**25,230,379**	**27,699,117**	**58,354,932**	**58,501,299**	**1,578,216**	**1,578,216**	**-**
2024	**52,737,798**	**11,211,105**	**9,094,768**	**8,195,928**	**24,235,997**	**24,246,651**	**55,248,639**	**54,097,976**	**1,459,425**	**1,457,955**	**-**
2025	**48,032,558**	**10,563,281**	**6,959,114**	**7,904,473**	**22,605,690**	**20,832,711**	**51,877,213**	**49,694,652**	**1,340,635**	**1,340,576**	**-**
2026	**43,817,922**	**9,930,670**	**5,353,109**	**7,100,677**	**21,433,466**	**17,780,630**	**48,633,872**	**45,291,328**	**1,221,844**	**1,222,871**	**-**
2027	**41,258,124**	**9,280,700**	**5,292,773**	**6,517,117**	**20,167,534**	**16,412,845**	**47,114,812**	**40,888,005**	**1,103,054**	**1,102,282**	**-**
2028	**38,812,690**	**8,610,423**	**5,379,086**	**5,952,727**	**18,870,454**	**15,525,534**	**45,684,197**	**36,484,681**	**984,264**	**985,538**	**-**
2029	**36,520,907**	**7,942,788**	**5,569,488**	**5,437,585**	**17,571,046**	**14,788,055**	**44,333,454**	**32,081,358**	**865,473**	**865,280**	**-**
2030	**33,905,743**	**7,261,265**	**5,256,464**	**5,134,243**	**16,253,771**	**13,418,498**	**42,546,031**	**27,678,034**	**746,683**	**746,875**	**-**
2031	**31,365,142**	**6,637,375**	**4,932,744**	**4,801,945**	**14,993,078**	**12,353,931**	**40,737,212**	**26,482,846**	**714,440**	**714,101**	**-**
2032	**28,981,658**	**6,047,991**	**4,622,529**	**4,493,902**	**13,817,236**	**11,344,785**	**38,876,018**	**25,287,658**	**682,196**	**682,535**	**-**
2033	**26,793,635**	**5,500,540**	**4,307,624**	**4,225,889**	**12,759,583**	**10,390,404**	**37,125,878**	**24,092,471**	**649,953**	**649,953**	**-**
2034	**24,637,756**	**4,983,527**	**3,987,465**	**3,938,606**	**11,728,158**	**9,460,928**	**35,292,279**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,719,745**	**4,530,915**	**3,662,372**	**3,712,502**	**10,813,957**	**8,611,642**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,536,734**	**4,194,310**	**3,316,312**	**3,305,101**	**9,721,011**	**7,838,093**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,422,931**	**3,963,592**	**2,969,775**	**2,873,270**	**8,616,293**	**7,178,011**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,305,113**	**3,731,243**	**2,617,608**	**2,437,905**	**7,518,357**	**6,510,579**	**27,150,918**	**18,116,531**	**-**	**-**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2039	**14,506,034**	**3,551,946**	**2,259,910**	**2,176,553**	**6,517,625**	**5,903,916**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,815,352**	**3,399,056**	**1,896,681**	**1,933,556**	**5,586,059**	**5,319,865**	**22,709,819**	**15,726,156**	**-**	**-**	**-742,930**
2041	**11,282,224**	**3,239,483**	**1,527,591**	**1,766,189**	**4,748,961**	**4,740,492**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,590,649**
2042	**9,789,480**	**3,074,584**	**1,153,276**	**1,588,147**	**3,973,473**	**4,157,731**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,503,670**
2043	**8,391,689**	**2,922,199**	**773,906**	**1,416,212**	**3,279,371**	**3,590,168**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,601,305**
2044	**7,087,132**	**2,780,921**	**389,463**	**1,238,581**	**2,678,168**	**3,035,732**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,545,962**
2045	**5,881,950**	**2,650,576**	**-**	**1,065,122**	**2,166,253**	**2,494,737**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,342,603**
2046	**5,151,299**	**2,535,706**	**-**	**874,682**	**1,740,910**	**2,383,564**	**13,409,501**	**7,045,318**	**-**	**-**	**-661,545**
2047	**4,492,155**	**2,433,093**	**-**	**703,635**	**1,355,426**	**2,287,108**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,925,541**	**2,337,409**	**-**	**562,815**	**1,025,316**	**2,197,164**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,462,539**	**2,246,651**	**-**	**438,152**	**777,736**	**2,111,852**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,098,033**	**2,166,385**	**-**	**334,675**	**596,974**	**2,036,402**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.4 Central scenario with frontloading of APCR allowances through 2026

Table 93: Central scenario with 2026 frontloading prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**63.12**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**66.10**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**73.54**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**76.95**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**78.08**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**82.48**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**89.60**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**95.96**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**90.11**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.62**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**95.06**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.57**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.82**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**59.34**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**61.46**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**47.23**	**99.05**	**127.27**	**42.38**	**155.49**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.29**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**67.11**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.58**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.70**	**169.41**	**217.68**	**72.48**	**265.95**

Table 94: Central scenario with 2026 frontloading volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,836,175**	**12,192,150**	**10,972,931**	**8,404,007**	**25,267,088**	**27,724,630**	**58,354,932**	**58,501,299**	**5,600,120**	**5,600,120**	**1,916.67**
2024	**52,781,955**	**11,227,208**	**9,094,768**	**8,203,283**	**24,256,696**	**24,266,988**	**55,248,639**	**54,097,976**	**-**	**-**	**-**
2025	**48,098,347**	**10,579,477**	**6,959,114**	**7,907,664**	**22,652,092**	**20,850,535**	**51,877,213**	**49,694,652**	**-**	**-**	**-**
2026	**43,846,259**	**9,944,554**	**5,353,109**	**7,099,291**	**21,449,304**	**17,793,917**	**48,633,872**	**45,291,328**	**-**	**-**	**-**
2027	**41,266,040**	**9,291,610**	**5,292,773**	**6,512,360**	**20,169,296**	**16,421,458**	**47,114,812**	**40,888,005**	**1,103,054**	**1,103,054**	**-**
2028	**38,808,044**	**8,619,589**	**5,379,086**	**5,946,092**	**18,863,278**	**15,531,825**	**45,684,197**	**36,484,681**	**984,264**	**983,398**	**-**
2029	**36,515,562**	**7,951,309**	**5,569,488**	**5,430,406**	**17,564,360**	**14,793,681**	**44,333,454**	**32,081,358**	**865,473**	**866,339**	**-**
2030	**33,900,756**	**7,270,239**	**5,256,464**	**5,126,862**	**16,247,191**	**13,424,459**	**42,546,031**	**27,678,034**	**746,683**	**746,569**	**-**
2031	**31,365,008**	**6,648,313**	**4,932,744**	**4,795,927**	**14,988,023**	**12,362,345**	**40,737,212**	**26,482,846**	**714,440**	**714,554**	**-**
2032	**28,987,584**	**6,061,532**	**4,622,529**	**4,489,123**	**13,814,400**	**11,356,048**	**38,876,018**	**25,287,658**	**682,196**	**682,196**	**-**
2033	**26,805,717**	**5,517,157**	**4,307,624**	**4,222,547**	**12,758,389**	**10,404,889**	**37,125,878**	**24,092,471**	**649,953**	**649,765**	**-**
2034	**24,650,267**	**5,002,947**	**3,987,465**	**3,934,993**	**11,724,862**	**9,477,903**	**35,292,279**	**22,897,283**	**617,710**	**62,556**	**-**
2035	**22,746,071**	**4,553,516**	**3,662,372**	**3,712,358**	**10,817,825**	**8,632,333**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,567,851**	**4,217,175**	**3,316,312**	**3,306,744**	**9,727,619**	**7,859,298**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,455,508**	**3,987,778**	**2,969,775**	**2,875,314**	**8,622,640**	**7,200,614**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,338,721**	**3,758,246**	**2,617,608**	**2,438,691**	**7,524,176**	**6,535,887**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,514,676**	**3,552,091**	**2,259,910**	**2,177,281**	**6,525,393**	**5,904,122**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,825,606**	**3,399,238**	**1,896,681**	**1,934,633**	**5,595,054**	**5,320,162**	**22,709,819**	**15,726,156**	**-**	**-**	**-372,487**
2041	**11,292,074**	**3,239,750**	**1,527,591**	**1,767,374**	**4,757,359**	**4,740,855**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,608,554**
2042	**9,799,033**	**3,075,067**	**1,153,276**	**1,589,575**	**3,981,116**	**4,158,288**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,521,261**
2043	**8,401,742**	**2,923,135**	**773,906**	**1,417,973**	**3,286,727**	**3,591,134**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,596,011**
2044	**7,097,958**	**2,782,675**	**389,463**	**1,240,730**	**2,685,091**	**3,037,436**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,550,824**
2045	**5,893,877**	**2,653,643**	**-**	**1,067,667**	**2,172,567**	**2,497,627**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,344,008**
2046	**5,164,718**	**2,540,669**	**-**	**877,578**	**1,746,472**	**2,388,229**	**13,409,501**	**7,045,318**	**-**	**-**	**-654,909**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2047	**4,507,341**	**2,440,505**	**-**	**706,734**	**1,360,101**	**2,294,075**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,942,708**	**2,347,615**	**-**	**565,971**	**1,029,122**	**2,206,759**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,481,600**	**2,259,574**	**-**	**441,222**	**780,804**	**2,124,000**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,118,467**	**2,181,532**	**-**	**337,493**	**599,442**	**2,050,640**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.5 Central scenario with frontloading of APCR allowances through 2040

Table 95: Central scenario with 2040 frontloading prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**52.85**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**56.26**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**62.64**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**65.79**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**70.29**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**74.41**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**78.13**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**82.56**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**87.43**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**93.31**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**101.84**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**105.77**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**68.12**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**62.25**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**62.81**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**64.27**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**47.76**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.29**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**67.02**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.33**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.20**	**169.41**	**217.68**	**72.48**	**265.95**

Table 96: Central scenario with 2040 frontloading volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,124,272**	**12,298,254**	**10,972,931**	**8,453,029**	**25,400,058**	**27,862,371**	**58,354,932**	**58,501,299**	**14,993,049**	**-**	**-**
2024	**53,232,172**	**11,444,121**	**9,094,768**	**8,257,086**	**24,436,197**	**24,514,911**	**55,248,639**	**54,097,976**	**-**	**-**	**-**
2025	**48,594,009**	**10,699,351**	**6,959,114**	**7,980,362**	**22,955,182**	**21,007,293**	**51,877,213**	**49,694,652**	**-**	**-**	**-**
2026	**44,491,487**	**10,098,210**	**5,353,109**	**7,252,800**	**21,787,367**	**18,014,943**	**48,633,872**	**45,291,328**	**-**	**-**	**-**
2027	**41,994,182**	**9,476,630**	**5,292,773**	**6,706,393**	**20,518,386**	**16,681,722**	**47,114,812**	**40,888,005**	**-**	**-**	**-**
2028	**39,587,140**	**8,825,059**	**5,379,086**	**6,162,528**	**19,220,467**	**15,816,292**	**45,684,197**	**36,484,681**	**-**	**3,030,261**	**-**
2029	**37,303,071**	**8,166,746**	**5,569,488**	**5,660,436**	**17,906,401**	**15,087,655**	**44,333,454**	**32,081,358**	**-**	**6,425,503**	**-**
2030	**34,673,833**	**7,479,659**	**5,256,464**	**5,357,553**	**16,580,157**	**13,700,282**	**42,546,031**	**27,678,034**	**-**	**5,531,049**	**-**
2031	**32,026,402**	**6,829,465**	**4,932,744**	**4,996,477**	**15,267,716**	**12,597,010**	**40,737,212**	**26,482,846**	**-**	**-**	**-**
2032	**29,506,066**	**6,192,780**	**4,622,529**	**4,651,495**	**14,039,262**	**11,530,568**	**38,876,018**	**25,287,658**	**-**	**-**	**-**
2033	**27,139,791**	**5,598,529**	**4,307,624**	**4,349,133**	**12,884,505**	**10,521,687**	**37,125,878**	**24,092,471**	**-**	**-**	**-**
2034	**24,866,623**	**5,044,438**	**3,987,465**	**4,034,833**	**11,799,887**	**9,549,297**	**35,292,279**	**22,897,283**	**-**	**-**	**-**
2035	**22,887,942**	**4,563,504**	**3,662,372**	**3,795,865**	**10,866,201**	**8,668,874**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,661,212**	**4,216,452**	**3,316,312**	**3,373,492**	**9,754,956**	**7,879,967**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,524,313**	**3,973,545**	**2,969,775**	**2,939,600**	**8,641,392**	**7,203,953**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,383,577**	**3,726,319**	**2,617,608**	**2,506,764**	**7,532,886**	**6,518,594**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,585,583**	**3,551,783**	**2,259,910**	**2,245,027**	**6,528,863**	**5,913,604**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,885,394**	**3,398,760**	**1,896,681**	**1,995,431**	**5,594,522**	**5,326,899**	**22,709,819**	**15,726,156**	**-**	**-**	**-5,448.11**
2041	**11,346,024**	**3,238,959**	**1,527,591**	**1,821,920**	**4,757,554**	**4,745,293**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,463,391**
2042	**9,843,913**	**3,073,558**	**1,153,276**	**1,637,218**	**3,979,861**	**4,160,300**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,387,620**
2043	**8,436,060**	**2,920,165**	**773,906**	**1,458,451**	**3,283,537**	**3,590,326**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,571,425**
2044	**7,121,136**	**2,777,109**	**389,463**	**1,273,887**	**2,680,678**	**3,033,066**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,513,931**
2045	**5,905,283**	**2,643,962**	**-**	**1,093,668**	**2,167,654**	**2,488,605**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,309,624**
2046	**5,162,148**	**2,525,147**	**-**	**895,279**	**1,741,722**	**2,373,639**	**13,409,501**	**7,045,318**	**-**	**-**	**-639,705**
2047	**4,491,078**	**2,417,602**	**-**	**717,877**	**1,355,599**	**2,272,546**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,913,622**	**2,316,541**	**-**	**572,100**	**1,024,982**	**2,177,549**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,441,659**	**2,220,886**	**-**	**443,679**	**777,093**	**2,087,633**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,070,783**	**2,136,933**	**-**	**337,655**	**596,195**	**2,008,717**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.6 Central scenario with frontloading through 2050

Table 97: Central scenario with 2050 frontloading prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**50.03**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**53.90**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**60.37**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**63.38**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**68.82**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**74.41**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**78.13**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**82.04**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**86.15**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.45**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**68.62**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**63.08**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**64.32**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**66.47**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**48.32**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**45.08**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.34**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**67.16**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.59**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.56**	**169.41**	**217.68**	**72.48**	**265.95**

Table 98: Central scenario with 2050 frontloading volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,189,144**	**12,318,737**	**10,972,931**	**8,465,862**	**25,431,615**	**27,891,133**	**58,354,932**	**58,501,299**	**17,094,969**	**-**	**-**
2024	**53,377,825**	**11,539,965**	**9,094,768**	**8,270,029**	**24,473,064**	**24,618,215**	**55,248,639**	**54,097,976**	**-**	**-**	**-**
2025	**48,692,095**	**10,714,994**	**6,959,114**	**7,998,927**	**23,019,059**	**21,032,364**	**51,877,213**	**49,694,652**	**-**	**-**	**-**
2026	**44,621,159**	**10,120,344**	**5,353,109**	**7,291,127**	**21,856,579**	**18,053,904**	**48,633,872**	**45,291,328**	**-**	**-**	**-**
2027	**42,147,318**	**9,507,633**	**5,292,773**	**6,755,706**	**20,591,205**	**16,732,337**	**47,114,812**	**40,888,005**	**-**	**-**	**-**
2028	**39,756,288**	**8,866,493**	**5,379,086**	**6,216,910**	**19,293,799**	**15,877,909**	**45,684,197**	**36,484,681**	**-**	**1,400,495**	**-**
2029	**37,489,486**	**8,219,680**	**5,569,488**	**5,719,754**	**17,980,564**	**15,160,946**	**44,333,454**	**32,081,358**	**-**	**5,643,064**	**-**
2030	**34,878,737**	**7,546,427**	**5,256,464**	**5,423,105**	**16,652,741**	**13,785,132**	**42,546,031**	**27,678,034**	**-**	**5,710,894**	**-**
2031	**32,264,430**	**6,912,019**	**4,932,744**	**5,072,481**	**15,347,186**	**12,696,675**	**40,737,212**	**26,482,846**	**-**	**135,230**	**-**
2032	**29,777,136**	**6,290,096**	**4,622,529**	**4,735,714**	**14,128,797**	**11,643,568**	**38,876,018**	**25,287,658**	**-**	**766,520**	**-**
2033	**27,445,976**	**5,706,908**	**4,307,624**	**4,442,706**	**12,988,739**	**10,644,960**	**37,125,878**	**24,092,471**	**-**	**1,590,408**	**-**
2034	**25,175,286**	**5,157,546**	**3,987,465**	**4,127,563**	**11,902,712**	**9,674,529**	**35,292,279**	**22,897,283**	**-**	**472,815**	**-**
2035	**23,168,256**	**4,674,020**	**3,662,372**	**3,878,696**	**10,953,168**	**8,787,953**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,899,931**	**4,317,700**	**3,316,312**	**3,440,559**	**9,825,360**	**7,987,147**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,710,661**	**4,067,829**	**2,969,775**	**2,992,150**	**8,680,906**	**7,301,965**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,546,085**	**3,816,082**	**2,617,608**	**2,550,028**	**7,562,367**	**6,610,085**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,654,625**	**3,554,341**	**2,259,910**	**2,284,351**	**6,556,022**	**5,921,566**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,944,647**	**3,399,312**	**1,896,681**	**2,030,347**	**5,618,307**	**5,331,538**	**22,709,819**	**15,726,156**	**-**	**-**	**-**
2041	**11,403,025**	**3,239,654**	**1,527,591**	**1,853,902**	**4,781,878**	**4,748,985**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,009,728**
2042	**9,896,827**	**3,074,704**	**1,153,276**	**1,666,153**	**4,002,694**	**4,163,461**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,303,706**
2043	**8,485,074**	**2,922,277**	**773,906**	**1,484,567**	**3,304,323**	**3,593,591**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,527,783**
2044	**7,167,193**	**2,780,939**	**389,463**	**1,297,358**	**2,699,433**	**3,037,277**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,483,145**
2045	**5,949,442**	**2,650,501**	**-**	**1,114,675**	**2,184,267**	**2,494,815**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,283,773**
2046	**5,204,717**	**2,535,496**	**-**	**913,119**	**1,756,102**	**2,383,366**	**13,409,501**	**7,045,318**	**-**	**-**	**-617,149**
2047	**4,533,235**	**2,432,706**	**-**	**733,073**	**1,367,456**	**2,286,744**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,956,103**	**2,336,813**	**-**	**584,997**	**1,034,293**	**2,196,604**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,484,712**	**2,245,843**	**-**	**454,530**	**784,339**	**2,111,092**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,113,714**	**2,165,364**	**-**	**346,540**	**601,810**	**2,035,442**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.7 Central scenario with 2027 expected linkage

Table 99: Central scenario with 2027 linkage prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	49.46	45.37	58.31	19.41	71.23
2024	49.31	47.65	61.21	20.39	74.79
2025	54.14	50.03	64.28	21.40	78.54
2026	56.36	52.53	67.49	22.47	82.46

Table 100: Central scenario with 2027 linkage volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,346,411**	**12,352,977**	**10,972,931**	**8,499,476**	**25,521,027**	**27,947,210**	**58,354,932**	**58,501,299**	**1,576,891**	**-**	**-**
2024	**53,748,933**	**11,678,525**	**9,094,768**	**8,322,327**	**24,653,313**	**24,787,016**	**55,248,639**	**54,097,976**	**1,460,750**	**-**	**-**
2025	**49,283,209**	**10,896,255**	**6,959,114**	**8,125,583**	**23,302,257**	**21,278,109**	**51,877,213**	**49,694,652**	**1,340,635**	**-**	**-**
2026	**45,360,418**	**10,149,112**	**5,353,109**	**7,572,652**	**22,285,545**	**18,206,434**	**48,633,872**	**45,291,328**	**1,221,844**	**-**	**-**

H.8 Central scenario with 2030 expected linkage

Table 101: Central scenario with 2030 linkage prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**58.00**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**57.91**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**63.49**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**64.43**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**59.87**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**61.17**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**66.14**	**60.81**	**78.13**	**26.02**	**95.46**

Table 102: Central scenario with 2030 linkage volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,130,944**	**12,294,917**	**10,972,931**	**8,461,365**	**25,401,731**	**27,864,567**	**58,354,932**	**58,501,299**	**1,578,216**	**-**	**-**
2024	**53,231,501**	**11,363,203**	**9,094,768**	**8,281,442**	**24,492,089**	**24,448,152**	**55,248,639**	**54,097,976**	**1,459,165**	**-**	**-**
2025	**48,747,741**	**10,695,966**	**6,959,114**	**8,056,974**	**23,035,687**	**21,042,995**	**51,877,213**	**49,694,652**	**1,340,895**	**-**	**-**
2026	**44,905,255**	**10,097,836**	**5,353,109**	**7,460,738**	**21,993,572**	**18,106,041**	**48,633,872**	**45,291,328**	**1,220,662**	**-**	**-**
2027	**42,704,326**	**9,482,872**	**5,292,773**	**7,044,232**	**20,884,450**	**16,828,501**	**47,114,812**	**40,888,005**	**1,103,793**	**-**	**-**
2028	**40,549,323**	**8,841,183**	**5,379,086**	**6,598,139**	**19,730,916**	**16,003,376**	**45,684,197**	**36,484,681**	**984,012**	**-**	**-**
2029	**38,469,396**	**8,180,902**	**5,569,488**	**6,158,307**	**18,560,699**	**15,285,599**	**44,333,454**	**32,081,358**	**865,317**	**-**	**-**

H.9 Central scenario with lower prices expected after 2025 linkage

Table 103: Central scenario with lower expected 2025 linkage prices, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**33.36**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**33.67**	**47.65**	**61.21**	**20.39**	**74.79**

Table 104: Central scenario with lower expected 2025 linkage prices, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,696,369**	**12,388,820**	**10,972,931**	**8,574,838**	**25,759,780**	**28,031,683**	**58,354,932**	**58,501,299**	**-**	**-**	**-**
2024	**54,479,626**	**12,019,095**	**9,094,768**	**8,405,926**	**24,959,837**	**25,175,762**	**55,248,639**	**54,097,976**	**-**	**-**	**-**

H.10 Central scenario with higher prices expected after 2025 linkage

Table 105: Central scenario with higher expected 2025 linkage prices, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**51.19**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**52.00**	**47.65**	**61.21**	**20.39**	**74.79**

Table 106: Central scenario with higher expected 2025 linkage prices, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,366,677**	**11,499,139**	**10,972,931**	**8,455,993**	**25,438,614**	**27,065,147**	**58,354,932**	**58,501,299**	**1,576,148**	**-**	**-**
2024	**52,786,074**	**10,926,942**	**9,094,768**	**8,260,454**	**24,503,911**	**23,999,600**	**55,248,639**	**54,097,976**	**1,460,218**	**-**	**-**

H.11 Central scenario (no frontloading of APCR allowances) without price ceiling

Table 107: Central scenario without price ceiling, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)
2023	**67.99**	**45.37**	**58.31**	**19.41**
2024	**67.87**	**47.65**	**61.21**	**20.39**
2025	**73.73**	**50.03**	**64.28**	**21.40**
2026	**76.29**	**52.53**	**67.49**	**22.47**
2027	**77.21**	**55.15**	**70.87**	**23.60**
2028	**81.48**	**57.91**	**74.41**	**24.77**
2029	**88.65**	**60.81**	**78.13**	**26.02**
2030	**95.15**	**63.85**	**82.04**	**27.32**
2031	**89.96**	**67.04**	**86.15**	**28.69**
2032	**90.45**	**70.40**	**90.45**	**30.11**
2033	**94.98**	**73.91**	**94.98**	**31.62**
2034	**97.56**	**77.61**	**99.73**	**33.20**
2035	**64.46**	**81.49**	**104.71**	**34.86**
2036	**58.69**	**85.57**	**109.95**	**36.60**
2037	**58.77**	**89.84**	**115.44**	**38.43**
2038	**59.76**	**94.33**	**121.21**	**40.35**
2039	**46.35**	**99.05**	**127.27**	**42.38**
2040	**44.49**	**104.00**	**133.63**	**44.49**
2041	**46.72**	**109.20**	**140.32**	**46.72**
2042	**49.05**	**114.66**	**147.34**	**49.05**
2043	**51.50**	**120.39**	**154.70**	**51.50**
2044	**54.08**	**126.42**	**162.43**	**54.08**
2045	**56.78**	**132.74**	**170.56**	**56.78**
2046	**59.62**	**139.38**	**179.09**	**59.62**
2047	**63.18**	**146.34**	**188.04**	**62.61**
2048	**66.91**	**153.66**	**197.44**	**65.74**
2049	**72.30**	**161.35**	**207.31**	**69.03**
2050	**81.46**	**169.41**	**217.68**	**72.48**

Table 108: Central scenario without price ceiling, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,767,211**	**12,175,759**	**10,972,931**	**8,388,487**	**25,230,035**	**27,698,259**	**58,354,932**	**58,501,299**	**1,578,216**	**1,577,750**	**-**
2024	**52,735,591**	**11,210,560**	**9,094,768**	**8,195,402**	**24,234,861**	**24,245,805**	**55,248,639**	**54,097,976**	**1,459,425**	**1,457,875**	**-**
2025	**48,030,227**	**10,562,346**	**6,959,114**	**7,903,706**	**22,605,063**	**20,831,389**	**51,877,213**	**49,694,652**	**1,340,635**	**1,341,965**	**-**
2026	**43,814,750**	**9,929,055**	**5,353,109**	**7,099,366**	**21,433,220**	**17,778,440**	**48,633,872**	**45,291,328**	**1,221,844**	**1,222,360**	**-**
2027	**41,252,565**	**9,278,099**	**5,292,773**	**6,515,081**	**20,166,612**	**16,409,473**	**47,114,812**	**40,888,005**	**1,103,054**	**1,103,224**	**-**
2028	**38,803,787**	**8,606,803**	**5,379,086**	**5,949,917**	**18,867,980**	**15,520,916**	**45,684,197**	**36,484,681**	**984,264**	**983,798**	**-**
2029	**36,510,418**	**7,938,419**	**5,569,488**	**5,434,586**	**17,567,925**	**14,782,709**	**44,333,454**	**32,081,358**	**865,473**	**865,939**	**-**
2030	**33,894,760**	**7,256,285**	**5,256,464**	**5,130,957**	**16,251,054**	**13,412,719**	**42,546,031**	**27,678,034**	**746,683**	**746,683**	**-**
2031	**31,353,644**	**6,632,115**	**4,932,744**	**4,798,555**	**14,990,229**	**12,347,995**	**40,737,212**	**26,482,846**	**714,440**	**714,440**	**-**
2032	**28,971,180**	**6,042,664**	**4,622,529**	**4,490,666**	**13,815,322**	**11,338,936**	**38,876,018**	**25,287,658**	**682,196**	**681,963**	**-**
2033	**26,782,465**	**5,495,275**	**4,307,624**	**4,222,423**	**12,757,143**	**10,384,635**	**37,125,878**	**24,092,471**	**649,953**	**585,890**	**-**
2034	**24,626,911**	**4,978,416**	**3,987,465**	**3,935,192**	**11,725,838**	**9,455,395**	**35,292,279**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,708,891**	**4,525,918**	**3,662,372**	**3,708,972**	**10,811,630**	**8,606,268**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,526,382**	**4,189,532**	**3,316,312**	**3,301,628**	**9,718,910**	**7,833,015**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,413,103**	**3,959,011**	**2,969,775**	**2,870,148**	**8,614,169**	**7,173,211**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,296,466**	**3,726,813**	**2,617,608**	**2,435,338**	**7,516,706**	**6,506,022**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,501,999**	**3,551,922**	**2,259,910**	**2,174,220**	**6,515,947**	**5,903,568**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,811,613**	**3,399,032**	**1,896,681**	**1,931,450**	**5,584,450**	**5,319,595**	**22,709,819**	**15,726,156**	**-**	**-**	**-812,705**
2041	**11,278,944**	**3,239,457**	**1,527,591**	**1,764,301**	**4,747,595**	**4,740,288**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,593,765**
2042	**9,786,577**	**3,074,546**	**1,153,276**	**1,586,471**	**3,972,283**	**4,157,575**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,506,597**
2043	**8,389,106**	**2,922,135**	**773,906**	**1,414,737**	**3,278,327**	**3,590,035**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,592,756**
2044	**7,084,826**	**2,780,808**	**389,463**	**1,237,297**	**2,677,259**	**3,035,592**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,546,017**
2045	**5,879,877**	**2,650,383**	**-**	**1,064,015**	**2,165,479**	**2,494,552**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,344,107**
2046	**5,149,447**	**2,535,397**	**-**	**873,790**	**1,740,260**	**2,383,273**	**13,409,501**	**7,045,318**	**-**	**-**	**-666,346**
2047	**4,490,483**	**2,432,635**	**-**	**702,922**	**1,354,926**	**2,286,677**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,923,979**	**2,336,782**	**-**	**562,243**	**1,024,955**	**2,196,575**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,461,070**	**2,245,885**	**-**	**437,712**	**777,474**	**2,111,131**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,096,701**	**2,165,514**	**-**	**334,376**	**596,812**	**2,035,583**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.12 Central scenario (no frontloading of APCR allowances) without price floor

Table 109: Central scenario without price floor, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price ceiling ($)
2023	**70.89**	**45.37**	**58.31**	**71.23**
2024	**70.75**	**47.65**	**61.21**	**74.79**
2025	**76.88**	**50.03**	**64.28**	**78.54**
2026	**79.49**	**52.53**	**67.49**	**82.46**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price ceiling ($)
2027	**80.54**	**55.15**	**70.87**	**86.59**
2028	**84.98**	**57.91**	**74.41**	**90.92**
2029	**92.41**	**60.81**	**78.13**	**95.46**
2030	**99.17**	**63.85**	**82.04**	**100.23**
2031	**94.24**	**67.04**	**86.15**	**105.24**
2032	**95.20**	**70.40**	**90.45**	**110.50**
2033	**101.52**	**73.91**	**94.98**	**116.03**
2034	**104.63**	**77.61**	**99.73**	**121.83**
2035	**67.34**	**81.49**	**104.71**	**127.92**
2036	**62.15**	**85.57**	**109.95**	**134.32**
2037	**67.15**	**89.84**	**115.44**	**141.04**
2038	**70.22**	**94.33**	**121.21**	**148.08**
2039	**31.94**	**99.05**	**127.27**	**155.49**
2040	**28.37**	**104.00**	**133.63**	**163.27**
2041	**28.06**	**109.20**	**140.32**	**171.43**
2042	**28.86**	**114.66**	**147.34**	**180.00**
2043	**27.49**	**120.39**	**154.70**	**189.00**
2044	**28.19**	**126.42**	**162.43**	**198.46**
2045	**29.99**	**132.74**	**170.56**	**208.37**
2046	**33.14**	**139.38**	**179.09**	**218.80**
2047	**38.56**	**146.34**	**188.04**	**229.73**
2048	**43.79**	**153.66**	**197.44**	**241.22**
2049	**50.14**	**161.35**	**207.31**	**253.28**
2050	**59.12**	**169.41**	**217.68**	**265.95**

Table 110: Central scenario without price floor, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,742,953**	**12,215,843**	**10,972,931**	**8,368,773**	**25,185,406**	**27,725,593**	**58,354,932**	**58,501,299**	**1,578,216**	**1,578,216**	**-**
2024	**52,708,284**	**11,263,659**	**9,094,768**	**8,177,769**	**24,172,089**	**24,288,734**	**55,248,639**	**54,097,976**	**1,459,425**	**1,459,425**	**-**
2025	**47,977,290**	**10,639,202**	**6,959,114**	**7,878,560**	**22,500,414**	**20,895,477**	**51,877,213**	**49,694,652**	**1,340,635**	**1,340,635**	**-**
2026	**43,717,192**	**10,038,285**	**5,353,109**	**7,018,882**	**21,306,916**	**17,852,307**	**48,633,872**	**45,291,328**	**1,221,844**	**1,221,844**	**-**
2027	**41,144,282**	**9,430,976**	**5,292,773**	**6,401,217**	**20,019,315**	**16,510,332**	**47,114,812**	**40,888,005**	**1,103,054**	**1,102,962**	**-**
2028	**38,716,221**	**8,813,309**	**5,379,086**	**5,818,954**	**18,704,873**	**15,669,679**	**45,684,197**	**36,484,681**	**984,264**	**983,563**	**-**
2029	**36,471,973**	**8,207,976**	**5,569,488**	**5,298,744**	**17,395,765**	**14,993,959**	**44,333,454**	**32,081,358**	**865,473**	**866,266**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2030	**33,928,641**	**7,591,657**	**5,256,464**	**5,001,038**	**16,079,482**	**13,682,951**	**42,546,031**	**27,678,034**	**746,683**	**746,487**	**-**
2031	**31,493,723**	**7,044,728**	**4,932,744**	**4,687,874**	**14,828,377**	**12,697,658**	**40,737,212**	**26,482,846**	**714,440**	**714,527**	**-**
2032	**29,234,526**	**6,532,806**	**4,622,529**	**4,407,443**	**13,671,748**	**11,768,978**	**38,876,018**	**25,287,658**	**682,196**	**682,305**	**-**
2033	**27,148,266**	**6,024,998**	**4,307,624**	**4,173,710**	**12,641,935**	**10,859,176**	**37,125,878**	**24,092,471**	**649,953**	**649,802**	**-**
2034	**25,132,213**	**5,551,109**	**3,987,465**	**3,930,271**	**11,663,368**	**9,978,183**	**35,292,279**	**22,897,283**	**617,710**	**617,861**	**-**
2035	**23,367,945**	**5,119,106**	**3,662,372**	**3,760,418**	**10,826,049**	**9,156,364**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**21,317,346**	**4,736,355**	**3,316,312**	**3,445,171**	**9,819,508**	**8,348,060**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**19,344,380**	**4,469,053**	**2,969,775**	**3,088,459**	**8,817,094**	**7,660,852**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**17,317,421**	**4,238,595**	**2,617,608**	**2,645,107**	**7,816,110**	**7,001,653**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**15,601,243**	**4,033,698**	**2,259,910**	**2,367,734**	**6,939,900**	**6,377,954**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**13,963,795**	**3,845,972**	**1,896,681**	**2,139,781**	**6,081,361**	**5,763,528**	**22,709,819**	**15,726,156**	**-**	**-**	**-**
2041	**12,527,085**	**3,649,915**	**1,527,591**	**2,017,076**	**5,332,503**	**5,150,094**	**20,802,497**	**14,530,968**	**-**	**-**	**-**
2042	**11,054,154**	**3,442,483**	**1,153,276**	**1,883,525**	**4,574,869**	**4,524,823**	**19,072,717**	**13,335,780**	**-**	**-**	**-**
2043	**9,630,020**	**3,235,257**	**773,906**	**1,748,278**	**3,872,578**	**3,900,714**	**17,461,103**	**11,763,164**	**-**	**-**	**-**
2044	**8,229,605**	**3,008,687**	**389,463**	**1,595,350**	**3,236,105**	**3,259,108**	**15,917,890**	**10,190,549**	**-**	**-**	**-**
2045	**6,844,546**	**2,741,374**	**-**	**1,432,010**	**2,671,162**	**2,581,187**	**14,442,484**	**8,617,933**	**-**	**-**	**-**
2046	**5,988,504**	**2,583,137**	**-**	**1,226,941**	**2,178,426**	**2,428,149**	**13,409,501**	**7,045,318**	**-**	**-**	**-**
2047	**5,247,931**	**2,504,400**	**-**	**1,026,995**	**1,716,537**	**2,354,136**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**4,593,199**	**2,438,738**	**-**	**847,693**	**1,306,767**	**2,292,414**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**4,051,150**	**2,381,323**	**-**	**679,632**	**990,195**	**2,238,443**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,624,191**	**2,334,238**	**-**	**536,782**	**753,171**	**2,194,183**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.13 Central scenario (no frontloading of APCR allowances) with no price controls

Table 111: Central scenario without price controls, prices by year

Year	Allowance price ($)
2023	**72.51**
2024	**72.49**
2025	**79.08**
2026	**81.94**
2027	**83.52**
2028	**88.51**
2029	**96.68**
2030	**103.43**
2031	**97.61**
2032	**99.03**
2033	**104.38**

Year	Allowance price ($)
2034	**107.88**
2035	**52.94**
2036	**46.14**
2037	**45.19**
2038	**48.16**
2039	**23.42**
2040	**20.88**
2041	**20.71**
2042	**21.45**
2043	**20.88**
2044	**21.80**
2045	**23.63**
2046	**26.46**
2047	**31.89**
2048	**37.06**
2049	**43.06**
2050	**50.53**

Table 112: Central scenario without price controls, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)
2023	**56,742,915**	**12,254,838**	**10,972,931**	**8,356,939**	**25,158,208**	**27,756,931**	**58,354,932**	**61,657,731**
2024	**52,717,064**	**11,320,621**	**9,094,768**	**8,169,621**	**24,132,054**	**24,341,005**	**55,248,639**	**57,016,826**
2025	**47,933,048**	**10,673,390**	**6,959,114**	**7,868,446**	**22,432,099**	**20,924,545**	**51,877,213**	**52,375,922**
2026	**43,663,368**	**10,083,709**	**5,353,109**	**6,998,959**	**21,227,590**	**17,889,003**	**48,633,872**	**47,735,017**
2027	**41,088,195**	**9,489,642**	**5,292,773**	**6,379,437**	**19,926,342**	**16,558,200**	**47,114,812**	**43,094,113**
2028	**38,665,338**	**8,886,010**	**5,379,086**	**5,801,360**	**18,598,882**	**15,733,315**	**45,684,197**	**38,453,208**
2029	**36,443,500**	**8,294,595**	**5,569,488**	**5,289,466**	**17,289,952**	**15,074,454**	**44,333,454**	**33,812,304**
2030	**33,998,024**	**7,746,809**	**5,256,464**	**5,007,069**	**15,987,682**	**13,829,417**	**42,546,031**	**29,171,399**
2031	**31,690,603**	**7,271,960**	**4,932,744**	**4,722,171**	**14,763,728**	**12,916,459**	**40,737,212**	**27,911,725**
2032	**29,537,684**	**6,808,576**	**4,622,529**	**4,466,548**	**13,640,032**	**12,036,625**	**38,876,018**	**26,652,051**
2033	**27,560,312**	**6,334,521**	**4,307,624**	**4,260,989**	**12,657,179**	**11,161,922**	**37,125,878**	**25,392,377**
2034	**25,616,818**	**5,863,428**	**3,987,465**	**4,044,053**	**11,721,872**	**10,285,832**	**35,292,279**	**24,132,703**
2035	**23,963,291**	**5,407,642**	**3,662,372**	**3,921,650**	**10,971,627**	**9,447,394**	**33,548,365**	**22,873,029**
2036	**21,998,642**	**4,981,542**	**3,316,312**	**3,669,339**	**10,031,448**	**8,600,756**	**31,495,134**	**21,613,355**
2037	**20,142,283**	**4,646,451**	**2,969,775**	**3,373,764**	**9,152,293**	**7,851,530**	**29,391,857**	**20,353,681**
2038	**18,065,377**	**4,355,450**	**2,617,608**	**2,914,922**	**8,177,397**	**7,134,589**	**27,150,918**	**19,094,007**
2039	**16,240,438**	**4,114,431**	**2,259,910**	**2,570,009**	**7,296,087**	**6,474,527**	**24,950,546**	**17,834,333**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)
2040	**14,551,078**	**3,912,532**	**1,896,681**	**2,303,040**	**6,438,826**	**5,843,972**	**22,709,819**	**16,574,659**
2041	**13,087,158**	**3,710,369**	**1,527,591**	**2,179,033**	**5,670,164**	**5,222,208**	**20,802,497**	**15,314,985**
2042	**11,606,529**	**3,503,987**	**1,153,276**	**2,052,710**	**4,896,555**	**4,594,817**	**19,072,717**	**14,055,311**
2043	**10,182,059**	**3,312,667**	**773,906**	**1,923,569**	**4,171,917**	**3,982,068**	**17,461,103**	**12,397,845**
2044	**8,797,396**	**3,125,346**	**389,463**	**1,774,260**	**3,508,328**	**3,373,418**	**15,917,890**	**10,740,379**
2045	**7,444,927**	**2,921,803**	**-**	**1,611,264**	**2,911,859**	**2,751,329**	**14,442,484**	**9,082,913**
2046	**6,467,403**	**2,682,659**	**-**	**1,398,783**	**2,385,962**	**2,521,699**	**13,409,501**	**7,425,447**
2047	**5,584,481**	**2,509,310**	**-**	**1,186,644**	**1,888,526**	**2,358,751**	**12,371,031**	**5,767,981**
2048	**4,880,787**	**2,446,607**	**-**	**991,268**	**1,442,911**	**2,299,811**	**11,357,658**	**4,110,515**
2049	**4,293,402**	**2,394,251**	**-**	**804,434**	**1,094,716**	**2,250,596**	**10,470,058**	**2,453,049**
2050	**3,829,401**	**2,354,590**	**-**	**643,507**	**831,304**	**2,213,315**	**9,721,375**	**795,584**

H.14 Central scenario (no frontloading of APCR allowances) with complementary policies

Table 113: Central scenario with complementary policies, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**65.00**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**64.68**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**70.38**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**73.18**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**74.64**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**79.15**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**86.39**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**92.76**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**88.54**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.32**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**63.94**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.12**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.43**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**60.26**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.86**	**99.05**	**127.27**	**42.38**	**155.49**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**62.72**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.04**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**70.95**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**79.33**	**169.41**	**217.68**	**72.48**	**265.95**

Table 114: Central scenario with complementary policies, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,602,836**	**12,234,805**	**10,972,931**	**8,403,883**	**24,991,217**	**27,767,246**	**58,070,370**	**58,501,299**	**1,578,216**	**1,577,437**	**-**
2024	**52,581,533**	**11,264,999**	**9,094,768**	**8,213,733**	**24,008,034**	**24,310,812**	**54,960,517**	**54,097,976**	**1,459,425**	**1,459,571**	**-**
2025	**47,946,468**	**10,635,286**	**6,959,114**	**7,928,888**	**22,423,180**	**20,917,113**	**51,542,849**	**49,694,652**	**1,340,635**	**1,340,237**	**-**
2026	**43,761,966**	**10,022,402**	**5,353,109**	**7,157,632**	**21,228,823**	**17,897,376**	**48,225,745**	**45,291,328**	**1,221,844**	**1,222,691**	**-**
2027	**41,231,082**	**9,392,390**	**5,292,773**	**6,594,366**	**19,951,553**	**16,553,359**	**46,634,532**	**40,888,005**	**1,103,054**	**1,103,238**	**-**
2028	**38,808,235**	**8,739,973**	**5,379,086**	**6,042,246**	**18,646,929**	**15,686,435**	**45,127,437**	**36,484,681**	**984,264**	**984,264**	**-**
2029	**36,473,346**	**8,087,031**	**5,569,488**	**5,534,267**	**17,282,560**	**14,963,680**	**43,625,501**	**32,081,358**	**865,473**	**865,473**	**-**
2030	**33,869,453**	**7,414,635**	**5,256,464**	**5,235,445**	**15,962,909**	**13,596,863**	**41,735,916**	**27,678,034**	**746,683**	**746,236**	**-**
2031	**31,327,345**	**6,793,998**	**4,932,744**	**4,906,962**	**14,693,641**	**12,532,670**	**39,816,792**	**26,482,846**	**714,440**	**714,886**	**-**
2032	**28,913,321**	**6,201,583**	**4,622,529**	**4,597,275**	**13,491,934**	**11,517,180**	**37,820,254**	**25,287,658**	**682,196**	**-**	**-**
2033	**26,684,559**	**5,648,068**	**4,307,624**	**4,327,988**	**12,400,880**	**10,554,150**	**35,925,610**	**24,092,471**	**649,953**	**165,791**	**-**
2034	**24,528,670**	**5,124,017**	**3,987,465**	**4,036,708**	**11,380,480**	**9,614,594**	**33,984,128**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,642,606**	**4,665,962**	**3,662,372**	**3,813,512**	**10,500,760**	**8,758,500**	**31,947,475**	**21,702,095**	**-**	**-**	**-**
2036	**20,484,668**	**4,319,421**	**3,316,312**	**3,403,484**	**9,445,451**	**7,972,886**	**29,764,041**	**20,506,907**	**-**	**-**	**-**
2037	**18,386,359**	**4,079,152**	**2,969,775**	**2,964,636**	**8,372,796**	**7,301,326**	**27,645,536**	**19,311,719**	**-**	**-**	**-**
2038	**16,290,089**	**3,836,280**	**2,617,608**	**2,516,457**	**7,319,744**	**6,621,316**	**25,407,928**	**18,116,531**	**-**	**-**	**-**
2039	**14,451,406**	**3,577,992**	**2,259,910**	**2,246,269**	**6,367,234**	**5,938,087**	**23,232,020**	**16,921,344**	**-**	**-**	**-**
2040	**12,774,029**	**3,399,490**	**1,896,681**	**1,996,303**	**5,481,555**	**5,327,669**	**20,944,630**	**15,726,156**	**-**	**-**	**-622,477**
2041	**11,275,577**	**3,239,708**	**1,527,591**	**1,824,419**	**4,683,860**	**4,746,234**	**18,967,834**	**14,530,968**	**-**	**-**	**-2,664,589**
2042	**9,804,654**	**3,074,481**	**1,153,276**	**1,641,400**	**3,935,497**	**4,161,469**	**17,171,366**	**13,335,780**	**-**	**-**	**-2,559,094**
2043	**8,417,005**	**2,921,493**	**773,906**	**1,464,160**	**3,257,446**	**3,591,854**	**15,508,958**	**11,763,164**	**-**	**-**	**-4,650,669**
2044	**7,106,207**	**2,779,149**	**389,463**	**1,280,908**	**2,656,687**	**3,035,166**	**13,931,999**	**10,190,549**	**-**	**-**	**-3,650,989**
2045	**5,878,554**	**2,647,098**	**-**	**1,101,701**	**2,129,755**	**2,491,577**	**12,439,884**	**8,617,933**	**-**	**-**	**-2,474,814**
2046	**5,111,286**	**2,529,781**	**-**	**903,989**	**1,677,517**	**2,377,994**	**11,415,740**	**7,045,318**	**-**	**-**	**-830,932**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2047	**4,407,657**	**2,424,036**	**-**	**726,779**	**1,256,842**	**2,278,593**	**10,484,993**	**5,472,702**	**-**	**-**	**-**
2048	**3,800,756**	**2,324,836**	**-**	**580,687**	**895,233**	**2,185,346**	**9,660,581**	**3,900,087**	**-**	**-**	**-**
2049	**3,316,396**	**2,230,641**	**-**	**451,523**	**634,231**	**2,096,803**	**8,922,023**	**2,327,471**	**-**	**-**	**-**
2050	**2,991,134**	**2,147,485**	**-**	**344,795**	**498,854**	**2,018,636**	**8,298,265**	**754,855**	**-**	**-**	**-**

H.15 Central scenario (no frontloading of APCR allowances) with shorter foresight in the first compliance period

Table 115: Central scenario with shorter foresight, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**52.29**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**61.55**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**72.54**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**78.56**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**79.16**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**83.32**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**90.61**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**97.06**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**90.78**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**91.22**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**96.02**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.59**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.78**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.92**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**60.68**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.92**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.23**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.96**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.36**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.55**	**169.41**	**217.68**	**72.48**	**265.95**

Table 116: Central scenario with shorter foresight, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,977,046**	**12,217,850**	**10,972,931**	**8,438,095**	**25,348,171**	**27,772,248**	**58,354,932**	**58,501,299**	**1,578,216**	**-**	**-**
2024	**52,876,112**	**11,253,257**	**9,094,768**	**8,221,627**	**24,306,460**	**24,303,586**	**55,248,639**	**54,097,976**	**1,459,425**	**3,037,345**	**-**
2025	**48,234,952**	**10,604,428**	**6,959,114**	**7,916,632**	**22,754,778**	**20,880,043**	**51,877,213**	**49,694,652**	**1,340,635**	**1,339,046**	**-**
2026	**43,892,427**	**9,961,709**	**5,353,109**	**7,093,613**	**21,483,996**	**17,808,598**	**48,633,872**	**45,291,328**	**1,221,844**	**1,223,268**	**-**
2027	**41,265,049**	**9,297,572**	**5,292,773**	**6,499,094**	**20,175,610**	**16,421,725**	**47,114,812**	**40,888,005**	**1,103,054**	**1,103,220**	**-**
2028	**38,774,413**	**8,616,001**	**5,379,086**	**5,928,684**	**18,850,641**	**15,521,499**	**45,684,197**	**36,484,681**	**984,264**	**983,332**	**-**
2029	**36,469,465**	**7,939,692**	**5,569,488**	**5,410,589**	**17,549,695**	**14,775,114**	**44,333,454**	**32,081,358**	**865,473**	**865,776**	**-**
2030	**33,846,802**	**7,252,458**	**5,256,464**	**5,106,053**	**16,231,828**	**13,400,752**	**42,546,031**	**27,678,034**	**746,683**	**747,311**	**-**
2031	**31,309,314**	**6,626,277**	**4,932,744**	**4,775,314**	**14,974,979**	**12,335,425**	**40,737,212**	**26,482,846**	**714,440**	**714,440**	**-**
2032	**28,931,781**	**6,037,467**	**4,622,529**	**4,469,807**	**13,801,978**	**11,328,047**	**38,876,018**	**25,287,658**	**682,196**	**682,033**	**-**
2033	**26,752,642**	**5,491,488**	**4,307,624**	**4,204,092**	**12,749,438**	**10,375,984**	**37,125,878**	**24,092,471**	**649,953**	**649,971**	**-**
2034	**24,602,496**	**4,975,984**	**3,987,465**	**3,918,976**	**11,720,071**	**9,448,728**	**35,292,279**	**22,897,283**	**617,710**	**102,821**	**-**
2035	**22,698,978**	**4,524,983**	**3,662,372**	**3,697,496**	**10,814,128**	**8,602,216**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,524,311**	**4,188,931**	**3,316,312**	**3,294,320**	**9,724,748**	**7,830,112**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,415,418**	**3,958,376**	**2,969,775**	**2,864,598**	**8,622,668**	**7,170,893**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,296,139**	**3,725,559**	**2,617,608**	**2,429,160**	**7,523,812**	**6,503,564**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,503,252**	**3,551,843**	**2,259,910**	**2,168,349**	**6,523,150**	**5,902,623**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,813,798**	**3,398,932**	**1,896,681**	**1,926,572**	**5,591,614**	**5,318,923**	**22,709,819**	**15,726,156**	**-**	**-**	**-543,789**
2041	**11,279,482**	**3,239,297**	**1,527,591**	**1,760,022**	**4,752,572**	**4,739,731**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,622,260**
2042	**9,785,668**	**3,074,240**	**1,153,276**	**1,582,721**	**3,975,431**	**4,157,018**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,534,090**
2043	**8,387,264**	**2,921,526**	**773,906**	**1,411,415**	**3,280,417**	**3,589,300**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,613,296**
2044	**7,081,936**	**2,779,657**	**389,463**	**1,234,312**	**2,678,505**	**3,034,432**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,567,103**
2045	**5,875,754**	**2,648,367**	**-**	**1,061,288**	**2,166,099**	**2,492,649**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,362,591**
2046	**5,144,131**	**2,532,147**	**-**	**871,494**	**1,740,490**	**2,380,218**	**13,409,501**	**7,045,318**	**-**	**-**	**-669,756**
2047	**4,483,603**	**2,427,815**	**-**	**700,897**	**1,354,891**	**2,282,146**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,915,394**	**2,330,212**	**-**	**560,422**	**1,024,760**	**2,190,399**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,450,857**	**2,237,629**	**-**	**436,038**	**777,190**	**2,103,371**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,085,161**	**2,155,879**	**-**	**332,832**	**596,450**	**2,026,526**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.16 Central scenario (no frontloading of APRC allowances) with longer foresight

Table 117: Central scenario with longer foresight, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**68.94**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**68.58**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**74.62**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**77.46**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**77.94**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**82.06**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**89.31**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**95.60**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**89.77**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.45**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.53**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.78**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**59.25**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**61.20**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**47.16**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.18**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.84**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.09**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**80.85**	**169.41**	**217.68**	**72.48**	**265.95**

Table 118: Central scenario with longer foresight, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,741,916**	**12,167,134**	**10,972,931**	**8,384,072**	**25,217,779**	**27,686,785**	**58,354,932**	**58,501,299**	**1,578,216**	**1,577,252**	**-**
2024	**52,707,247**	**11,200,986**	**9,094,768**	**8,191,106**	**24,220,388**	**24,233,753**	**55,248,639**	**54,097,976**	**1,459,425**	**1,459,625**	**-**
2025	**47,985,110**	**10,551,160**	**6,959,114**	**7,897,967**	**22,576,869**	**20,817,292**	**51,877,213**	**49,694,652**	**1,340,635**	**1,340,753**	**-**
2026	**43,765,329**	**9,918,269**	**5,353,109**	**7,090,332**	**21,403,619**	**17,763,698**	**48,633,872**	**45,291,328**	**1,221,844**	**1,222,490**	**-**
2027	**41,210,962**	**9,269,262**	**5,292,773**	**6,507,317**	**20,141,609**	**16,397,675**	**47,114,812**	**40,888,005**	**1,103,054**	**1,102,490**	**-**
2028	**38,772,723**	**8,601,718**	**5,379,086**	**5,944,814**	**18,847,105**	**15,513,980**	**45,684,197**	**36,484,681**	**984,264**	**984,270**	**-**
2029	**36,494,078**	**7,937,232**	**5,569,488**	**5,431,814**	**17,555,544**	**14,780,514**	**44,333,454**	**32,081,358**	**865,473**	**865,178**	**-**
2030	**33,889,999**	**7,258,463**	**5,256,464**	**5,131,118**	**16,243,954**	**13,414,604**	**42,546,031**	**27,678,034**	**746,683**	**747,086**	**-**
2031	**31,361,387**	**6,636,578**	**4,932,744**	**4,802,796**	**14,989,269**	**12,352,853**	**40,737,212**	**26,482,846**	**714,440**	**714,889**	**-**
2032	**28,984,635**	**6,048,326**	**4,622,529**	**4,497,041**	**13,816,738**	**11,345,163**	**38,876,018**	**25,287,658**	**682,196**	**437,432**	**-**
2033	**26,801,549**	**5,501,383**	**4,307,624**	**4,231,012**	**12,761,530**	**10,391,520**	**37,125,878**	**24,092,471**	**649,953**	**405,989**	**-**
2034	**24,642,742**	**4,984,370**	**3,987,465**	**3,943,745**	**11,727,161**	**9,461,783**	**35,292,279**	**22,897,283**	**617,710**	**31,752**	**-**
2035	**22,736,478**	**4,531,759**	**3,662,372**	**3,721,584**	**10,820,764**	**8,613,154**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,557,884**	**4,193,734**	**3,316,312**	**3,315,359**	**9,732,479**	**7,838,369**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,439,382**	**3,960,965**	**2,969,775**	**2,882,537**	**8,626,106**	**7,176,363**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,313,934**	**3,725,080**	**2,617,608**	**2,444,314**	**7,526,931**	**6,505,510**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,520,147**	**3,551,954**	**2,259,910**	**2,181,899**	**6,526,384**	**5,904,626**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,828,637**	**3,398,977**	**1,896,681**	**1,938,755**	**5,594,224**	**5,320,402**	**22,709,819**	**15,726,156**	**-**	**-**	**-393,997**
2041	**11,292,763**	**3,239,230**	**1,527,591**	**1,771,313**	**4,754,630**	**4,740,740**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,596,748**
2042	**9,796,808**	**3,073,944**	**1,153,276**	**1,592,942**	**3,976,646**	**4,157,476**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,509,968**
2043	**8,395,983**	**2,920,783**	**773,906**	**1,420,434**	**3,280,861**	**3,589,043**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,598,217**
2044	**7,087,964**	**2,778,128**	**389,463**	**1,242,021**	**2,678,353**	**3,033,195**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,558,030**
2045	**5,878,775**	**2,645,601**	**-**	**1,067,643**	**2,165,531**	**2,490,068**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,359,956**
2046	**5,143,457**	**2,527,640**	**-**	**876,108**	**1,739,709**	**2,375,982**	**13,409,501**	**7,045,318**	**-**	**-**	**-688,339**
2047	**4,479,360**	**2,421,129**	**-**	**704,103**	**1,354,128**	**2,275,862**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,907,903**	**2,321,150**	**-**	**562,502**	**1,024,252**	**2,181,881**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,440,472**	**2,226,397**	**-**	**437,246**	**776,829**	**2,092,814**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,072,775**	**2,142,998**	**-**	**333,563**	**596,213**	**2,014,419**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.17 Central scenario (no frontloading of APCR allowances) with high financial sector sensitivity to prices

Table 119: Central scenario with high price sensitivity, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**63.27**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**64.66**	**47.65**	**61.21**	**20.39**	**74.79**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2025	**69.29**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**72.60**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**74.63**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**78.38**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**84.64**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**91.27**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**88.63**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.45**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**101.52**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**60.83**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**57.38**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**57.54**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**57.43**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**47.21**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**45.88**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**64.06**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.32**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**69.03**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**74.40**	**169.41**	**217.68**	**72.48**	**265.95**

Table 120: Central scenario with high price sensitivity, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,905,294**	**12,237,018**	**10,972,931**	**8,409,909**	**25,285,437**	**27,773,337**	**58,354,932**	**58,501,299**	**1,578,216**	**1,574,880**	**-**
2024	**52,882,721**	**11,272,558**	**9,094,768**	**8,215,640**	**24,299,755**	**24,319,477**	**55,248,639**	**54,097,976**	**1,459,425**	**1,462,761**	**-**
2025	**48,263,133**	**10,645,201**	**6,959,114**	**7,934,070**	**22,724,749**	**20,929,651**	**51,877,213**	**49,694,652**	**1,340,635**	**1,340,635**	**-**
2026	**44,106,413**	**10,035,252**	**5,353,109**	**7,164,453**	**21,553,599**	**17,913,218**	**48,633,872**	**45,291,328**	**1,221,844**	**1,220,663**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2027	**41,598,558**	**9,405,076**	**5,292,773**	**6,599,609**	**20,301,100**	**16,567,850**	**47,114,812**	**40,888,005**	**1,103,054**	**1,102,350**	**-**
2028	**39,178,642**	**8,748,492**	**5,379,086**	**6,047,695**	**19,003,368**	**15,696,834**	**45,684,197**	**36,484,681**	**984,264**	**986,148**	**-**
2029	**36,900,386**	**8,087,109**	**5,569,488**	**5,540,309**	**17,703,479**	**14,965,985**	**44,333,454**	**32,081,358**	**865,473**	**863,907**	**-**
2030	**34,282,076**	**7,400,395**	**5,256,464**	**5,239,152**	**16,386,064**	**13,584,905**	**42,546,031**	**27,678,034**	**746,683**	**748,249**	**-**
2031	**31,709,908**	**6,758,871**	**4,932,744**	**4,903,184**	**15,115,109**	**12,499,372**	**40,737,212**	**26,482,846**	**714,440**	**713,889**	**-**
2032	**29,277,636**	**6,141,723**	**4,622,529**	**4,586,805**	**13,926,579**	**11,459,596**	**38,876,018**	**25,287,658**	**682,196**	**547,515**	**-**
2033	**27,001,077**	**5,561,217**	**4,307,624**	**4,303,114**	**12,829,123**	**10,468,343**	**37,125,878**	**24,092,471**	**649,953**	**785,166**	**-**
2034	**24,803,509**	**5,010,953**	**3,987,465**	**4,011,474**	**11,793,617**	**9,505,306**	**35,292,279**	**22,897,283**	**617,710**	**291,958**	**-**
2035	**22,857,246**	**4,530,794**	**3,662,372**	**3,786,602**	**10,877,478**	**8,628,811**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,651,023**	**4,179,067**	**3,316,312**	**3,379,634**	**9,776,010**	**7,838,459**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,528,607**	**3,920,259**	**2,969,775**	**2,944,901**	**8,693,672**	**7,149,730**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,415,551**	**3,714,303**	**2,617,608**	**2,502,924**	**7,580,715**	**6,504,889**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,607,074**	**3,551,158**	**2,259,910**	**2,234,300**	**6,561,706**	**5,911,224**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,896,212**	**3,397,109**	**1,896,681**	**1,986,847**	**5,615,575**	**5,324,315**	**22,709,819**	**15,726,156**	**-**	**-**	**-**
2041	**11,347,770**	**3,235,020**	**1,527,591**	**1,818,690**	**4,766,469**	**4,741,284**	**20,802,497**	**14,530,968**	**-**	**-**	**-455,821**
2042	**9,835,927**	**3,064,836**	**1,153,276**	**1,637,993**	**3,979,822**	**4,152,157**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,170,664**
2043	**8,416,810**	**2,902,564**	**773,906**	**1,461,340**	**3,279,000**	**3,573,922**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,265,690**
2044	**7,083,346**	**2,745,155**	**389,463**	**1,277,108**	**2,671,620**	**3,003,113**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,516,045**
2045	**5,843,575**	**2,591,674**	**-**	**1,095,739**	**2,156,162**	**2,439,460**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,714,821**
2046	**5,073,321**	**2,447,852**	**-**	**895,228**	**1,730,241**	**2,300,981**	**13,409,501**	**7,045,318**	**-**	**-**	**-1,256,201**
2047	**4,375,847**	**2,314,311**	**-**	**715,151**	**1,346,386**	**2,175,452**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,778,167**	**2,191,678**	**-**	**567,034**	**1,019,454**	**2,060,178**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,294,074**	**2,083,513**	**-**	**436,909**	**773,652**	**1,958,502**	**10,470,058**	**2,327,471**	**-**	**-**	**-534,096**
2050	**2,919,486**	**1,993,871**	**-**	**331,348**	**594,268**	**1,874,239**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.18 Central scenario (no frontloading of APCR allowances) with low financial sector sensitivity to prices

Table 121: Central scenario with low price sensitivity, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**69.29**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**68.36**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**75.13**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**77.54**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**78.44**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**83.18**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**90.85**	**60.81**	**78.13**	**26.02**	**95.46**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2030	**97.35**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**90.37**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**91.01**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**95.36**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.67**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**62.78**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**57.14**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**57.77**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**59.42**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**45.33**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.18**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**68.00**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**75.67**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**88.52**	**169.41**	**217.68**	**72.48**	**265.95**

Table 122: Central scenario with low price sensitivity, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,728,693**	**12,160,710**	**10,972,931**	**8,381,833**	**25,213,220**	**27,678,913**	**58,354,932**	**58,501,299**	**1,578,216**	**1,578,216**	**-**
2024	**52,684,693**	**11,183,508**	**9,094,768**	**8,190,020**	**24,216,397**	**24,215,641**	**55,248,639**	**54,097,976**	**1,459,425**	**1,459,425**	**-**
2025	**47,942,427**	**10,525,363**	**6,959,114**	**7,894,262**	**22,563,689**	**20,789,614**	**51,877,213**	**49,694,652**	**1,340,635**	**1,339,723**	**-**
2026	**43,708,060**	**9,878,957**	**5,353,109**	**7,081,901**	**21,394,093**	**17,720,677**	**48,633,872**	**45,291,328**	**1,221,844**	**1,222,756**	**-**
2027	**41,122,735**	**9,215,401**	**5,292,773**	**6,493,218**	**20,121,343**	**16,339,557**	**47,114,812**	**40,888,005**	**1,103,054**	**1,103,054**	**-**
2028	**38,656,974**	**8,532,787**	**5,379,086**	**5,925,094**	**18,820,007**	**15,439,364**	**45,684,197**	**36,484,681**	**984,264**	**984,264**	**-**
2029	**36,351,647**	**7,854,510**	**5,569,488**	**5,408,167**	**17,519,482**	**14,691,565**	**44,333,454**	**32,081,358**	**865,473**	**865,473**	**-**
2030	**33,730,807**	**7,166,676**	**5,256,464**	**5,105,488**	**16,202,179**	**13,319,708**	**42,546,031**	**27,678,034**	**746,683**	**746,683**	**-**
2031	**31,204,446**	**6,542,286**	**4,932,744**	**4,779,314**	**14,950,103**	**12,256,948**	**40,737,212**	**26,482,846**	**714,440**	**714,021**	**-**
2032	**28,839,566**	**5,957,122**	**4,622,529**	**4,476,801**	**13,783,114**	**11,253,361**	**38,876,018**	**25,287,658**	**682,196**	**682,383**	**-**
2033	**26,676,067**	**5,415,618**	**4,307,624**	**4,214,742**	**12,738,084**	**10,305,999**	**37,125,878**	**24,092,471**	**649,953**	**650,185**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2034	**24,534,531**	**4,905,765**	**3,987,465**	**3,932,528**	**11,708,773**	**9,384,221**	**35,292,279**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,647,089**	**4,458,523**	**3,662,372**	**3,716,604**	**10,809,591**	**8,541,888**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,485,822**	**4,129,777**	**3,316,312**	**3,317,128**	**9,722,606**	**7,776,804**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,381,049**	**3,905,257**	**2,969,775**	**2,883,517**	**8,622,500**	**7,123,032**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,292,953**	**3,713,979**	**2,617,608**	**2,440,885**	**7,520,480**	**6,494,292**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,502,969**	**3,551,521**	**2,259,910**	**2,175,466**	**6,516,071**	**5,903,328**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,802,392**	**3,398,646**	**1,896,681**	**1,928,524**	**5,578,541**	**5,318,889**	**22,709,819**	**15,726,156**	**-**	**-**	**-1,999,853**
2041	**11,259,349**	**3,239,063**	**1,527,591**	**1,755,792**	**4,736,902**	**4,739,109**	**20,802,497**	**14,530,968**	**-**	**-**	**-2,766,875**
2042	**9,756,644**	**3,074,137**	**1,153,276**	**1,573,051**	**3,956,180**	**4,156,224**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,663,240**
2043	**8,354,091**	**2,921,748**	**773,906**	**1,397,302**	**3,261,134**	**3,588,818**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,668,868**
2044	**7,046,611**	**2,780,571**	**389,463**	**1,216,853**	**2,659,725**	**3,034,837**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,549,320**
2045	**5,840,477**	**2,650,527**	**-**	**1,041,666**	**2,148,284**	**2,494,621**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,238,448**
2046	**5,111,278**	**2,536,264**	**-**	**851,274**	**1,723,740**	**2,384,088**	**13,409,501**	**7,045,318**	**-**	**-**	**-442,243**
2047	**4,454,631**	**2,434,633**	**-**	**681,317**	**1,338,680**	**2,288,555**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,891,193**	**2,340,296**	**-**	**542,313**	**1,008,584**	**2,199,878**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,433,444**	**2,251,090**	**-**	**419,987**	**762,366**	**2,116,025**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,073,699**	**2,172,581**	**-**	**317,745**	**583,373**	**2,042,226**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.19 Central scenario (no frontloading of APCR allowances) with low financial sector hurdle rate

Table 123: Central scenario with low hurdle rate, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**71.23**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**69.86**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**75.48**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**77.95**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**77.64**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**81.47**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**88.40**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**94.54**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**89.50**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.45**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.12**	**77.61**	**99.73**	**33.20**	**121.83**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2035	**68.21**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**61.65**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**61.80**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**63.96**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**49.28**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**45.69**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**62.66**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.28**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**71.92**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**80.92**	**169.41**	**217.68**	**72.48**	**265.95**

Table 124: Central scenario with low hurdle rate, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,711,860**	**12,159,542**	**10,972,931**	**8,377,667**	**25,201,720**	**27,675,081**	**58,354,932**	**58,501,299**	**1,578,216**	**1,578,216**	**-**
2024	**52,688,978**	**11,196,475**	**9,094,768**	**8,187,327**	**24,210,407**	**24,227,077**	**55,248,639**	**54,097,976**	**1,459,425**	**1,458,409**	**-**
2025	**47,959,834**	**10,548,098**	**6,959,114**	**7,895,687**	**22,556,935**	**20,813,083**	**51,877,213**	**49,694,652**	**1,340,635**	**1,341,651**	**-**
2026	**43,762,721**	**9,918,510**	**5,353,109**	**7,091,975**	**21,399,127**	**17,764,669**	**48,633,872**	**45,291,328**	**1,221,844**	**1,221,547**	**-**
2027	**41,231,750**	**9,277,198**	**5,292,773**	**6,513,690**	**20,148,088**	**16,408,026**	**47,114,812**	**40,888,005**	**1,103,054**	**1,103,351**	**-**
2028	**38,817,338**	**8,621,747**	**5,379,086**	**5,954,451**	**18,862,053**	**15,537,198**	**45,684,197**	**36,484,681**	**984,264**	**983,351**	**-**
2029	**36,564,363**	**7,973,077**	**5,569,488**	**5,443,549**	**17,578,249**	**14,819,607**	**44,333,454**	**32,081,358**	**865,473**	**865,567**	**-**
2030	**33,980,841**	**7,312,385**	**5,256,464**	**5,143,659**	**16,268,333**	**13,469,538**	**42,546,031**	**27,678,034**	**746,683**	**746,910**	**-**
2031	**31,464,875**	**6,708,334**	**4,932,744**	**4,813,678**	**15,010,120**	**12,423,763**	**40,737,212**	**26,482,846**	**714,440**	**715,031**	**-**
2032	**29,097,111**	**6,134,572**	**4,622,529**	**4,505,281**	**13,834,729**	**11,428,929**	**38,876,018**	**25,287,658**	**682,196**	**198,043**	**-**
2033	**26,917,140**	**5,600,654**	**4,307,624**	**4,235,855**	**12,773,006**	**10,486,802**	**37,125,878**	**24,092,471**	**649,953**	**58,067**	**-**
2034	**24,761,336**	**5,094,893**	**3,987,465**	**3,945,155**	**11,733,823**	**9,567,060**	**35,292,279**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,844,182**	**4,654,671**	**3,662,372**	**3,714,169**	**10,812,971**	**8,728,529**	**33,548,365**	**21,702,095**	**-**	**-**	**-**
2036	**20,654,331**	**4,317,528**	**3,316,312**	**3,298,911**	**9,721,579**	**7,953,810**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,528,746**	**4,093,231**	**2,969,775**	**2,864,899**	**8,600,842**	**7,299,396**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,436,159**	**3,878,442**	**2,617,608**	**2,431,977**	**7,508,131**	**6,648,333**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,614,167**	**3,663,057**	**2,259,910**	**2,173,318**	**6,517,882**	**6,007,946**	**24,950,546**	**16,921,344**	**-**	**-**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2040	**12,870,260**	**3,444,021**	**1,896,681**	**1,932,259**	**5,597,299**	**5,361,981**	**22,709,819**	**15,726,156**	**-**	**-**	**-**
2041	**11,306,003**	**3,241,310**	**1,527,591**	**1,767,148**	**4,769,954**	**4,742,300**	**20,802,497**	**14,530,968**	**-**	**-**	**-1,826,589**
2042	**9,826,258**	**3,077,634**	**1,153,276**	**1,592,263**	**4,003,085**	**4,160,895**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,466,462**
2043	**8,441,104**	**2,927,950**	**773,906**	**1,424,432**	**3,314,815**	**3,595,977**	**17,461,103**	**11,763,164**	**-**	**-**	**-4,679,354**
2044	**7,149,424**	**2,791,805**	**389,463**	**1,251,533**	**2,716,623**	**3,046,299**	**15,917,890**	**10,190,549**	**-**	**-**	**-3,628,680**
2045	**5,958,348**	**2,670,147**	**-**	**1,082,973**	**2,205,228**	**2,513,187**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,390,285**
2046	**5,243,450**	**2,568,604**	**-**	**896,834**	**1,778,011**	**2,414,488**	**13,409,501**	**7,045,318**	**-**	**-**	**-729,908**
2047	**4,602,765**	**2,484,589**	**-**	**729,007**	**1,389,169**	**2,335,514**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**4,056,956**	**2,412,429**	**-**	**589,961**	**1,054,566**	**2,267,684**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,616,315**	**2,348,193**	**-**	**465,551**	**802,571**	**2,207,302**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,273,753**	**2,295,146**	**-**	**360,988**	**617,619**	**2,157,437**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.20 Central scenario (no frontloading of APCR allowances) with high financial sector hurdle rate

Table 125: Central scenario with high hurdle rate, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**63.33**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**64.04**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**70.00**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**72.97**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**75.66**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**80.77**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**88.53**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**95.12**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**90.64**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**91.92**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**96.53**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**63.41**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.11**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.44**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**59.72**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.00**	**99.05**	**127.27**	**42.38**	**155.49**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.52**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**67.43**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.92**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**82.58**	**169.41**	**217.68**	**72.48**	**265.95**

Table 126: Central scenario with high hurdle rate, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,874,994**	**12,216,569**	**10,972,931**	**8,406,896**	**25,278,598**	**27,750,932**	**58,354,932**	**58,501,299**	**1,578,216**	**1,577,918**	**-**
2024	**52,846,298**	**11,248,078**	**9,094,768**	**8,213,335**	**24,290,117**	**24,293,648**	**55,248,639**	**54,097,976**	**1,578,216**	**1,577,918**	**-**
2025	**48,192,462**	**10,609,362**	**6,959,114**	**7,925,235**	**22,698,751**	**20,889,320**	**51,877,213**	**49,694,652**	**1,459,425**	**1,459,137**	**-**
2026	**43,994,139**	**9,982,731**	**5,353,109**	**7,136,877**	**21,521,423**	**17,848,569**	**48,633,872**	**45,291,328**	**1,340,635**	**1,341,052**	**-**
2027	**41,427,760**	**9,333,738**	**5,292,773**	**6,556,615**	**20,244,635**	**16,480,739**	**47,114,812**	**40,888,005**	**1,221,844**	**1,222,013**	**-**
2028	**38,964,427**	**8,657,243**	**5,379,086**	**5,990,751**	**18,937,347**	**15,585,921**	**45,684,197**	**36,484,681**	**1,103,054**	**1,103,054**	**-**
2029	**36,640,629**	**7,978,002**	**5,569,488**	**5,472,566**	**17,620,572**	**14,835,183**	**44,333,454**	**32,081,358**	**984,264**	**984,264**	**-**
2030	**33,996,628**	**7,281,056**	**5,256,464**	**5,165,627**	**16,293,481**	**13,448,081**	**42,546,031**	**27,678,034**	**865,473**	**864,679**	**-**
2031	**31,425,068**	**6,640,882**	**4,932,744**	**4,828,650**	**15,022,792**	**12,366,245**	**40,737,212**	**26,482,846**	**746,683**	**746,902**	**-**
2032	**29,014,876**	**6,036,403**	**4,622,529**	**4,516,274**	**13,839,670**	**11,341,235**	**38,876,018**	**25,287,658**	**714,440**	**714,542**	**-**
2033	**26,802,858**	**5,475,837**	**4,307,624**	**4,245,680**	**12,773,717**	**10,373,369**	**37,125,878**	**24,092,471**	**682,196**	**682,668**	**-**
2034	**24,629,937**	**4,948,555**	**3,987,465**	**3,956,820**	**11,737,098**	**9,433,268**	**35,292,279**	**22,897,283**	**649,953**	**649,763**	**-**
2035	**22,713,169**	**4,487,262**	**3,662,372**	**3,735,038**	**10,828,498**	**8,576,019**	**33,548,365**	**21,702,095**	**617,710**	**460,768**	**-**
2036	**20,534,269**	**4,148,303**	**3,316,312**	**3,330,487**	**9,739,166**	**7,799,691**	**31,495,134**	**20,506,907**	**-**	**-**	**-**
2037	**18,416,625**	**3,910,463**	**2,969,775**	**2,898,338**	**8,638,050**	**7,132,257**	**29,391,857**	**19,311,719**	**-**	**-**	**-**
2038	**16,324,429**	**3,714,027**	**2,617,608**	**2,459,515**	**7,533,278**	**6,497,779**	**27,150,918**	**18,116,531**	**-**	**-**	**-**
2039	**14,533,192**	**3,551,396**	**2,259,910**	**2,195,489**	**6,526,396**	**5,906,053**	**24,950,546**	**16,921,344**	**-**	**-**	**-**
2040	**12,832,744**	**3,398,237**	**1,896,681**	**1,949,516**	**5,588,310**	**5,320,979**	**22,709,819**	**15,726,156**	**-**	**-**	**-**
2041	**11,290,539**	**3,238,028**	**1,527,591**	**1,779,134**	**4,745,785**	**4,740,354**	**20,802,497**	**14,530,968**	**-**	**-**	**-1,088,168**
2042	**9,786,613**	**3,071,672**	**1,153,276**	**1,597,502**	**3,964,163**	**4,155,668**	**19,072,717**	**13,335,780**	**-**	**-**	**-2,604,067**
2043	**8,378,433**	**2,916,434**	**773,906**	**1,421,631**	**3,266,462**	**3,585,014**	**17,461,103**	**11,763,164**	**-**	**-**	**-2,515,018**
2044	**7,062,721**	**2,770,276**	**389,463**	**1,239,890**	**2,663,092**	**3,025,759**	**15,917,890**	**10,190,549**	**-**	**-**	**-4,554,689**
2045	**5,845,311**	**2,632,492**	**-**	**1,062,439**	**2,150,380**	**2,477,730**	**14,442,484**	**8,617,933**	**-**	**-**	**-3,504,152**
2046	**5,101,274**	**2,507,521**	**-**	**868,245**	**1,725,508**	**2,357,070**	**13,409,501**	**7,045,318**	**-**	**-**	**-2,308,410**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2047	**4,428,355**	**2,392,819**	**-**	**694,433**	**1,341,103**	**2,249,250**	**12,371,031**	**5,472,702**	**-**	**-**	**-591,599**
2048	**3,849,105**	**2,284,706**	**-**	**551,921**	**1,012,478**	**2,147,624**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,376,836**	**2,183,643**	**-**	**426,597**	**766,596**	**2,052,624**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,007,260**	**2,096,509**	**-**	**323,194**	**587,558**	**1,970,718**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.21 Central scenario (no frontloading of APCR allowances) with slower power sector decarbonization

Table 127: Central scenario with slower power sector decarbonization, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**71.23**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**71.62**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**78.09**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**80.77**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**81.56**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**85.85**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**93.32**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**99.72**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**92.60**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**92.12**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**99.73**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.81**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**59.00**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**59.43**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**60.51**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.81**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.11**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**66.74**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.01**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**80.93**	**169.41**	**217.68**	**72.48**	**265.95**

Table 128: Central scenario with slower power sector decarbonization, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**57,669,319**	**12,053,805**	**12,070,224**	**8,367,494**	**25,177,797**	**28,660,024**	**59,452,225**	**58,501,299**	**1,578,216**	**1,578,216**	**1,891,688**
2024	**53,439,781**	**11,102,909**	**10,004,244**	**8,175,142**	**24,157,486**	**25,035,954**	**56,158,116**	**54,097,976**	**1,459,425**	**1,458,813**	**-**
2025	**48,458,892**	**10,450,374**	**7,655,025**	**7,875,654**	**22,477,838**	**21,401,100**	**52,573,124**	**49,694,652**	**1,340,635**	**1,341,247**	**-**
2026	**44,010,734**	**9,825,875**	**5,888,420**	**7,016,746**	**21,279,694**	**18,174,287**	**49,169,182**	**45,291,328**	**1,221,844**	**1,221,844**	**-**
2027	**41,386,079**	**9,173,905**	**5,822,051**	**6,397,617**	**19,992,507**	**16,788,764**	**47,644,089**	**40,888,005**	**1,103,054**	**1,102,832**	**-**
2028	**38,901,117**	**8,493,114**	**5,916,995**	**5,811,086**	**18,679,921**	**15,893,913**	**46,222,105**	**36,484,681**	**984,264**	**984,485**	**-**
2029	**36,591,097**	**7,808,505**	**6,126,437**	**5,282,883**	**17,373,273**	**15,157,705**	**44,890,403**	**32,081,358**	**865,473**	**865,473**	**-**
2030	**33,908,898**	**7,101,298**	**5,782,110**	**4,971,188**	**16,054,302**	**13,739,048**	**43,071,678**	**27,678,034**	**746,683**	**746,155**	**-**
2031	**31,325,274**	**6,464,344**	**5,426,018**	**4,632,661**	**14,802,250**	**12,634,305**	**41,230,486**	**26,482,846**	**714,440**	**714,967**	**-**
2032	**28,923,939**	**5,873,653**	**5,084,782**	**4,326,623**	**13,638,881**	**11,598,290**	**39,338,271**	**25,287,658**	**682,196**	**682,196**	**-**
2033	**26,733,734**	**5,330,536**	**4,738,386**	**4,062,758**	**12,602,054**	**10,621,620**	**37,556,640**	**24,092,471**	**649,953**	**628,126**	**-**
2034	**24,566,833**	**4,821,351**	**4,386,211**	**3,780,084**	**11,579,187**	**9,672,096**	**35,691,026**	**22,897,283**	**617,710**	**289,637**	**-**
2035	**22,650,060**	**4,378,339**	**4,028,609**	**3,561,486**	**10,681,627**	**8,804,005**	**33,914,602**	**21,702,095**	**-**	**-**	**-**
2036	**20,499,390**	**4,073,873**	**3,647,944**	**3,167,873**	**9,609,700**	**8,031,090**	**31,826,765**	**20,506,907**	**-**	**-**	**-**
2037	**18,426,645**	**3,885,931**	**3,266,753**	**2,752,256**	**8,521,706**	**7,380,939**	**29,688,835**	**19,311,719**	**-**	**-**	**-**
2038	**16,365,592**	**3,713,661**	**2,879,369**	**2,333,682**	**7,438,880**	**6,739,111**	**27,412,679**	**18,116,531**	**-**	**-**	**-**
2039	**14,571,082**	**3,551,256**	**2,485,901**	**2,083,575**	**6,450,350**	**6,116,194**	**25,176,537**	**16,921,344**	**-**	**-**	**-**
2040	**12,865,336**	**3,398,420**	**2,086,349**	**1,851,689**	**5,528,878**	**5,499,277**	**22,899,487**	**15,726,156**	**-**	**-**	**-510,977**
2041	**11,312,139**	**3,238,821**	**1,680,350**	**1,692,747**	**4,700,221**	**4,885,651**	**20,955,256**	**14,530,968**	**-**	**-**	**-2,571,990**
2042	**9,797,827**	**3,073,719**	**1,268,604**	**1,523,177**	**3,932,328**	**4,267,568**	**19,188,044**	**13,335,780**	**-**	**-**	**-2,517,703**
2043	**8,376,326**	**2,920,843**	**851,297**	**1,359,457**	**3,244,729**	**3,663,503**	**17,538,494**	**11,763,164**	**-**	**-**	**-4,602,979**
2044	**7,046,031**	**2,778,645**	**428,409**	**1,189,788**	**2,649,190**	**3,071,270**	**15,956,836**	**10,190,549**	**-**	**-**	**-3,604,608**
2045	**5,812,894**	**2,646,799**	**-**	**1,023,850**	**2,142,245**	**2,491,063**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,447,632**
2046	**5,093,369**	**2,529,761**	**-**	**842,351**	**1,721,256**	**2,377,976**	**13,409,501**	**7,045,318**	**-**	**-**	**-770,708**
2047	**4,443,146**	**2,424,375**	**-**	**678,513**	**1,340,258**	**2,278,913**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,883,532**	**2,325,596**	**-**	**543,498**	**1,014,438**	**2,186,061**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,425,413**	**2,231,924**	**-**	**423,488**	**770,001**	**2,098,008**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,064,677**	**2,149,320**	**-**	**323,830**	**591,527**	**2,020,361**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.22 Central scenario (no frontloading of APCR allowances) with faster power sector decarbonization

Table 129: Central scenario with faster power sector decarbonization, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**60.97**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**61.21**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**66.17**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**68.86**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**71.41**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**76.24**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**83.34**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**89.63**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**87.20**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**90.21**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**94.98**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**96.23**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**64.30**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**58.66**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**58.79**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**59.87**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**46.22**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**63.31**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**67.10**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**72.52**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**81.58**	**169.41**	**217.68**	**72.48**	**265.95**

Table 130: Central scenario with faster power sector decarbonization, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**55,896,578**	**12,276,026**	**9,875,638**	**8,423,284**	**25,321,631**	**26,723,695**	**57,257,639**	**58,501,299**	**1,578,216**	**1,576,670**	**-**
2024	**52,120,161**	**11,344,645**	**8,185,291**	**8,234,067**	**24,356,158**	**23,492,706**	**54,339,162**	**54,097,976**	**1,459,425**	**872,013**	**-**
2025	**47,707,403**	**10,677,664**	**6,263,202**	**7,957,400**	**22,809,137**	**20,278,046**	**51,181,302**	**49,694,652**	**1,340,635**	**1,929,192**	**-**
2026	**43,769,553**	**10,074,227**	**4,817,798**	**7,216,931**	**21,660,597**	**17,439,915**	**48,098,561**	**45,291,328**	**1,221,844**	**1,222,074**	**-**
2027	**41,295,314**	**9,452,587**	**4,763,496**	**6,669,142**	**20,410,089**	**16,113,606**	**46,585,535**	**40,888,005**	**1,103,054**	**1,102,378**	**-**
2028	**38,889,142**	**8,805,122**	**4,841,178**	**6,124,659**	**19,118,183**	**15,244,150**	**45,146,288**	**36,484,681**	**984,264**	**985,110**	**-**
2029	**36,598,104**	**8,153,239**	**5,012,539**	**5,619,392**	**17,812,933**	**14,502,435**	**43,776,506**	**32,081,358**	**865,473**	**865,473**	**-**
2030	**34,015,312**	**7,477,188**	**4,730,817**	**5,319,764**	**16,487,543**	**13,158,931**	**42,020,385**	**27,678,034**	**746,683**	**746,683**	**-**
2031	**31,479,913**	**6,848,547**	**4,439,470**	**4,985,811**	**15,206,086**	**12,115,657**	**40,243,938**	**26,482,846**	**714,440**	**713,761**	**-**
2032	**29,079,891**	**6,244,501**	**4,160,276**	**4,667,715**	**14,007,400**	**11,116,298**	**38,413,765**	**25,287,658**	**681,997**	**-**	**-**
2033	**26,866,767**	**5,678,713**	**3,876,861**	**4,391,147**	**12,920,046**	**10,170,099**	**36,695,115**	**24,092,471**	**650,153**	**270,988**	**-**
2034	**24,696,580**	**5,143,095**	**3,588,718**	**4,094,969**	**11,869,796**	**9,249,490**	**34,893,533**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,766,073**	**4,672,526**	**3,296,135**	**3,860,671**	**10,936,742**	**8,410,787**	**33,182,128**	**21,702,095**	**-**	**-**	**-**
2036	**20,573,942**	**4,321,002**	**2,984,681**	**3,439,400**	**9,828,859**	**7,652,324**	**31,163,503**	**20,506,907**	**-**	**-**	**-**
2037	**18,446,306**	**4,074,321**	**2,672,798**	**2,994,143**	**8,705,044**	**7,007,164**	**29,094,880**	**19,311,719**	**-**	**-**	**-**
2038	**16,315,742**	**3,823,038**	**2,355,848**	**2,544,921**	**7,591,936**	**6,352,550**	**26,889,157**	**18,116,531**	**-**	**-**	**-**
2039	**14,441,878**	**3,556,243**	**2,033,919**	**2,273,260**	**6,578,456**	**5,695,590**	**24,724,555**	**16,921,344**	**-**	**-**	**-**
2040	**12,760,726**	**3,399,211**	**1,707,013**	**2,019,004**	**5,635,498**	**5,140,425**	**22,520,151**	**15,726,156**	**-**	**-**	**-940,497**
2041	**11,246,845**	**3,239,351**	**1,374,832**	**1,843,056**	**4,789,606**	**4,594,911**	**20,649,738**	**14,530,968**	**-**	**-**	**-2,610,501**
2042	**9,773,401**	**3,073,935**	**1,037,949**	**1,655,916**	**4,005,601**	**4,046,674**	**18,957,389**	**13,335,780**	**-**	**-**	**-2,491,615**
2043	**8,396,160**	**2,920,574**	**696,516**	**1,474,759**	**3,304,312**	**3,514,118**	**17,383,713**	**11,763,164**	**-**	**-**	**-4,617,315**
2044	**7,113,227**	**2,777,606**	**350,516**	**1,287,860**	**2,697,244**	**2,994,950**	**15,878,943**	**10,190,549**	**-**	**-**	**-3,531,377**
2045	**5,930,691**	**2,644,625**	**-**	**1,105,420**	**2,180,646**	**2,489,263**	**14,442,484**	**8,617,933**	**-**	**-**	**-2,290,650**
2046	**5,182,364**	**2,526,063**	**-**	**904,552**	**1,751,748**	**2,374,500**	**13,409,501**	**7,045,318**	**-**	**-**	**-607,744**
2047	**4,506,948**	**2,418,847**	**-**	**725,105**	**1,362,997**	**2,273,716**	**12,371,031**	**5,472,702**	**-**	**-**	**-**
2048	**3,925,892**	**2,318,146**	**-**	**577,639**	**1,030,108**	**2,179,057**	**11,357,658**	**3,900,087**	**-**	**-**	**-**
2049	**3,451,242**	**2,222,816**	**-**	**447,848**	**780,578**	**2,089,447**	**10,470,058**	**2,327,471**	**-**	**-**	**-**
2050	**3,078,240**	**2,139,078**	**-**	**340,630**	**598,532**	**2,010,733**	**9,721,375**	**754,855**	**-**	**-**	**-**

H.23 Central scenario (no frontloading of APCR allowances) with slower transportation sector decarbonization

Table 131: Central scenario with slower transportation sector decarbonization, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**69.17**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**69.20**	**47.65**	**61.21**	**20.39**	**74.79**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2025	**75.43**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**78.22**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**80.82**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**86.15**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**94.10**	**60.81**	**78.13**	**26.02**	**95.46**
2030	**100.23**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**98.32**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**100.63**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**105.06**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**105.70**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**78.00**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**71.97**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**71.56**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**72.29**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**51.36**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**47.63**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**47.57**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**60.66**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**66.28**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**71.75**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**78.80**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**89.78**	**169.41**	**217.68**	**72.48**	**265.95**

Table 132: Central scenario with slower transportation sector decarbonization, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,409,245**	**11,862,415**	**10,972,931**	**8,372,229**	**25,201,671**	**27,374,373**	**58,354,932**	**58,501,299**	**1,578,216**	**1,577,609**	**-**
2024	**52,569,284**	**11,102,905**	**9,094,768**	**8,181,312**	**24,190,300**	**24,130,004**	**55,248,639**	**54,097,976**	**1,459,425**	**1,460,032**	**-**
2025	**47,814,371**	**10,450,361**	**6,959,114**	**7,878,775**	**22,526,121**	**20,706,720**	**51,877,213**	**49,694,652**	**1,340,635**	**1,339,430**	**-**
2026	**43,477,892**	**9,825,847**	**5,353,109**	**6,976,528**	**21,322,408**	**17,621,213**	**48,633,872**	**45,291,328**	**1,221,844**	**1,221,534**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2027	**41,047,488**	**9,173,394**	**5,292,773**	**6,310,701**	**20,270,619**	**16,222,737**	**47,262,357**	**40,888,005**	**1,103,054**	**1,104,570**	**-**
2028	**38,728,316**	**8,491,549**	**5,379,086**	**5,680,310**	**19,177,371**	**15,302,986**	**45,982,556**	**36,484,681**	**984,264**	**984,264**	**-**
2029	**36,544,402**	**7,806,229**	**5,569,488**	**5,111,588**	**18,057,097**	**14,536,113**	**44,785,506**	**32,081,358**	**865,473**	**865,473**	**-**
2030	**34,009,790**	**7,096,134**	**5,256,464**	**4,752,202**	**16,904,990**	**13,139,943**	**43,153,312**	**27,678,034**	**746,683**	**746,683**	**-**
2031	**31,487,709**	**6,442,107**	**4,932,744**	**4,337,104**	**15,775,754**	**12,045,224**	**41,500,280**	**26,482,846**	**714,440**	**714,440**	**-**
2032	**29,122,674**	**5,812,381**	**4,622,529**	**3,975,671**	**14,712,094**	**11,002,224**	**39,785,325**	**25,287,658**	**682,196**	**682,196**	**-**
2033	**26,939,079**	**5,224,909**	**4,307,624**	**3,664,648**	**13,741,899**	**10,015,827**	**38,174,406**	**24,092,471**	**649,953**	**649,953**	**-**
2034	**24,919,520**	**4,774,408**	**3,987,465**	**3,353,692**	**12,803,956**	**9,158,109**	**36,473,367**	**22,897,283**	**617,710**	**617,710**	**-**
2035	**23,076,974**	**4,349,832**	**3,662,372**	**3,099,094**	**11,965,677**	**8,342,113**	**34,857,461**	**21,702,095**	**-**	**-**	**-**
2036	**21,037,497**	**4,061,666**	**3,316,312**	**2,694,322**	**10,965,197**	**7,624,409**	**32,963,471**	**20,506,907**	**-**	**-**	**-**
2037	**19,108,737**	**3,879,742**	**2,969,775**	**2,327,355**	**9,931,865**	**7,020,907**	**31,031,589**	**19,311,719**	**-**	**-**	**-**
2038	**17,208,846**	**3,708,331**	**2,617,608**	**1,992,777**	**8,890,130**	**6,423,516**	**28,928,277**	**18,116,531**	**-**	**-**	**-**
2039	**15,534,404**	**3,545,803**	**2,259,910**	**1,792,754**	**7,935,937**	**5,845,057**	**26,835,704**	**16,921,344**	**-**	**-**	**-**
2040	**13,897,077**	**3,392,621**	**1,896,681**	**1,590,385**	**7,017,390**	**5,273,380**	**24,676,880**	**15,726,156**	**-**	**-**	**-**
2041	**12,397,076**	**3,232,008**	**1,527,591**	**1,449,436**	**6,188,041**	**4,703,375**	**22,828,509**	**14,530,968**	**-**	**-**	**-**
2042	**10,880,394**	**3,064,640**	**1,153,276**	**1,299,314**	**5,363,164**	**4,127,588**	**21,135,488**	**13,335,780**	**-**	**-**	**-133,759**
2043	**9,424,895**	**2,907,513**	**773,906**	**1,155,678**	**4,587,798**	**3,563,597**	**19,539,602**	**11,763,164**	**-**	**-**	**-3,227,825**
2044	**8,034,171**	**2,758,266**	**389,463**	**1,006,611**	**3,879,831**	**3,008,405**	**17,991,786**	**10,190,549**	**-**	**-**	**-2,118,454**
2045	**6,719,582**	**2,616,017**	**-**	**861,255**	**3,242,311**	**2,461,640**	**16,491,186**	**8,617,933**	**-**	**-**	**-886,661**
2046	**5,872,768**	**2,485,490**	**-**	**705,710**	**2,681,568**	**2,336,361**	**15,413,124**	**7,045,318**	**-**	**-**	**-**
2047	**5,070,957**	**2,364,966**	**-**	**564,769**	**2,141,223**	**2,223,068**	**14,291,175**	**5,472,702**	**-**	**-**	**-**
2048	**4,347,213**	**2,252,337**	**-**	**450,404**	**1,644,472**	**2,117,197**	**13,146,460**	**3,900,087**	**-**	**-**	**-**
2049	**3,750,865**	**2,149,484**	**-**	**349,011**	**1,252,370**	**2,020,515**	**12,115,074**	**2,327,471**	**-**	**-**	**-**
2050	**3,279,738**	**2,063,006**	**-**	**263,973**	**952,759**	**1,939,226**	**11,214,928**	**754,855**	**-**	**-**	**-**

H.24 Central scenario (no frontloading of APCR allowances) with faster transportation sector decarbonization

Table 133: Central scenario with faster transportation sector decarbonization, prices by year

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2023	**66.03**	**45.37**	**58.31**	**19.41**	**71.23**
2024	**65.83**	**47.65**	**61.21**	**20.39**	**74.79**
2025	**71.69**	**50.03**	**64.28**	**21.40**	**78.54**
2026	**74.47**	**52.53**	**67.49**	**22.47**	**82.46**
2027	**74.87**	**55.15**	**70.87**	**23.60**	**86.59**
2028	**78.59**	**57.91**	**74.41**	**24.77**	**90.92**
2029	**85.28**	**60.81**	**78.13**	**26.02**	**95.46**

Year	Allowance price ($)	APCR1 trigger price ($)	APCR2 trigger price ($)	Price floor ($)	Price ceiling ($)
2030	**91.72**	**63.85**	**82.04**	**27.32**	**100.23**
2031	**86.15**	**67.04**	**86.15**	**28.69**	**105.24**
2032	**86.93**	**70.40**	**90.45**	**30.11**	**110.50**
2033	**91.38**	**73.91**	**94.98**	**31.62**	**116.03**
2034	**92.63**	**77.61**	**99.73**	**33.20**	**121.83**
2035	**58.53**	**81.49**	**104.71**	**34.86**	**127.92**
2036	**53.04**	**85.57**	**109.95**	**36.60**	**134.32**
2037	**52.73**	**89.84**	**115.44**	**38.43**	**141.04**
2038	**53.41**	**94.33**	**121.21**	**40.35**	**148.08**
2039	**43.95**	**99.05**	**127.27**	**42.38**	**155.49**
2040	**44.49**	**104.00**	**133.63**	**44.49**	**163.27**
2041	**46.72**	**109.20**	**140.32**	**46.72**	**171.43**
2042	**49.05**	**114.66**	**147.34**	**49.05**	**180.00**
2043	**51.50**	**120.39**	**154.70**	**51.50**	**189.00**
2044	**54.08**	**126.42**	**162.43**	**54.08**	**198.46**
2045	**56.78**	**132.74**	**170.56**	**56.78**	**208.37**
2046	**59.62**	**139.38**	**179.09**	**59.62**	**218.80**
2047	**62.60**	**146.34**	**188.04**	**62.61**	**229.73**
2048	**65.74**	**153.66**	**197.44**	**65.74**	**241.22**
2049	**70.57**	**161.35**	**207.31**	**69.03**	**253.28**
2050	**79.11**	**169.41**	**217.68**	**72.48**	**265.95**

Table 134: Central scenario with faster transportation sector decarbonization, volumes by year

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2023	**56,899,375**	**12,264,375**	**10,972,931**	**8,401,965**	**25,260,105**	**27,795,592**	**58,354,932**	**58,501,299**	**1,578,216**	**1,576,483**	**-**
2024	**52,878,336**	**11,292,980**	**9,094,768**	**8,212,352**	**24,278,237**	**24,338,015**	**55,248,639**	**54,097,976**	**1,459,425**	**1,461,158**	**-**
2025	**48,225,113**	**10,662,414**	**6,959,114**	**7,929,813**	**22,673,772**	**20,944,736**	**51,877,213**	**49,694,652**	**1,340,635**	**1,340,635**	**-**
2026	**44,111,488**	**10,060,482**	**5,353,109**	**7,176,758**	**21,521,140**	**17,943,891**	**48,633,872**	**45,291,328**	**1,221,844**	**1,220,941**	**-**
2027	**41,336,892**	**9,446,654**	**5,292,773**	**6,633,558**	**19,963,907**	**16,622,341**	**46,903,869**	**40,888,005**	**1,103,054**	**1,102,836**	**-**
2028	**38,707,941**	**8,815,990**	**5,379,086**	**6,100,449**	**18,412,415**	**15,783,095**	**45,269,135**	**36,484,681**	**984,264**	**984,516**	**-**
2029	**36,278,707**	**8,189,461**	**5,569,488**	**5,609,059**	**16,910,699**	**15,090,617**	**43,723,671**	**32,081,358**	**865,473**	**866,342**	**-**
2030	**33,562,177**	**7,545,093**	**5,256,464**	**5,326,452**	**15,434,168**	**13,749,464**	**41,754,646**	**27,678,034**	**746,683**	**746,683**	**-**
2031	**30,964,696**	**6,950,707**	**4,932,744**	**5,023,704**	**14,057,541**	**12,711,972**	**39,779,315**	**26,482,846**	**714,440**	**105,657**	**-**
2032	**28,539,794**	**6,378,353**	**4,622,529**	**4,732,122**	**12,806,790**	**11,715,354**	**37,775,635**	**25,287,658**	**682,085**	**-**	**-**
2033	**26,329,830**	**5,840,313**	**4,307,624**	**4,478,826**	**11,703,068**	**10,766,204**	**35,904,777**	**24,092,471**	**650,065**	**-**	**-**

Year	Total emissions (MTCO2e)	Industry emissions (MTCO2e)	Power emissions (MTCO2e)	Building emissions (MTCO2e)	Transport emissions (MTCO2e)	No cost emissions (MTCO2e)	BAU emissions (MTCO2e)	Cap excluding all reserves (MTCO2e)	APCR1 releases (MTCO2e)	APCR2 releases (MTCO2e)	Price ceiling/floor releases (MTCO2e)
2034	**24,168,713**	**5,325,450**	**3,987,465**	**4,201,267**	**10,654,531**	**9,834,208**	**33,971,195**	**22,897,283**	**617,710**	**-**	**-**
2035	**22,255,961**	**4,876,656**	**3,662,372**	**3,986,398**	**9,730,536**	**8,984,489**	**32,147,600**	**21,702,095**	**-**	**-**	**-**
2036	**20,073,924**	**4,522,775**	**3,316,312**	**3,581,280**	**8,653,557**	**8,189,317**	**30,011,988**	**20,506,907**	**-**	**-**	**-**
2037	**17,969,088**	**4,278,814**	**2,969,775**	**3,128,076**	**7,592,423**	**7,511,476**	**27,848,935**	**19,311,719**	**-**	**-**	**-**
2038	**15,861,473**	**4,036,744**	**2,617,608**	**2,649,005**	**6,558,115**	**6,828,685**	**25,595,375**	**18,116,531**	**-**	**-**	**-**
2039	**14,019,615**	**3,779,710**	**2,259,910**	**2,356,164**	**5,623,830**	**6,142,782**	**23,418,162**	**16,921,344**	**-**	**-**	**-**
2040	**12,253,718**	**3,499,525**	**1,896,681**	**2,091,230**	**4,766,282**	**5,432,880**	**21,226,027**	**15,726,156**	**-**	**-**	**-2,913,080**
2041	**10,678,811**	**3,241,131**	**1,527,591**	**1,910,088**	**4,000,001**	**4,755,711**	**19,384,443**	**14,530,968**	**-**	**-**	**-3,454,854**
2042	**9,248,845**	**3,076,335**	**1,153,276**	**1,718,058**	**3,301,176**	**4,168,731**	**17,731,912**	**13,335,780**	**-**	**-**	**-3,173,032**
2043	**7,914,404**	**2,924,489**	**773,906**	**1,532,264**	**2,683,745**	**3,598,007**	**16,204,155**	**11,763,164**	**-**	**-**	**-5,114,303**
2044	**6,669,156**	**2,784,289**	**389,463**	**1,340,760**	**2,154,645**	**3,041,554**	**14,747,216**	**10,190,549**	**-**	**-**	**-4,064,840**
2045	**5,519,403**	**2,655,740**	**-**	**1,153,811**	**1,709,852**	**2,499,857**	**13,358,552**	**8,617,933**	**-**	**-**	**-2,879,671**
2046	**4,835,787**	**2,543,490**	**-**	**946,706**	**1,345,591**	**2,390,880**	**12,410,428**	**7,045,318**	**-**	**-**	**-1,199,962**
2047	**4,238,337**	**2,444,273**	**-**	**761,755**	**1,032,310**	**2,297,617**	**11,481,112**	**5,472,702**	**-**	**-**	**-89,431**
2048	**3,741,534**	**2,352,493**	**-**	**609,196**	**779,845**	**2,211,343**	**10,603,100**	**3,900,087**	**-**	**-**	**-13,033**
2049	**3,333,469**	**2,265,413**	**-**	**474,522**	**593,534**	**2,129,488**	**9,835,340**	**2,327,471**	**-**	**-**	**-**
2050	**3,010,156**	**2,187,872**	**-**	**363,094**	**459,190**	**2,056,600**	**9,190,077**	**754,855**	**-**	**-**	**-**