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RMI was philanthropically funded from September 2024 through June 2025 to perform an analysis of technical decarbonization pathways for Washington's EITE industries, options for determining allocation of no-cost allowances to EITEs, and complementary policies to support the technical decarbonization pathways.

We presented preliminary analysis to the EITE Advisory Groups in November 2024 and May 2025, as well as conducted over two dozen interviews with stakeholders in early 2025. Our final report, entitled "Opportunities for Industrial Modernization in Washington: Technical Pathways, Investments, Policy, and Decarbonizing Options for Emissions-Intensive, Trade-Exposed Industries" is uploaded as a file accompanying this comment as well as available at this url: https://rmi.org/insight/opportunities-for-industrial-modernization-in-washington/

Rocky Mountain Institute (RMI) is an independent, nonpartisan nonprofit founded in 1982 that transforms global energy systems through market-driven solutions to secure a prosperous, resilient, clean energy future for all. In collaboration with businesses, policymakers, funders, communities, and other partners, RMI drives investment to scale clean energy solutions, reduce energy waste, and boost access to affordable clean energy in ways that enhance security, strengthen the economy, and improve people's livelihoods. RMI is active in over 60 countries.

Thank you for the opportunity to comment and we welcome questions about our analysis and recommendations.

Opportunities for Industrial Modernization in Washington

Technical Pathways, Investments, Policy, and Decarbonizing Options for Emissions-Intensive, Trade-Exposed Industries

Report / June 2025

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About RMI

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Executive Summary

Washington's Cap-and-Invest program is a powerful tool for meeting the state's greenhouse gas (GHG) targets and funding investments that further support its businesses and residents. But how the program considers industrial emissions beyond 2034 will have to be revisited by Washington's legislative and regulatory bodies for it to function efficiently and equitably in the long term.

The Problem Today: The state's carbon targets for 2040 and 2050 are in tension with the current design of the Cap-and-Invest program because industrial allowance allocations in the program will distort the carbon market and thwart the state's legislated carbon targets. Therefore, a range of solutions must be considered to align the carbon targets and the Cap-and-Invest no-cost allowance structure and support the economic viability of industry.

The majority of industrial sector emitters — approximately 40 emissions-intensive, trade-exposed entities (EITEs) — constituted 15% of all allowances issued under the Cap-and-Invest program in 2023.[i] Because of their importance to Washington's economy and the relative challenge to achieving near-term decarbonization, the EITEs are given most of the allowances they need for compliance at no cost, an estimated value of at least $5.4 billion from 2023 to 2034. During the third compliance period (2031–2034), EITEs will receive no-cost allowances from the Washington Department of Ecology (Ecology) equivalent to 94% of a 2015–2019 emissions baseline. Because the Climate Commitment Act does not specify the level of no-cost allowances in subsequent compliance periods (2035–2050), Ecology presumes it is required to allocate no-cost allowances to EITEs at the 94% level through 2050, absent further legislative direction. If no-cost allowances are maintained at the 94% level, by the mid-2040s the amount of no-cost allowances required to be given to EITEs will exceed the number of allowances of Washington's overall emissions cap, a contradiction that threatens the function of the program.

Solutions In the Next Decade: RMI has performed a technical pathways analysis for each of Washington's EITE sectors and found that enough industrial emissions can be reduced by the end of 2034 and by 2050 to justify sectoral benchmarking and new no-cost allowance reduction schedules post-2034. RMI found that existing and near-term technologies could reduce emissions from EITEs 39% by the end of 2034, largely through implementing energy and material efficiency measures and electrifying applications.

Longer-Term Solutions: In the longer term and without anticipating technological breakthroughs, EITEs could implement technology to reduce their emissions 91% by 2050, incorporating additional electrification measures and low-carbon fuels such as green hydrogen, and employing carbon capture and storage (CCS) for the hardest to decarbonize emissions. Based on these pathways, industrial electricity demand would increase by approximately 13,975 gigawatt-hours, reflecting a broad shift toward electrifying process heat where feasible, integrating hydrogen for high-temperature applications, and pairing residual fossil fuel use with point-source CCS to drive deep decarbonization across industry.

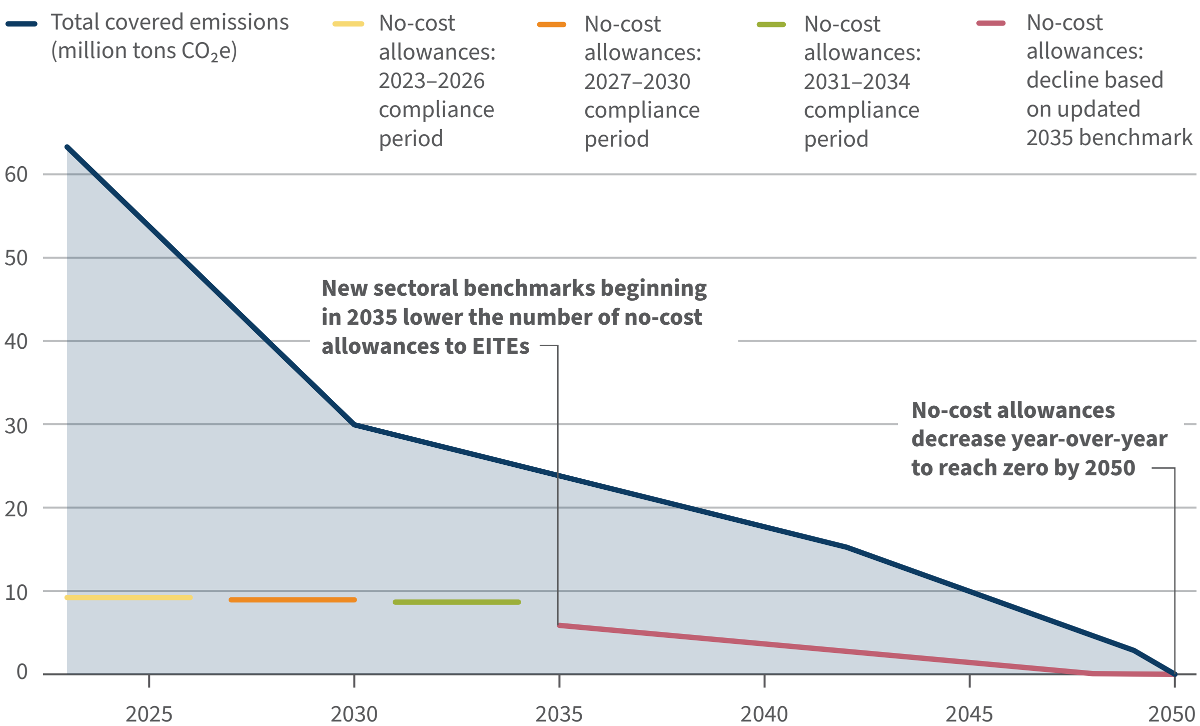
i Criteria for classification as an EITE entity are outlined in the Revised Code of Washington Chapter 70A.65.110. Broadly, this classification encompasses entities with high energy use and greenhouse gas emissions that also face significant national or global competition for their products.

The Costs: Modeling indicates that the overall cost to implement the 2023 through 2034 portion of the EITE industrial decarbonization pathways, paid for from a variety of sources, equates to $2.94 billion, far lower than the projected $5.4 billion value of the no-cost allowances. The cost to implement the full EITE industrial decarbonization pathways, 2023 through 2050, equates to $17.5 billion. Funding for technical improvements could come from grants, tax credits, low-cost financing, private capital, and the reselling of no-cost allowances.

The Path Forward: We present and explore seven approaches to handle EITE allowances. From this, we recommend that each industrial sector's respective technical ability to decarbonize over the first three compliance periods (2023 through 2034) be considered for setting sector-specific benchmarks. For example, from each sector-specific benchmark, new no-cost allowance reduction schedules would be applied from 2035 onwards. This recommended action would encourage industrial pollution reductions prior to 2035, ensure EITEs have policy certainty under the Cap-and-Invest program, avoid leakage, and safeguard the value of pollution allowances being put to the highest and best possible use for the people of Washington. The other six options for determining no-cost allowances to EITEs are also evaluated.

Exhibit ES1 **Projected annual emissions cap and EITE no-cost allowances with estimated new 2035 sectoral benchmarks**

New EITE sectoral 2035 emissions benchmarks, estimated based on emissions reduction potential, would see EITE no-cost allowances adjusted between 2034 and 2035 before declining steadily through 2050.



Note: Total annual Cap-and-Invest program allowance budgets through 2050 based on set total program budget allowance decreases relative to statutory total program baseline values for the 2023-2026 compliance period through 2034. Excludes no-cost allowance allocations to electric and natural gas utilities. Updated 2035 emissions benchmark and 2035-2050 values based on RMI estimates, and exclude aerospace and aluminum.

RMI Graphic. Source: Washington Department of Ecology, Environmental Protection Agency FLIGHT, RMI estimates

To help EITEs decarbonize and ensure the Cap-and-Invest program meets its objectives, we also detail 18 new policy ideas pertaining to Washington's industrial sector. We categorize these ideas under updating standards and regulations, Cap-and-Invest program evolution and EITE treatment, or state support, and prioritize the policy ideas as essential, recommended, or worth consideration.

New policies, more funding, and updates to the Climate Commitment Act's treatment of EITEs will likely all be necessary to enable EITEs to smoothly and judiciously implement decarbonization technology over the next decade. Post-2034 policy support and a gradual reduction of no-cost allowances will enable Washington to maintain its economic competitiveness and meet its GHG reduction targets.

Exhibit ES2 **New policy opportunities**

	Updating Standards and Regulations	Cap-and-Invest Program Evolution + EITE Treatment	State Support
Essential (★★★)	Expedite electrical grid enhancements for industrial electrification		
	Accelerate permitting procedures for critical decarbonization projects		
Recommended (★★☆)	Reform industrial electricity tariffs and ratemaking	Consign EITE no-cost allowances at auction	Set up an industrially focused green bank
	Update existing rules on oil refineries	Require additional criteria to qualify as an EITE	Increase funding for the Hard-to-Decarbonize Sector Grants Program
Worth Consideration (★☆☆)	Introduce a clean heat standard	Allow opt-in EITE entities to receive no-cost allowances	Augment technical assistance planning grants for decarbonization
	Expand methane regulations	Develop additional offset protocols	Strengthen state procurement requirements
			Introduce tax credits for emissions-reducing equipment
			Introduce tax credits for clean manufacturing production
			Invest in common carrier infrastructure for the transportation of green hydrogen
			Incentivize transitions of refineries to other functions

RMI Graphic

Introduction

In 2021, the Washington legislature passed the Climate Commitment Act (CCA), which established a market-based Cap-and-Invest program to reduce carbon pollution and help achieve the GHG limits set in state law: 45% below 1990 levels by 2030, 70% below 1990 levels by 2040, 95% below 1990 levels by 2050.[1] The program began operating on January 1, 2023, with the first emissions allowance auction held on February 28, 2023.[2] Voters decisively affirmed the Cap-and-Invest program through ballot measure Initiative 2117 in November 2024.[3]

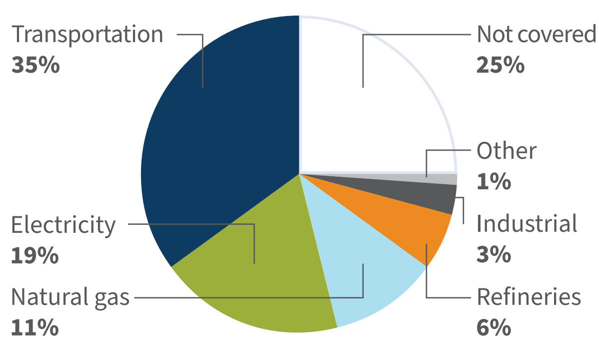
The overall emissions limit, referred to as a "cap," is divided into allowances, each equivalent to 1 ton (t) of GHG pollution. The allowances are then sold at quarterly auctions held by the Washington Department of Ecology (Ecology).[4] The emissions cap — and thus the number of allowances auctioned — steadily declines over time in accordance with Washington's economy-wide GHG targets. Businesses covered by the program must obtain allowances equal to their emissions and submit them to Ecology according to a staggered four-year compliance schedule.[5] The revenue generated by the program is then invested by the state to further reduce pollution in ways specified by the Washington legislature. The Washington Cap-and-Invest program functions similarly to programs in California, Québec, and for the power sector in Northeastern states.[6]

Washington is currently considering linking its carbon allowance market to that of California and Québec, which originally joined their markets in 2014. The CCA directs Ecology to seek to enter linkage agreements with other jurisdictions. Ecology expects the state's membership in the California–Québec market to result in stable allowance prices and an increase in overall market activity.[7] An analysis from Resources for the Future noted likely lower carbon prices for covered Washington entities, higher prices for California, and an overall decrease in carbon emissions across the linked markets.[8]

The Cap-and-Invest program covers approximately 75% of Washington's statewide GHG emissions.[9] Covered sources of emissions include gasoline and on-road diesel, electricity consumed in Washington, facilities emitting more than 25,000 t of GHG pollution per year, natural gas distributed to homes and businesses, waste-to-energy (beginning in 2027), railroads (beginning in 2031), and certain landfills (beginning in 2031). Emissions from agriculture, aviation fuels, most marine fuels, biogenic sources, and businesses emitting less than 25,000 t of GHG pollution per year are not covered by Cap-and-Invest.

Exhibit 1

Covered and noncovered emissions under the CCA



RMI Graphic. Source: Washington State Department of Ecology, **https://ecology.wa.gov/ecology/media/BlogMedia/CCA-Covered-Emissions.png**

EITEs are a subset of businesses covered by Cap-and-Invest that receive no-cost allowances to cover nearly all their baseline emissions at least through 2034.[10] EITEs produce a variety of products such as paper, food, beverages, steel, aluminum, glass, cement, building materials, airplanes, semiconductors, fertilizer, and transportation fuels. Although some industrial sources of emissions are not considered EITEs by the program due to low annual emissions or because they do not fall under an applicable North American Industry Classification System (NAICS) code,[11] they still experience the price impact of the Cap-and-Invest program through their purchase of electricity and natural gas from electric and natural gas utilities, both of which are covered entities.

The Washington legislature created the EITE designation for several reasons: to acknowledge that certain industries face unique challenges in reducing their GHG emissions in the near term, to dissuade industries from relocating out of state (economic leakage), and to avoid in-state industries being unfairly subjected to a carbon price while out-of-state industries are not (leading to emissions leakage). Because the Washington legislature did not specify the level of no-cost allowances to be given to EITEs post-2034, Ecology has been tasked with preparing a report with recommendations on how EITEs are treated under the program.

RMI investigated Washington's industrial sector and EITE treatment under the Cap-and-Invest program. Our objective was to establish a foundational analysis of decarbonization pathways for Washington's existing and future industry and explore market and policy opportunities to support industrial decarbonization and regional cleantech development. We have:

- Identified technical decarbonization pathways for existing EITE industries and manufacturing in Washington.
- Engaged with stakeholders to understand Washington industries' barriers to decarbonization and preferences for future investments (*see Appendix A, Exhibit A1*).
- Assessed potential changes to the approach for allocating no-cost allowances to EITEs post-2034 to ensure an equitable and orderly drawdown of industrial sector emissions.
- Analyzed the applicability of federal incentives to Washington's industries.
- Produced recommendations for changes in complementary policy and use of Cap-and-Invest revenue to accelerate industrial decarbonization.

The Challenges

EITE allowances

Under the current structure of the Cap-and-Invest program, Ecology is required to freely allocate no-cost allowances to each EITE according to a reduction schedule equivalent to 100% of the EITE's baseline emissions in the first compliance period (2023–2026), 97% of baseline emissions in the second compliance period (2027–2030), and 94% of baseline emissions in the third compliance period (2031–2034). There were approximately 9.2 million allowances (~15% of the overall cap) allocated to EITEs for 2023. Some EITEs use a mass-based baseline, while most use a carbon-intensity baseline; both baseline methods use averages of emissions from years 2015–2019.[ii] Left undetermined by the CCA are the appropriate levels of no-cost allowances to be allocated to EITEs in compliance periods post-2034. Ecology has interpreted this to mean that allocation levels from the third compliance period (94% of baseline) are the default to continue through 2050 absent legislative and subsequent regulatory action to establish revised allocation levels.[12]

GHG impact of EITE allowances

Because this is a market-based program, the value of future allowances is uncertain, but the allowance price floor and ceiling constrain the range of expected future allowance values. The total value of no-cost allowances to be allocated to EITEs through the first, second, and third compliance periods is estimated to be $6.7 billion if Washington's carbon market does not link with California and Québec (*see Appendix B, Exhibit B1*). If linkage begins in 2026, the total value of EITE no-cost allowances 2023 through 2034 is estimated to be $5.4 billion. If prices always stay at price floors between 2026 and 2034, however, that value could be as low as $4.2 billion, compared to $12.4 billion if prices in future auctions through 2034 remain at the price ceiling (*see Appendix C, Exhibit C1*).[iii]

The overall emissions cap declines more steeply than the level of no-cost allowances in the first, second, and third compliance periods, which means no-cost allowances allocated to EITEs will become an increasingly larger proportion of the pre-2035 emissions cap. Specifically, EITE allowances grow from roughly 15% of the overall emissions cap in 2023 to 35% in 2034, equating to approximately $811 million in value that year, assuming no linkage, or $545 million assuming linkage.

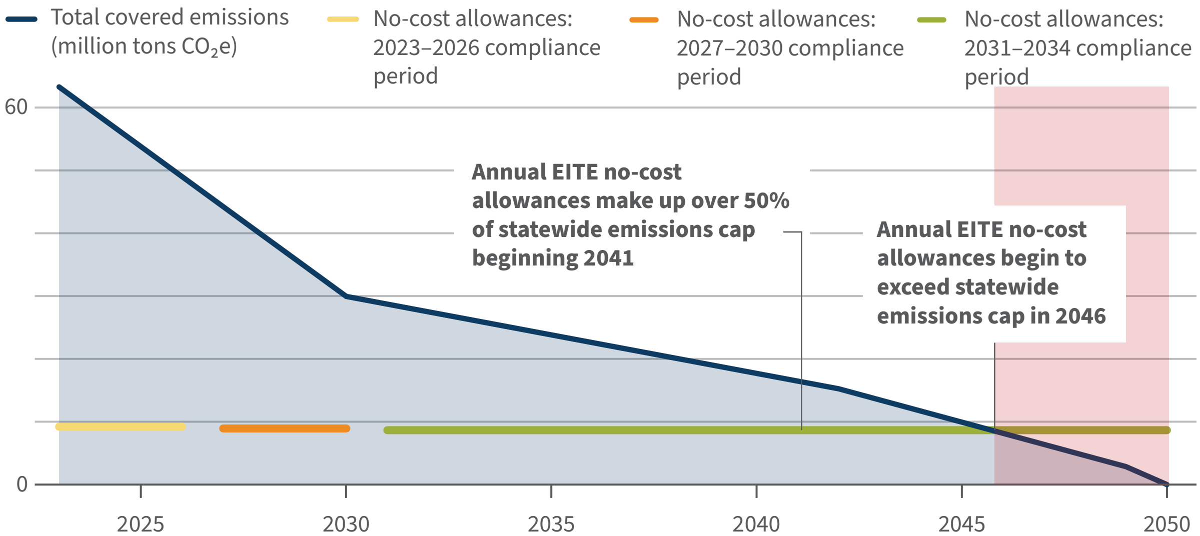
If allocations for no-cost allowances remain unchanged past 2034 and EITE industries continue emitting at a rate equivalent to 94% of their 2024 level of no-cost allowances, then the level of no-cost allowances for EITEs will make up over 50% of the overall state emissions cap (an approximately $1.3 billion value without linkage, or $844 million with linkage) by 2041. Furthermore, the level of EITE no-cost allowances would intersect with the economy-wide cap in 2046, causing a failure to meet CCA targets and economic distortions associated with all allowances being initially held by EITEs. This strongly suggests that regardless of emissions reductions in other sectors like transportation, no-cost allocations for EITEs post-2034 will need to be determined through legislation to maintain the viability of the CCA, increase equity among covered entities, and ensure the Cap-and-Invest program fulfills its intended purpose to reduce emissions.

ii Mass-based baseline: Determines allowances based on the facility's average annual emissions over 2015 through 2019. Carbon-intensity baseline: Calculates allowances based on the facility's emissions per unit of production.

iii EITE no-cost allowance value estimates for linkage, price floor, and price ceiling use 2023–2024 historical auction prices and Ecology price estimates for 2025.

Exhibit 2 **Projected annual emissions cap and EITE no-cost allowances with no change to EITE no-cost allowances post-2034**

If EITE no-cost allowances remain unchanged post-2034 and EITE industries continue emitting at a rate equivalent to 94% of their 2024 level of no-cost allowances, then the level of EITE no-cost allowances would intersect with the economy-wide cap in 2046.



Note: Total annual Cap-and-Invest program allowance budgets through 2050 based on set total program budget allowance decreases relative to statutory total program baseline values for the 2023-2026 compliance period. EITE no-cost allowance figures exclude no-cost allowance allocations to electric and natural gas utilities.

RMI Graphic. Source: Washington Department of Ecology

Economic considerations

The 12-year-long runway (2023–2034) of no-cost allowances to EITEs is intended to prevent leakage and enable deployment of emissions-reducing technology. Meanwhile, many of the remaining emitting sectors (e.g., transportation fuel suppliers, power plants, natural gas utilities) must pay for allowances at auction. Because revenue from the Cap-and-Invest program is a limited and declining resource, the value of allowances allocated to EITEs at no cost is an important factor in making strategic use of state funds to ease decarbonization while growing the state economy.

Auction revenues are held in three primary accounts and four subaccounts, each of which is earmarked for specific project types.[13] The Climate Commitment Account, in particular, focuses on issues relevant to industrial decarbonization projects, including investing in energy efficiency and deploying carbon dioxide removal (CDR). The CCA requires that a minimum of 35% of auction revenue go toward projects benefiting vulnerable populations within overburdened communities, while 10% of revenues must go toward projects with tribal support.

RMI analysis suggests different industrial facilities can reduce carbon emissions on different timelines, with variance based on the maturation, complexity, and availability of different technological solutions. The rest of this report assesses the viability of technological pathways and time frames for implementation to offer guidance to the State of Washington in determining post-2034 no-cost allowance allocations to EITEs, as well as state actions that could help enable uptake of those decarbonization pathways.

Technical Pathways

Summary

We examined existing technical pathways for reducing GHG emissions across Washington's EITEs. Our analysis identifies viable decarbonization options without presuming facility shutdowns, focusing instead on technological and operational improvements that can be implemented in the near term (0–4 years), medium term (5–10 years), and long term (10-plus years) with minor variations across sectors. We identify feasible technological pathways for eight key industrial sectors — refineries, pulp and paper, cement, glass production, food processing, chemicals and hydrogen, iron and steel, and electronics — by determining the sequence for introducing specific technological levers.[iv] Our analysis considers three critical factors: technological readiness level (TRL), marginal cost of abatement ($/t$CO_2$e), and relative emissions-reduction potential for each sector. This analysis is based on existing scientific literature and case studies, the US Department of Energy (DOE)'s "The Pathway to: Industrial Decarbonization Commercial Liftoff" (particularly for marginal abatement cost estimates and TRL), as well as RMI's sector expertise.[14] These technical pathways can also be used to provide a foundation for determining EITE no-cost allowance allocation levels after 2034 and policy opportunities to support industrial decarbonization, as discussed later in this report. *Appendix D* contains more information about the technical pathway methodology.

Below, we introduce common decarbonization levers applicable across the majority of EITE sectors, including energy and material efficiency improvements, electrification of processes, alternative fuels including hydrogen, and carbon capture and storage (CCS) as well as sector-specific technological levers such as incorporating supplementary cementitious materials (SCMs) for cement or biorefinery conversion for refineries.

Exhibit 3 **Crosscutting technical interventions for technical decarbonization pathways**

IMMEDIATE–4 YEARS — **5–10 YEARS** — **10+ YEARS**

Energy efficiency

- Near-term solutions not requiring substantial process changes
- Includes improvements in system efficiencies, process yield, and recovery of thermal energy; expansion of energy management practices; and increased implementation of smart manufacturing strategies

Electrification

- Gives an opportunity to leverage decarbonized electricity sources and reduce industrial emissions from on-site fossil fuel combustion
- Includes electrification of process heat (e.g., heat pumps) or electrification of hydrogen production for industrial process use

Low-carbon fuels and hydrogen

- Decarbonized industrial processes with low-carbon fuels is effective where electrification is challenging due to high temperature needs or chemical processes
- Includes use of biogenic fuels (biomass or biogas), waste fuels or tire-derived fuel, and green hydrogen

Carbon capture

- Implementing CC(U)S technologies allows industries to capture CO_2 emissions for storage or conversion into valuable products. Critical component for deep decarbonization
- Current costs and technical considerations push the technology to the horizon

RMI Graphic

iv The scope of this technical pathways analysis encompasses the eight sectors identified above, while the aerospace and aluminum sectors fall outside the current assessment parameters due to their reduced emissions significance relative to the 2015–2019 reference period and data constraints that preclude detailed evaluation.

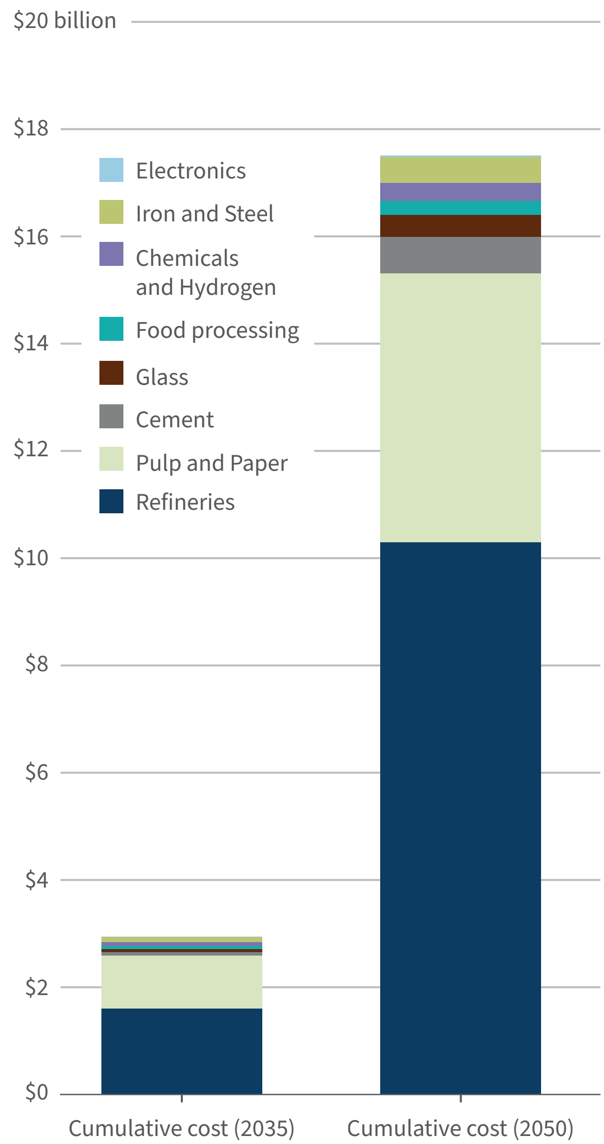
We find that technologies deployable within the next decade could reduce industrial emissions by a cumulative 44.9 million tons (Mt) CO_2e between 2023 and 2034. In aggregate, EITE sectors can reduce emissions by up to 39% by 2035 and by 91% by 2050 compared to 2015–19 baseline levels, with the largest absolute emissions reductions driven by the refineries, pulp and paper, and food processing sectors. *Appendix E, Exhibits E2 through E10* includes additional detailed technical decarbonization pathway figures.

The estimated marginal cost abatement for implementing these technologies ranges from −$150 to $500 per ton of CO_2e reduced, leading to cumulative costs of $2.94 billion by 2035. Although energy and material efficiency measures can be deployed in the short term across all sectors with positive economic returns, certain hard-to-abate sectors like refineries and cement will require more specialized solutions, including hydrogen and carbon capture, utilization, and storage (CCUS) as a final backstop technology. However, current economics and TRLs limit the relevance of these technologies in the long-term implementation horizons. For certain sectors, particularly electronics manufacturing, glass production, and food processing, application of CCUS is not feasible.

Among the evaluated issues for implementation beyond technological challenges and costs is access to stable clean electricity generation, which has also been identified as relevant across all the sectors. Hence, we modeled an incremental annual increase in electricity demand for the eight EITE sectors using an RMI-developed model.[v] On average, a relative increase across all sectors by 2030 represents 35% of baseline electricity purchased from the grid in 2018. By 2050 this number increases to 65%, with the highest absolute increase represented by refineries (5,522 gigawatt-hours [GWh]), pulp and paper (3,574 GWh), and food processing (1,704 GWh). More information on both new electricity demand from industrial decarbonization and pathway implementation costs from RMI's analysis can be found in *Appendix F, Exhibit F1*.

Exhibit 4

Projected total cost of established technical decarbonization pathways from 2023 to 2034 and from 2023 to 2050



RMI Graphic

v The model assumes full electrification of low-temperature heat processes (< 100°C) and a combination of electrification, green hydrogen, and CCS for high-temperature applications. Annual growth of 2% was assumed for each sector excluding refineries, for which a 2% annual contraction was assumed in the model.

In this regard, sectors that would benefit most from on-site renewable energy systems — due to favorable resource availability, compatible load profiles, or existing infrastructure — include pulp and paper, food processing, electronics, and chemicals and hydrogen. On-site renewables present greater implementation challenges for refineries, glass production, cement, and iron and steel due to their high-temperature process requirements, continuous operation demands, or existing waste-heat recovery systems. Hence, accounting for the specific operational characteristics and energy profiles of each sector helps identify more feasible and applicable decarbonization pathways.

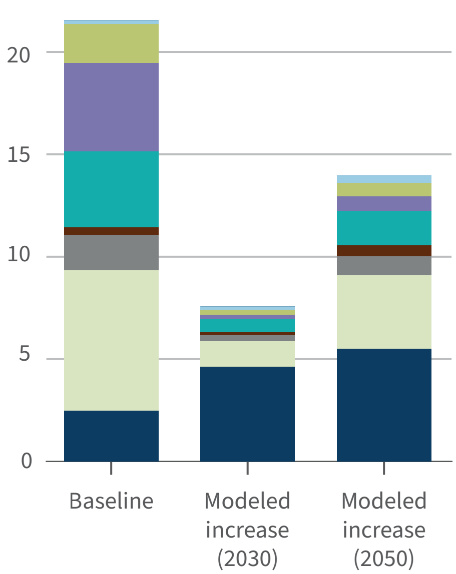
Existing technological pathways allow Washington's industrial sectors to demonstrate diverse but effective trajectories toward emissions reduction by 2035. Electronics manufacturing is projected to lead in relative terms with a 54% reduction by 2035, followed by glass production and chemicals and hydrogen at 53% and 46%, respectively. Food processing and iron and steel are also set to achieve substantial medium-term progress, with modeled reductions of 40% to 45%. In contrast, refineries show a more gradual pathway, targeting a 36% reduction potential.

In terms of absolute annual emissions savings by 2035, the refinery sector is projected to deliver the largest reduction — over 2.31 $MtCO_2e$ — followed closely by pulp and paper (non-biogenic) with nearly 0.49 $MtCO_2e$ and food processing with 0.3 $MtCO_2e$. These reductions reflect both the scale of emissions in these sectors and the availability of mature decarbonization technologies.

By 2050, all sectors can achieve deep decarbonization, with targets ranging from 70% to 93%. Realizing these ambitions will require a strategic mix of technology deployment, infrastructure investment, and coordinated policy support. Collectively, these efforts will enable Washington to decarbonize its industrial base while maintaining economic resilience.

Exhibit 5

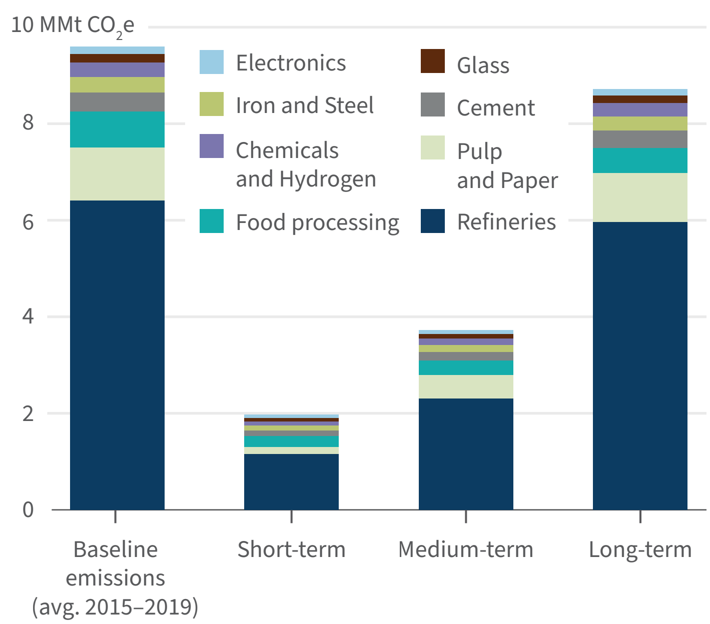
Incremental increase in annual electricity demand (thousand GWh)



RMI Graphic. Source: RMI analysis

Exhibit 6

Emissions-reduction potential by sector by 2050



RMI Graphic. Source: RMI analysis, GHG Reporting Program Publication

Refineries

Washington is home to five major petroleum refineries whose combined operations release roughly 6.4 $MtCO_2e$ each year — about 68% of total EITE emissions. To meet decarbonization goals without presuming facility shutdowns, we recommend sequencing six core strategies over the next decade and beyond.

Near-term opportunities

Refineries should first pursue marginal optimizations and efficiencies that require minimal capital outlay. Switching to lighter, lower-sulfur crudes, coprocessing bio-feedstocks (such as hydroprocessed esters and fatty acids) in existing heaters and boilers, and tightening maintenance and automation protocols can yield substantial emissions savings. Recovering waste heat and upgrading steam traps and insulation will further reduce fuel demand.

Simultaneously, refineries can begin electrifying low- and mid-temperature heating systems. Replacing steam-driven rotating equipment and gas-fired heat applications with electric drives or boilers — where grid capacity allows — can eliminate tens of thousands of tons of CO_2e per facility each year.

Medium-term opportunities

Potential road transport fuel shifts present an opportunity to retire, repurpose, or experimentally electrify heating for most gasoline units and fuel-grade cokers within refineries. These refining units convert lighter and heavier crude fractions, like naphtha and vacuum tower bottoms, respectively, into road transport fuels and will see increasing pressure to adapt as transport demand transitions from primarily gasoline and diesel to electric vehicles. This continues the spirit of using refinery unit modular adjustments to meet evolving societal needs over much of the past century, as seen in changes since 2000 with the gasoline additive methyl tert-butyl ether (MTBE) and corresponding refinery production units.[15] Refineries that shut down these units can redirect higher-sulfur fractions to nonfuel applications like petrochemicals and asphalt inputs, preserving residual value while slashing emissions. Alternatively, replacements of aging heaters and boilers with modern electric or hybrid alternatives will lock in further efficiency gains.

Between years 5 and 10, using hydrogen derived from natural gas through methane pyrolysis, in hydroprocessing units and other remaining high-temperature heat applications can displace conventional fuel use without requiring full grid-scale electrification. Complementing this, deploying advanced membrane and adsorption separations in waste gas recovery units can drive down carbon intensity across the plant.

Long-term opportunities

Direct electrification or green hydrogen produced via electrolysis offers the cleanest heat and feedstock solution for high-intensity units. Finally, capturing CO_2 from fluid catalytic cracking off-gas and converting it to methanol tackles one of the largest point-source emissions streams, paving the way for advanced sustainable aviation fuels and low-emissions chemicals.

Taken together, these six levers from low-cost optimizations to high-value carbon capture can reduce refinery emissions by up to 93% by 2050 compared to the baseline.[16],[vi] Focusing on the near- to medium-term solutions, a reduction of 36% can be achieved by 2035, with a cumulative reduction of 14.27 $MtCO_2e$ and a cumulative cost of $1.61 billion from 2023 to 2034. Efficiency upgrades start at around −$100 to $22/$tCO_2e$ avoided, while electrification, hydrogen, and CCUS options range up to $130 to $360/t. Full deployment of these measures is projected to increase statewide annual electricity demand by approximately 4,639.45 GWh by 2030 and 5,522.63 GWh by 2050. Notably, while Washington's already relatively clean grid makes electrification including electrolysis carbon-beneficial, refinery operators in interviews emphasized the need for clear regulatory signals and grid reliability guarantees to underwrite large-scale electrification investments.

Pulp and Paper

Washington's 13 kraft and sulfite pulp-and-paper mills constitute the state's most carbon-intensive manufacturing subsector.[17,vii] The 16% of the sector's emissions from non-biogenic sources — originating from natural gas auxiliary boilers, lime-kiln firing near 1,000°C, and bark- or gas-fired power boilers — is covered by the Cap-and-Invest program. The combined annual emissions of pulp and paper nonbiogenic sources total approximately 1.2 $MtCO_2e$. Because steam generation accounts for more than four-fifths of total energy use, any measure that reduces or electrifies steam demand delivers outsized climate benefit. The remaining 84% of stack emissions are biogenic, released when black liquor and wood waste are combusted, and therefore are not covered within the Cap-and-Invest program.[viii]

Near-term opportunities

Steam system optimization, leak repair, variable-speed drives, and insulation upgrades together cut fossil and process CO_2 by about 10%–15% at negative to very low marginal cost (from −$100 up to roughly $20/t).[18] Capturing waste heat from dryer sections and recovery-boiler flue gas adds a further 10%–20% reduction at approximately $20–$40/t.[19] Expanding biomass cofiring in auxiliary boilers provides an additional 15%–30% reduction at around −$6 to $16/t, assuming sustainable feedstock supply.[ix] These interventions are typically executed during planned maintenance and involve modest capital outlays relative to production scale.

Medium-term opportunities

Electrification of low- and medium-pressure steam — via electric package boilers or high-temperature heat pumps — can achieve an incremental 25%–40% reduction at about $100–$160/t.[20] Partial hydrogen blending (approximately 20% by volume) in lime kilns and auxiliary boilers falls within the same cost envelope, contingent on regional green hydrogen availability.[21] Sector-wide adoption of these measures is expected to increase annual electricity demand by 3,574 GWh by 2050.

vi We use the average reported by the EITE sector emissions from 2015 to 2019 as our main baseline level of emissions in this analysis. Alternative estimates also use 2022 emissions from the Environmental Protection Agency FLIGHT dataset.
vii Thirteen facilities with over 10,000 t in annual CO_2e emissions and five facilities with over 25,000 t.
viii Biogenic CO_2 emissions are defined as CO_2 emissions related to the natural carbon cycle, as well as those resulting from the combustion, harvest, digestion, fermentation, decomposition, or processing of biologically based materials. Hence, because they are part of the short-term carbon cycle, they are not typically included in decarbonization pathways.
ix Assumes $0.03/kilowatt-hour for biomass purchased in the United States.

Long-term opportunities

Capturing flue-gas CO_2 from recovery boilers and kilns can eliminate 40%–90% of residual emissions at roughly $90–$180/t, with higher costs when transport and storage are included. Electrified rotary lime kilns now progressing through European demonstration programs are expected to become commercially viable over the next decade; when paired with solvent capture, they would remove both combustion and calcination CO_2.

A sequential approach beginning with efficiency measures today, targeted electrification and clean fuels by 2035, and breakthrough kiln electrification, gasification, and carbon capture thereafter can reduce the sector's regulated emissions by more than 93% while preserving the industry's economic importance in Washington. Market analysts expect flat to modest growth (0%–1% per year) in Washington's pulp and paper output through 2035, although there is potential for a higher increase in cardboard and packaging annual demand of 3.95% due to growing e-commerce, increasing population, and expansion of the food and beverage manufacturing sector.[22] The suggested technologies are projected to deliver cumulative emission reductions of 16.2 $MtCO_2e$ by 2050 with an associated cost of $5.01 billion.

Cement

Washington's cement production sector consists of a single facility in Seattle, generating about 0.36 $MtCO_2e$ annually.[23] This represents approximately 3% of the state's total EITE industry emissions. The majority of emissions (about 88%) occur during clinker production, with 53% coming from the chemical calcination process itself and 35% from combustion for thermal energy.[24] To achieve state emissions-reduction targets, multiple decarbonization strategies can be implemented sequentially over the coming decades.

Near-term opportunities

Replacing clinker with SCMs like calcined clays, natural pozzolans, fly ash, and slag can significantly reduce process emissions. According to recent life-cycle assessment studies, SCM substitution rates of 20%–50% are technically feasible in the near term, with potential to reduce emissions by 4%–40%, and some pilot projects are aiming for a 70% reduction.[25] This approach offers attractive abatement costs (−$20 to $25/ tCO_2e[26]), representing potential cost savings while also reducing emissions. The capital investment required is relatively modest compared to other decarbonization options, making this a logical first priority. In addition to being less expensive than portland cement and enhancing durability, SCMs reduce up-front production costs and extend structure life span, thereby lowering overall life-cycle expenses.[27]

Energy efficiency measures are another short-term option, although they have higher capital expenditures relative to integrating SCMs. Optimal efficiency measures include integrating waste-heat recovery systems, which can cover up to 30% of a plant's power needs, and investing in advanced equipment such as vertical roller mills, multistage preheaters with inline calciners, and high-efficiency coolers that lower kiln thermal energy demand.[28]

Medium-term opportunities

Medium-term strategies include more complex and capital-intensive technologies such as the introduction of alternative fuels and partial electrification. Switching to low-carbon alternative fuels such as sustainably sourced biomass, municipal solid waste, or refuse-derived fuel can displace 35%–50% of conventional fossil fuels.[29] Fuel switching can result in potential emissions reductions of 40%–50%. Expected abatement costs fall within \$20–\$80/tCO_2e, with capital expenditure needs around \$50–\$100/t for the necessary fuel handling modifications.

Material handling, grinding, and finish-milling processes can be electrified to reduce indirect emissions, which is particularly valuable in Washington given the hydro-dominated electricity grid.[x] Facilities can also electrify thermal processes to further reduce combustion emissions, though this remains technically challenging for the main pyroprocessing steps and is therefore recommended as a long-term strategy.

Long-term opportunities

Full-scale CCUS implementation on kiln exhaust streams offers the most significant single reduction opportunity, with potential to abate 50%–90% of remaining emissions. However, existing studies indicate costs of \$150–\$300/tCO_2e, making this technology currently economically noncompetitive unless supported by strong public incentives. Geological storage potential in basalt formations in the Columbia River basin provides a regional advantage for Washington's cement industry.

Exploring novel production pathways, companies like Sublime, Brimstone, and Fortera are in the early stages of redefining the cement-making process. For instance, research into alternatives like belite-ye'elimite-ferrite (BYF) cements or alkali-activated materials could reduce calcination emissions by 20%–30% compared to portland cement. While technically promising, these options are currently at a very early stage of development, face market acceptance challenges, and would require significant investment in new production infrastructure.

Full electrification can also become a feasible option in the long term with low-cost electricity availability. The electrification of current thermal processes would increase annual electricity consumption at the facility by approximately 930 GWh by 2030 once electrification is implemented, requiring coordination with grid planning authorities.

A systematic implementation of these strategies yields a significant emissions-reduction trajectory, including an approximately 45% emissions reduction between 2023 and 2034 (avoiding about 1.17 MtCO_2e) and up to a 90% emissions reduction by 2050 through comprehensive implementation of all available technologies, including reliance on full-scale CCUS. The relative emissions reduction translates into 5.2 MtCO_2e reduced by 2050 at a total cost of \$0.68 billion.

Regional availability of suitable SCMs is one of the key constraints to these strategies, with fly ash supplies declining due to coal plant retirements. RMI's research identified calcined clays as a promising alternative that could be sourced within Washington. CO_2 transport infrastructure connecting the sole Seattle facility to geological storage sites would also be necessary to enable CCUS implementation at scale.

x While Washington's grid is frequently characterized as relatively clean due to hydroelectric capacity, the state faces mounting electricity demand and complex politics around dam operations. A comprehensive strategy for discussing Washington's grid profile is out of scope of this analysis.

Glass production

Washington's glass industry is represented by two manufacturing plants — one container glass facility and one flat glass facility — that together emit 0.126 $MtCO_2e$ per year, or roughly 1.5% of the state's EITE emissions. A third facility, Ardagh Glass, announced its closure at the end of 2024. An estimated 60%–85% of the sector's total energy demand — and therefore most of its direct CO_2 emissions — comes from the high-temperature melting process.[30]

Near-term opportunities

Two primary approaches for immediate emissions reductions in glass manufacturing are material efficiency through increased cullet, or recycled glass, usage and targeted energy efficiency upgrades. Cullet melts at lower temperatures than raw materials and avoids process-related CO_2 emissions from limestone decomposition. For every 10% increase in cullet, energy consumption falls by approximately 2.5%–3%, while also cutting particulate, NO_x, and SO_x emissions. This strategy typically yields negative marginal abatement costs, delivering both environmental and economic benefits. Complementing this, energy efficiency measures such as enhanced furnace insulation, low-NO_x burners, and advanced combustion controls can achieve a 10%–15% reduction in emissions. Batch and cullet preheaters, as well as waste-heat recovery systems that repurpose flue gas heat, can boost thermal efficiency by an additional 12%–25%.[31] Additionally, other waste-heat recovery systems, such as regenerators or recuperative burners, offer further savings of 10%–25% CO_2e by capturing flue gas heat to preheat combustion air or feedstock, with abatement costs ranging from negative to moderate values depending on system design.[32]

Medium-term opportunities

Hybrid electric-gas melting systems and oxy-fuel combustion retrofits both offer substantial emissions reductions but require significant capital investments and infrastructure upgrades. Hybrid electric-gas furnaces integrate electric heating elements with traditional combustion, enabling up to 80% of the melting energy to be supplied by renewable electricity. This approach can reduce CO_2 emissions by approximately 60%–64%, depending on the share of renewable energy used and the specific furnace design.[33] For instance, a hybrid furnace operating with 60% electrical heating has achieved a 64% reduction in carbon emissions.[34] However, the adoption of hybrid furnaces requires a reliable source of renewable electricity and sufficient local electrical grid capacity. Oxy-fuel combustion retrofits involve replacing air with pure oxygen in the combustion process, eliminating nitrogen from the oxidizer, and significantly reducing the volume of flue gases. This method enhances thermal efficiency and reduces fuel consumption. Oxy-fuel combustion can lead to a 20% reduction in CO_2 emissions compared to conventional air-fuel furnaces.[35] However, the implementation of oxy-fuel technology requires significant capital investment and may involve operational adjustments.

Long-term opportunities

Long-term strategies for the glass industry focus on transformative technologies such as fully electric melting furnaces, hydrogen- or biogas-fueled annealing systems, and CCS, each offering significant emissions reductions but accompanied by substantial capital investments and infrastructure requirements, and higher technological risks.

Electric melting furnaces can eliminate 60%–80% of glass manufacturing emissions when powered by low-carbon electricity sources. These advanced systems achieve energy efficiencies of 2.8 gigajoules per ton (0.78 megawatt-hours per ton), representing a 20% improvement over conventional methods. Implementation costs range from $100 to $400/t$CO_2$ abated, with total installed costs around $300/t of capacity.[36] These systems require substantial grid capacity enhancements and reliable renewable electricity access, adding approximately 164 GWh of annual electricity demand by 2030.

Hydrogen or upgraded biogas can replace fossil fuels in forming lehrs and annealing ovens that are challenging to electrify. These alternative fuels can reduce 50%–70% of remaining thermal emissions at abatement costs between $190 and $550/t$CO_2$. However, hydrogen adoption requires infrastructure modifications due to its lower calorific value compared to natural gas, and its combustion produces water vapor that may affect glass quality.

CCUS technologies applied to large oxy-fuel or legacy fossil-fired melters can remove 70%–90% of remaining stack emissions. Abatement costs for industrial CCS range from $140 to $290/t$CO_2$.[37]

Combined implementation of these technologies could reduce glass sector emissions by 53% by 2035, avoiding roughly 0.64 MtCO_2e between 2023 and 2034, and achieve up to 90% abatement by 2050 with an associated cost of $0.41 billion.

Food processing

Washington's food sector is largely dominated by potato processing, which consists of eight frozen potato and snack facilities clustered primarily in the Columbia River basin. Food processing facilities cumulatively emit approximately 0.59 MtCO_2e per year, representing roughly 6% of the state's EITE emissions. The potato processing industry transforms raw potatoes into various products including french fries, chips, dehydrated potato products, and potato starch. Approximately 70% of these facilities' total energy demand and the majority of direct CO_2 emissions comes from natural gas boilers that generate steam for blanching, drying, and frying operations. The remaining energy consumption is primarily associated with refrigeration and cold storage electricity use.

Processors emphasize their thin operating margins and continuous-run production schedules, requiring interventions to align with planned annual shutdowns (typically two weeks) or major refits. The demand for frozen potato exports is projected to grow at approximately 2% annually through 2035, underscoring the necessity for scalable, cost-effective decarbonization strategies that maintain the competitiveness of the state's agricultural value chain.

Near-term opportunities

The immediate focus for decarbonization combines energy and material efficiency improvements. Energy efficiency upgrades including condensate recovery, continuous blow-down heat exchangers, boiler-house insulation, and variable-speed drives on pumps and fans can reduce fuel use by 8%–15% at costs ranging from −$20 to $10/t$CO_2$e, with payback periods of one to three years.[38] Steam system optimization through automated trap monitoring and low-pressure flash steam reuse, combined with electric resistance heaters for low-temperature wash water, can deliver an additional reduction in emissions. On material efficiency, improved sorting technology and optical grading systems can increase yield by 2%–3%, reducing both

waste and energy requirements per unit of output. Water recirculation systems offer 20%–30% reductions in water consumption while decreasing the energy needed for pumping and heating process water. Refrigeration retrofits — switching from R-404A to ammonia or transcritical CO_2 systems and adding permanent magnet motors — can lower indirect emissions by 10%–15% at costs of $30–$80/tCO_2e.[39]
Medium-term opportunities

As facilities undergo planned retooling, more substantial process changes become viable. Medium-temperature industrial heat pumps (100°C–120°C) can supply blanching water and barrel washers, replacing up to 40% of boiler steam at abatement costs ranging from $60 to $120/t$CO_2$e. Electric boilers designed for peak and shoulder steam loads avoid inefficiencies associated with part-load operations in gas boilers, achieving an additional reduction in fuel emissions at $70–$140/tCO_2e. Process intensity redesign measures — including countercurrent blanching, low-moisture infrared drying, and optimized fryer heat-transfer surfaces — can collectively reduce thermal energy demand by 10%–15%. Advanced material efficiency measures become increasingly important during this time frame. Pulse electric field pretreatment for potatoes can reduce cutting losses by 3%–5% and shorten frying times by up to 10%, thereby reducing energy consumption by approximately 5%–8% during frying.[40] Advanced production planning systems integrating real-time data analytics can optimize batch sizes and reduce transition losses, improving overall resource efficiency by 3%–5%.

Long-term opportunities

Deep decarbonization of potato processing will require fundamental technology shifts. High-temperature heat pumps (up to 190°C), currently in late-stage demonstrations, could displace nearly all remaining medium-pressure steam, reducing thermal CO_2 emissions by 60%–80% at costs of $120–$200/tCO_2e.[41] Cofiring on-site green hydrogen or upgraded biogas in directly heated fryers and dryers can address the highest-temperature thermal loads, eliminating an additional 15%–25% of remaining fossil emissions at abatement costs of $150–$300/tCO_2e. Full electrification of direct-fired equipment (infrared or radio-frequency dryers, induction fryers) will finalize the decarbonization pathway as capital stock turns over. However, both these technologies are currently expensive, and applications only become feasible for this sector with substantial cost decreases.

Implemented sequentially, the proposed energy and material efficiency and electrification measures could achieve a 40% emissions reduction by 2035, preventing approximately 0.52 MtCO_2e cumulatively from 2023 to 2034, and up to a 70% reduction by 2050 with an associated cost of $0.26 billion. It would increase annual sectoral electricity consumption by an estimated 1,704 GWh by 2050; however, material efficiency measures could partially offset this rise by reducing overall production energy intensity.

Chemicals and hydrogen

Washington's chemicals and hydrogen sector includes four major facilities: Air Liquide Hydrogen Plant (Anacortes), Emerald Kalama Chemical (Kalama), Solvay Chemicals (Longview), and Matheson (Anacortes). These facilities collectively emitted approximately 0.237 $MtCO_2e$ in 2022. This sector accounts for an estimated 3% of the state's industrial emissions, primarily originating from energy use for purification and separation and direct process emissions from steam methane reforming (SMR) and steam cracking.

Near-term opportunities

The most immediate opportunities for this sector focus on energy efficiency and electrification. Control system upgrades, waste-heat recovery, and process integration improvements can reduce emissions by 10%–20%, with marginal abatement costs as low as −\$50 to \$30/tCO_2e.[42] Electrification of reactors and process heaters can deliver 20%–35% emissions reductions, though at higher abatement costs of \$40 to \$70/tCO_2e and with two to five years to implement.[43]

Medium-term opportunities

Deployment of low-carbon inputs, including combinations of green and blue hydrogen, offers additional decarbonization potential. Green hydrogen integrated with CCS in SMR-based plants can reduce emissions by 25%–60%, with marginal abatement costs of \$60–\$150/tCO_2e. All natural gas–fed hydrogen and chemicals assets should source low-leak methane inputs to optimize overall marginal emissions abatement costs. For full asset replacements, electrolytic hydrogen production systems (green hydrogen) should be evaluated as the pathway that offers the most emissions-reduction certainty, especially as costs fall and first projects are de-risked. Of the fossil pathways, autothermal reforming and methane pyrolysis inherently integrate CCS at higher capture rates and lower costs than SMR.[44] Use of recycled or bio-based feedstocks in such blue hydrogen pathways can also be considered at this stage and may reduce emissions by 18%.

Long-term opportunities

By 2050, a combination of green hydrogen substitution, process electrification, full-scale CCUS deployment, and circular feedstock integration could enable emissions reductions of up to 90%–95% across the sector. Process reconfiguration to accommodate alternative chemistries and heat sources will require reliable, low-carbon electricity, increasing demand for firm power. Full deployment of hydrogen and CCUS is projected to raise electricity demand by 11%–25%, requiring regional coordination with utilities and regulators.

With sequential implementation of efficiency, fuel switching, electrification, and CCUS measures, the sector can reduce emissions by 46% by 2035 and 93% by 2050, for a projected total of \$0.344 billion.

Grid integration and availability of low-cost green electricity will be a key constraint and opportunity in long-term deep decarbonization. As electrification and hydrogen production scale, firm renewable electricity and expanded transmission infrastructure will be essential to avoid shifting emissions upstream. Sequential implementation of the suggested technologies is projected to increase annual electricity demand by 687 GWh by 2050. Sectoral growth — driven by global demand for advanced materials, solvents, and hydrogen — will require a proactive approach to ensure decarbonization does not lag behind output expansion.

Iron and steel

Washington's steel industry consists of a single electric arc furnace (EAF) facility that emits approximately 0.084 $MtCO_2e$/year, representing roughly 1% of the state's EITE emissions. The facility transforms recycled scrap metal into various steel products including rebar, structural shapes, and merchant bar. Approximately 70% of the facility's total energy demand — and the majority of direct CO_2 emissions — comes from electricity consumption for the EAF operation, while the remaining emissions are associated with natural gas–fired reheating furnaces, carbon electrodes, and other process inputs. As an EAF-based operation, the facility already represents a lower-carbon steelmaking route compared to traditional blast furnace–basic oxygen furnace production.

Near-term opportunities

The immediate focus for decarbonization combines energy and material efficiency improvements. Energy efficiency upgrades including optimized transformer-regulation systems, improved furnace sealing, and variable-speed drives on auxiliary equipment can reduce emissions by 10%–20% at costs ranging from −\$15 to \$30/tCO_2e, with payback periods of one to three years.[45] Combustion optimization in the reheating furnace through advanced burner technologies and automated control systems, combined with improved insulation and refractory materials, can deliver an additional 5%–10% reduction in natural gas emissions. For material efficiency, enhanced scrap sorting and quality control systems can reduce emissions by 15%–20%, resulting in fewer processing steps and reduced energy consumption per ton of output. Advanced process control systems offer 8%–12% reductions in yield losses while decreasing energy needed for remelting and rework. Oxygen injection and foamy slag practices can improve energy transfer efficiency by 10%–15% at costs of \$20–\$50/tCO_2e.[46] Implementation of predictive maintenance and real-time energy management systems presents additional opportunities to reduce unplanned downtime and optimize energy consumption across steel production processes.

Medium-term opportunities

Electrification at a steel facility using EAFs is a key decarbonization strategy because EAFs already operate on electricity rather than directly on coal. Additional emissions reductions of 40%–80% can be achieved by replacing residual natural gas burners (used in ladle heating or reheat furnaces) with electric alternatives and by increasing the share of power sourced through renewable power purchase agreements (PPAs). Partial electrification upgrades can be implemented within two to four years, with full transitions taking 6 to 10 years.

Long-term opportunities

Deep decarbonization of EAF steel production will ultimately require additional technology shifts. Hydrogen-based technologies for reheating furnaces could replace natural gas. Together with earlier interventions, these technologies can achieve approximately 90%–95% total emissions reduction by 2050. CCS retrofits targeting process emissions from electrodes and other carbon inputs can address residual emissions, capturing an additional 5%–10% of remaining CO_2. Although CCS is a more natural fit for decarbonizing blast furnace steelmaking, where emissions are high and concentrated, it can also support EAF-based facilities by capturing emissions from auxiliary fossil fuel use. Depending on the setup, CCS can reduce emissions by 50%–90%, but it currently faces significant financial and technological challenges, particularly around high capital costs and underperformance in capturing the promised volumes of CO_2. Additionally, both hydrogen and CCS solutions will increase clean electricity demand by 11%–25%, requiring reliable, low-carbon power to deliver net climate benefits.[47] Overall, suggested decarbonization pathways could increase annual electricity demand by 683 GWh by 2050.

The long-term vision for green steel can also include integration into circular economy systems. Closed-loop resource networks integrating slag valorization, waste-heat utilization, and material flows between steel production and complementary industries could reduce primary resource demand by 25%–35%.[48] Advanced separation technologies for recovering alloying elements from EAF dust can preserve critical materials while reducing waste disposal requirements. Incorporation of alternative iron sources such as direct reduced iron produced with green hydrogen at other locations could further reduce the carbon footprint of the Washington facility by providing lower-carbon metallic inputs for the EAF process.

Implemented sequentially, these energy and material efficiency measures can achieve a 45% emissions reduction by 2035, preventing approximately 1.94 $MtCO_2e$ between 2023 and 2034, and up to a 95% reduction by 2050 at a cumulative cost of $0.49 billion. Abatement costs range from −$25/$tCO_2e$ for efficiency projects to approximately $220–$500/tCO_2e for hydrogen heating and CCUS retrofits.[49] Global steel demand is projected to grow at approximately 1.5% annually through 2035, underscoring the need for scalable, cost-effective decarbonization pathways that maintain the competitiveness of Washington's steel production. Regional coordination will be needed to develop shared infrastructure such as hydrogen production facilities and potential CO_2 transportation networks.

Electronics

Washington's electronics manufacturing industry consists of two high-volume facilities. These facilities produce semiconductors, printed-circuit substrates, and advanced assemblies, emitting approximately 0.12 $MtCO_2e$/year, representing roughly 1% of the state's EITE emissions. Approximately 50% of emissions originate from electricity used for maintaining ultraclean environments and powering process equipment, while the remaining 50% comes from high global warming potential (GWP) perfluorocarbons (PFCs) utilized in etching and chamber-cleaning processes.[50]

Near-term opportunities

Immediate decarbonization efforts should prioritize both PFC emissions reduction and energy efficiency. Installing specialized abatement units on etch and chemical-vapor-deposition tools can achieve 90%–95% PFC capture efficiency. Process optimization to minimize PFC usage without compromising production quality offers additional reductions.

Energy efficiency measures such as intelligent cleanroom management with real-time particle monitoring can optimize air-change rates, reducing unnecessary energy use. Upgrading heating, ventilation, and air-conditioning (HVAC) systems to variable-frequency drives, modernizing facility lighting with LED fixtures, and implementing waste-heat recovery from chillers and vacuum pumps can collectively reduce electricity-related emissions by 10%–15% at costs ranging from $0 to $30/$tCO_2e$ with paybacks of one to three years.[51]

Medium-term opportunities

Further emissions reductions can be achieved through shifts in process chemistry and electrification strategies. Transitioning to lower-GWP alternatives such as hexafluorobutadiene (C_4F_6) or nitrogen trifluoride (NF_3) plasma can reduce PFC emissions by 20%–30%, while advanced process control systems optimize etching and cleaning cycles.[52] Electrifying residual gas-fired equipment such as diffusion furnaces and reflow ovens during regular equipment replacement cycles, coupled with renewable PPAs and initial on-site solar installations, could provide additional emissions reductions of 40%–60%. Electrification capital costs are anticipated at around $100–$150/kilowatt, with abatement costs approximately $90–$150/ tCO_2e. Digital twin modeling integrating real-time process data may optimize production efficiency, improving resource use by an additional 5%–8%.

Long-term opportunities

Deep decarbonization requires fundamental technological transformations, including fully PFC-free etching and cleaning processes like atomic-layer etching with inert precursors. Integration of medium-temperature heat pumps delivering 60°C–90°C water loops can replace conventional direct-resistance heating for solvent baths. A comprehensive transition to renewable energy procurement, along with expanded on-site solar-plus-storage systems, would support near-complete electrification.

Implementing carbon removal strategies to offset any residual hard-to-abate emissions further supports long-term carbon neutrality. Together, these long-term technologies can achieve total emissions reductions of approximately 80% by 2050 preventing cumulative emissions of 2.01 $MtCO_2e$. Introduction of these technologies is expected to increase annual electricity demand by 347 GWh by 2050 at a total cost of $0.02 billion.

Implemented sequentially, these combined efficiency, electrification, and technological measures can achieve a 40% emissions reduction by 2035, with up to an 80% reduction in CO_2e by 2050.

The industry is projected to grow at approximately 4% annually through 2035, driven by rising demand for edge computing, vehicle electrification, and regional data center expansion.[53] As a result, both total energy use and emissions could increase without targeted interventions, underscoring the importance of proactive grid planning. Electrification of thermal processes and growing production throughput will contribute to both higher base and peak load requirements, increasing the urgency for grid modernization and resilient energy infrastructure.

Determining Allocation of No-Cost Allowances to EITEs Post-2034

The legal framework of Washington's Cap-and-Invest program is in the Revised Code of Washington (RCW), Chapter 70A.65 — Climate Commitment Act.[54] The portion of the CCA pertaining to allocation of allowances to EITEs, RCW 70A.65.110, currently does not specify the appropriate levels of no-cost allowances to be allocated to EITEs in compliance periods post-2034.[55] Specifying appropriate levels will require legislative action to amend that part of the CCA, and can be informed by the technically feasible decarbonization options available to industries that are identified in the Technical Pathways section of this report. Subsequently, portions of the Washington Administrative Code, Chapter 173-446 WAC — Cap-and-Invest Program, will need to be adapted.[56] Changes to allocation of no-cost allowances will also have to be aligned with the environmental justice requirements of the Healthy Environment for All (HEAL) Act, and the economic goals of the Building Economic Strength Through Manufacturing Act and Washington Clean Manufacturing Leadership Act to increase manufacturing employment.[57]

For the Cap-and-Invest program to meet its objectives and continue functioning properly through the 2030s and 2040s, it is necessary to determine the levels of no-cost allowances allocated to EITEs post-2034. Failure to do so would eventually result in the number of no-cost allowances required to be allocated to EITEs exceeding the number of allowances available to the entire Cap-and-Invest program. While not exhaustive of all conceivable options, what follows are seven approaches to consider, presented in order of least to most favorable, and the recommended best approach.

Potential approaches

1. No change to law or regulation

The Washington legislature could choose not to change current law regarding EITEs and their allocation of no-cost allowances. This would almost certainly lead to violation of the CCA targets by 2050 if not 2040 due to continued emissions from industry and residual emissions from other sectors. Post-2034, but prior to violation of CCA targets, this also cedes control of the allowance market to EITES in the late 2030s and 2040s because their no-cost allowances would constitute the majority of the overall allowances.

2. Exempt EITEs from Cap-and-Invest

Changing current law to exempt EITEs from compliance with the Cap-and-Invest program would avoid the issue of no-cost allowance allocations to EITEs ever exceeding the total number of allowances under the cap. However, it would remove the strongest existing incentive for EITEs to decarbonize. Exempting EITEs from compliance would also likely make it impossible for Washington to meet its economy-wide GHG targets due to a preponderance of emissions continuing from industry.

3. Issue more allowances in the 2040s

In the 2040s, Ecology could issue enough additional allowances to EITEs to avoid hitting the overall emissions cap. Issuing more allowances to EITEs sidesteps the issue of market implosion, but it undermines the purpose of the Cap-and-Invest program in helping Washington meet its economy-wide GHG targets. It also cedes effective control of the secondary allowance market to EITEs, forcing other regulated entities to purchase allowances from the EITEs to comply with their obligations.

4. Cease no-cost allowances after 2034

Ceasing no-cost allowances to EITEs after 2034 would mean that EITE firms would have to pay for all their allowances for compliance either at auction or through the secondary market. Although this would generate more revenue for the state through allowance auctions, it also may lead EITE firms to move out of state in the mid-2030s. Ceasing no-cost allowances after 2034 would also likely chill potential investment in decarbonization by EITE firms prior to 2035 due to an expectation of leaving Washington in the mid-2030s.

5. Shift to an economic value basis

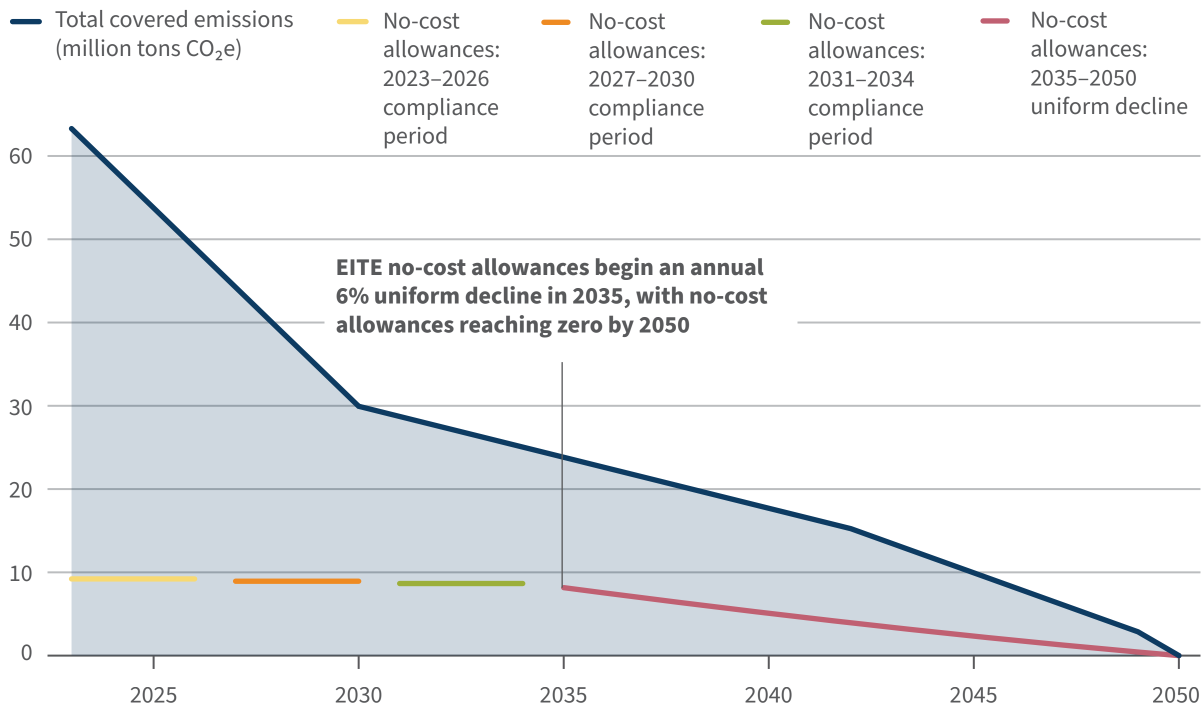
As part of Washington's 2021 State Energy Strategy, the Regional Economic Models Inc. (REMI) economic model was used to estimate the economic impact of Washington's 12 largest industrial sectors.[58] Although the REMI model's output categories do not map cleanly onto EITE subsector categories, it is similar enough to suggest that current allocations of no-cost allowances by EITE subsector do not have much of a relationship with that subsector's contribution to state gross domestic product (GDP). That is, relatively high emissions from an EITE subsector do not correspond with relatively high contribution to state GDP, and vice versa. More economic analysis would be required to estimate the GDP value of each EITE subsector, and then subsequently develop a tiered approach to allocation and reduction schedules based on economic value.

An economic value basis for allocating no-cost allowances would be a radical departure from the method used in the first, second, and third compliance periods. It would shift which industries most benefit from no-cost allowances and shift the amount of allowances each subsector would have to acquire at auction for compliance; in essence, different industrial winners and losers from the Cap-and-Invest program.

6. Apply a uniform reduction with the cap from 2035 onwards

This option would be similar to a request by Ecology to the legislature in 2021–22, proposed as HB 1682, which did not pass during that legislative session.[59] The reduction schedule for EITEs as a whole would be updated for years post-2034. In 2035, no-cost allowance allocations to EITEs would be 88% of the EITE's baseline (whether mass-based or carbon intensity-based). For each year 2035 through 2049, EITEs would be awarded no-cost allowances 6% below the percentage of no-cost allowances they were awarded during the preceding year. A visual representation of this scenario without defined multiyear compliance periods is included in Exhibit 7, although multiyear compliance periods would be maintained under this approach. This option would not differentiate between types of EITEs and their ability to decarbonize.

Exhibit 7 Projected annual emissions cap and EITE no-cost allowances with no change to EITE no-cost allowances post-2034



Note: Total annual Cap-and-Invest program allowance budgets through 2034 based on set total program budget allowance decreases relative to statutory total program baseline values for the 2023–2025 compliance period. EITE no-cost allowance figures exclude no-cost allowance allocations to electric and natural gas utilities.
RMI Graphic. Source: Washington Department of Ecology

One way the state could effectuate these declines is through the addition of a cap adjustment factor to the existing formula for the allocation of no-cost allowances. For California's cap-and-trade program, for example, the regulation behind the program identifies a cap adjustment factor for industrial allowances calculated by a product-based method.[60] California's factor decreases each year in proportion to overall annual allowance caps.

7. Set sector-specific benchmarking and reduction schedules

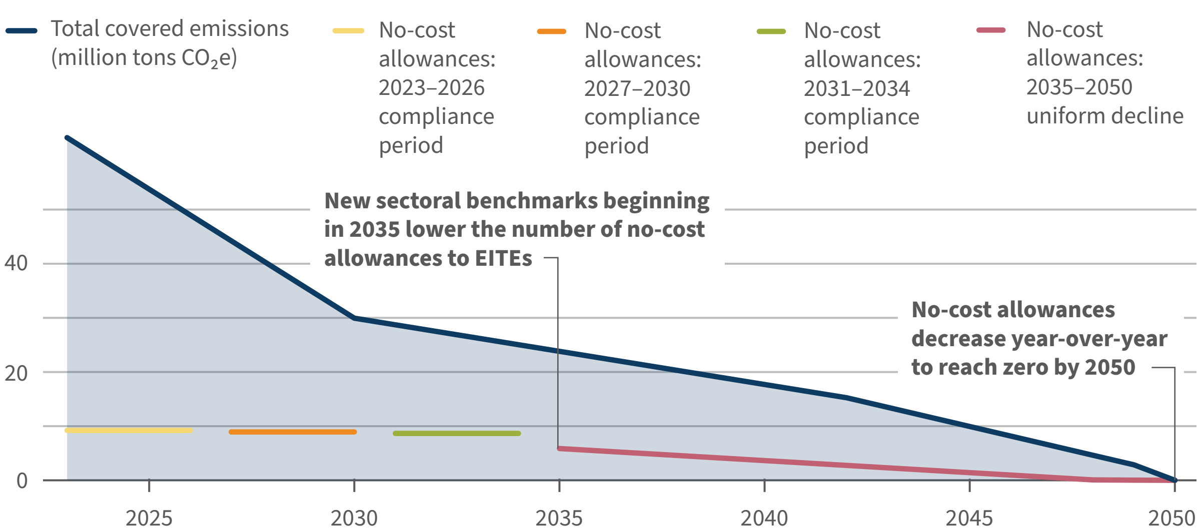
Recognizing variability in EITE's pre-2035 technical ability to reduce emissions, this option would introduce sector-specific benchmarks that would serve as the starting point for the scheduled reduction of no-cost allowances beginning in 2035. Sector-specific benchmarks are based on the technical pathways detailed in the Technical Pathways section of this report. In each subsequent year, a cap adjustment factor, or new reduction schedule for each sector, would guide the allocation of no-cost allowances. This is necessary to prevent intersection with the overall cap in the late 2040s. Although the allocation of no-cost allowances would decrease each year, multiyear compliance periods would be maintained. Once quantitative analysis of leakage risk has been performed, it would also be appropriate to add an assistance factor to reflect sector-specific emissions leakage risk, similar to the assistance factor present in California's program.

Exhibit 8 Sector-specific benchmarks and new no-cost allowance reduction schedule

Industrial subsector	Starting emissions levels baseline (tCO_2e) *2015–19 average*	New 2035 subsector annual benchmark (annual tCO_2e)	Emissions-reduction ability by 2035 compared to baseline	Total emissions-reduction ability through 2050 compared to baseline	Annual reduction in no-cost allowances compared to 2035 benchmark	Final year of no-cost allowances
Refineries	6,411,617	4,103,435	36%	93%	7.7%	2047
Pulp and paper — total	6,903,598	3,831,497	44%	93%	N/A	N/A
Pulp and paper — non-biogenic	1,097,726	609,238	44%	93%	7.7%	2047
Cement	392,191	215,705	45%	90%	7.7%	2047
Glass	178,739	84,901	52%	90%	7.7%	2047
Food processing	743,420	446,052	40%	70%	6.7%	2049
Chemicals and hydrogen	292,702	158,791	46%	93%	7.7%	2047
Iron and steel	331,110	182,111	45%	90%	7.7%	2047
Electronics	147,639	68,652	54%	85%	7.1%	2048

Note: Aerospace and aluminum not included. RMI Graphic. Source: EPA FLIGHT data, RMI analysis

Exhibit 9 EITE no-cost allowances declines under scenario with updated sector-specific benchmarks post-2034



Total annual Cap-and-Invest program allowance budgets through 2050 based on set total program budget allowance decreases relative to statutory total program baseline values for the 2023–2026 compliance period through 2034. Excludes no-cost allowance allocations to electric and natural gas utilities. Updated 2035 emissions benchmark and 2035–2050 values based on RMI estimates and exclude aerospace and aluminum.
RMI Graphic. Source: Washington Department of Ecology, EPA FLIGHT, RMI estimates

Recommended approach for determining allocation of no-cost allowances to EITEs

LEAST FAVORED

- **No change to law or regulation**
- **Exempt EITEs from Cap-and-Invest**
- **Issue more allowances in the 2040s**
- **Cease no-cost allowances after 2034**
- **Shift to an economic value basis**
- **Apply a uniform reduction with the cap from 2035 onwards**
- **Set sector-specific benchmarks and reduction schedules**

MOST FAVORED

We do not recommend changing the levels of no-cost allowances in the reduction schedule for the first (2023–2026), second (2027–2030), or third (2031–2034) compliance periods; stability in this key area of Cap-and-Invest policy is very important over the next decade so EITE firms can plan and budget accordingly.

At the beginning of the fourth compliance period (2035), we recommend implementing the **sector-specific benchmarking and reduction** approach. The approach would use sector-specific benchmarks that account for the existing and near-term technical opportunities for decarbonization in each sector available during the first, second, and third compliance periods. This is important for:

- Setting expectations over the next decade for industries to proactively decarbonize while the majority of their compliance needs are being met by no-cost allowances
- Avoiding a windfall of excess value being transferred to EITEs in the late 2030s and 2040s in the form of no-cost allowances that significantly exceed what is needed for an EITE firm's compliance, as could happen in the uniform reduction with cap approach.

From the sector-specific benchmarks, applying a cap adjustment factor or new sector-specific reduction schedules to the allocation equation will be necessary so that the number of no-cost allowances steadily declines from 2035 through 2050. This would be similar to California's method for calculating allocation of no-cost allowances to industry. A cap adjustment factor or new sector-specific reduction schedules ensure that no-cost allowances to EITEs do not exceed the total number of allowances under the cap, and also that no-cost allowances from EITEs do not come to dominate the allowance market. Once quantitative analysis of leakage risk has been performed, it would also be appropriate to add an assistance factor to reflect sector-specific emissions leakage risk.

This approach supports EITE industries by continuing a moderate amount of no-cost allowances while also establishing a long-term pathway for EITE industries to take emissions-reducing actions. Alternative approaches — such as complete discontinuation of no-cost allowances post-2034, treating EITE sectors uniformly and without regard to progress that can be made in the first three compliance periods, full continuation of no-cost allowances at the third compliance period levels, or raising the cap levels to create more allowances — are too extreme to support the dual objectives of supporting EITE industries while also reducing statewide GHG emissions.

Opportunities for Near-Term Investments

Resources to implement the technical pathways in each industrial subsector will come from a variety of sources, both new and existing. The largest and likely most crucial source of funding for industrial decarbonization measures will be revenue for EITEs from the reselling of no-cost allowances on the secondary market. As EITEs make their processes more efficient and invest in technologies to reduce emissions, they will need fewer allowances for compliance than they receive at no cost based on their 2015–2019 baseline. These excess allowances can then be sold to other entities on the secondary market and the revenue used to finance additional emissions-reduction equipment. This market-based mechanism is a key feature of cap-and-trade and cap-and-invest programs. When the Washington legislature decided to allocate no-cost allowances to EITEs, it was a decision to give those industries something with market value, not just value as a compliance instrument or permit. Each EITE firm can decide if its no-cost allowances are more valuable to submit for compliance, or for selling and then investing the revenue in emissions reduction.

RMI maintains the Decarbonizing Industry Resource Tool (DIRT) to help project developers, industrial companies, and investors discover the state and federal financial incentives that may be applicable to their heavy industry projects.[xi] Changes to federal law and policy — such as the Infrastructure Investment and Jobs Act, the CHIPS and Science Act, and the Inflation Reduction Act — were made after passage of Washington's CCA and have significantly expanded the opportunities for industrial decarbonization. Key tax credits include 45V for clean hydrogen production (up to $3/kg), 45Q for carbon capture ($12–$36/t), 45X for manufacturing clean energy components, and 45Z for clean fuel production (up to $1.75/gallon). While not directly targeting industrial emissions, clean electricity tax credits (production tax credits [PTCs] and investment tax credits [ITCs]) can support electrification strategies. Federal grants include the 48C Advanced Energy Project Credit and DOE's Industrial Demonstration Program for hard-to-abate sectors. Loan support is available through DOE's Title 17 Clean Energy Financing Program and State Energy Financing Institution loans as well as the Energy Infrastructure Reinvestment Program, which supports emissions reductions or repurposing of shuttered energy infrastructure, with loan authority available through September 2026. However, federal tax credits, grants, and loan programs may be subject to rollback under the current administration.

Complementing federal programs, Washington offers its own Hard-to-Decarbonize Sector Grants. Administered by the Washington Department of Commerce, these grants fund projects targeting sectors like iron, steel, aluminum, cement, concrete, glass, pulp and paper, food and beverage, wood and building products, aerospace, electronics, chemicals, and heavy-duty transportation. Grant recipients must demonstrate an ability to achieve significant emissions reductions in Washington by or before 2030. The most recent funding round awarded $20 million, with additional rounds anticipated.

Existing opportunities, especially given likely upcoming changes to federal policy that remove or diminish incentives, will not be sufficient to ensure effective decarbonization of Washington's industrial sector. In the next section, we detail options for complementing, augmenting, and/or improving Washington's Cap-and-Invest program and the state's broader approach to supporting industrial decarbonization.

xi The DIRT tool can be found at **https://rmi.org/decarbonizing-industry-resource-tool-dirt/**.

New Policy Opportunities

The transition to a low-carbon industrial economy in Washington requires not only technical advancements but also the strategic alignment of policies to catalyze decarbonization efforts, including the technical pathways contained in this report. There are a host of actions Washington can take to support demand-pull, supply-push, and input investments that would enable, encourage, or accelerate local industrial decarbonization by reducing costs, increasing value, or otherwise easing the path toward reduced GHG output. Notably, these actions are in addition to legislating the post-2034 EITE no-cost allocation pathway. Furthermore, while these policy opportunities are not directly centered around carbon leakage risks, policies supporting industrial decarbonization efforts will help limit the risk of industries ceasing business in Washington in favor of operations in states with less stringent emissions rules or carbon markets.

This section identifies three categories of policy opportunities designed to expand the scope and effectiveness of the CCA, including the Cap-and-Invest program:

Updating standards and regulations refers to potential changes to state decision-making processes and rules, standards, or regulations governing issues relevant to industrial decarbonization.

Cap-and-Invest program evolution and EITE treatment refers to actions affecting the future of compliance pathways and allowance allocations for EITE industries.

State support refers to financial mechanisms Washington could leverage to aid industrial decarbonization.

The mix of policy opportunities pursued in concert acknowledges that different kinds and sizes of EITEs need different kinds of support to decarbonize, such as grants, loans, technical assistance (TA), and regulatory reform.

Policies contained within these three categories are further divided into the following categories:

Essential changes are those fundamentally necessary to enable technical decarbonization measures to be implemented.

Recommended changes are those highly likely to enable implementation of the technical measures and realistically achieve emissions-reduction targets.

Changes worth consideration are policy opportunities likely to improve the pace of Washington's industrial decarbonization, but that require additional study to effectively implement in Washington.

Exhibit 10 New policy opportunities

	Updating Standards and Regulations	Cap-and-Invest Program Evolution + EITE Treatment	State Support
Essential	Expedite electrical grid enhancements for industrial electrification		
	Accelerate permitting procedures for critical decarbonization projects		
Recommended	Reform industrial electricity tariffs and ratemaking	Consign EITE no-cost allowances at auction	Set up an industrially focused green bank
	Update existing rules on oil refineries	Require additional criteria to qualify as an EITE	Increase funding for the Hard-to-Decarbonize Sector Grants Program
Worth Consideration	Introduce a clean heat standard	Allow opt-in EITE entities to receive no-cost allowances	Augment technical assistance planning grants for decarbonization
	Expand methane regulations	Develop additional offset protocols	Strengthen state procurement requirements
			Introduce tax credits for emissions-reducing equipment
			Introduce tax credits for clean manufacturing production
			Invest in common carrier infrastructure for the transportation of green hydrogen
			Incentivize transitions of refineries to other functions

RMI Graphic

These policy pathways not only support the uptake of emissions-reducing technologies to maintain and grow the state's heavy industry, they can also aid in efforts to reduce local air pollutants in accordance with state legislation like the HEAL Act.

Essential changes

Expedite electrical grid enhancements for industrial electrification

More clean electricity supply must be built out to support additional loads from industrial decarbonization — estimated at an additional 7,567 GWh annually by 2030 and an additional 13,975 GWh annually by 2050. This is in addition to increased supply needed to meet increasing electricity demand from data centers, transportation electrification, and building electrification. Advancing electrical grid reliability, capacity, and affordability improvements outside of adding additional generation capacity can facilitate easier access to the electricity needed for industrial electrification. It can also potentially reduce financial and logistical barriers to transitions from fossil fuel–based processes to electric alternatives.[61]

Recent state legislative efforts attempt to address some of these issues, including a proposal with direct references to reconductoring and one focused on grid transmission needs.[62]

Financial assistance is another avenue to support grid enhancements. The Washington Department of Commerce announced on April 8, 2025, that it is awarding $23 million in grants, in part funded through the CCA, to multiple projects advancing grid strength, reliability, and preparedness.[63]

Accelerate permitting procedures for critical decarbonization projects

Efficient and effective permitting and siting of industrial locations is a crucial element to facilitate the energy transition, and is often cited by developers as one of the greatest barriers to new projects. Washington has taken some crucial steps in the past few years to address these barriers. In November 2022, the Washington State Departments of Ecology and Commerce, in response to a directive by the state legislature, released a comprehensive report with recommendations for improving the siting and permitting processes for industrial clean energy facilities.[64] This report identified four key issues and issued 73 recommendations across eight strategies to resolve them.

The state legislature subsequently passed HB 1216 in 2023, which aimed to improve the permitting and siting process for large-scale industrial, utility, and energy infrastructure projects. HB 1216 fully addresses 20 recommendations from the report, partially addresses 26 recommendations, and leaves 27 recommendations to future work.[65] *Appendix G, Exhibit G1* shows each recommendation from the report and where and how it has been addressed by HB 1216 (if it has been addressed).

Among other things, HB 1216 requires Ecology to create a fully coordinated permitting process, which offers project developers a single point of contact and a unified timeline for project permitting. It also requires Ecology to develop a consolidated permit application system and nonproject environmental impact statements for green hydrogen, wind, and solar projects, which will be due by June 30, 2025. Additionally, Washington State University must complete a pumped storage siting study by June 30, 2025. Many of the impacts of this bill cannot be interpreted yet because the deadlines for action are either still too recent or have not yet passed.

HB 1216 represents a strong first step toward improving the permitting and siting process for clean industrial projects in Washington, addressing many of the most important recommendations from the legislature's 2022 report. However, additional action will be necessary to fully support an industrial green transition at the scale and speed required. After the current reforms are fully implemented and evaluated — particularly following the key deadlines in June 2025 — the legislature should prioritize addressing the remaining recommendations outlined by the Departments of Ecology and Commerce. These unaddressed recommendations, detailed in *Appendix G, Exhibit G1*, represent critical opportunities to further streamline permitting, enhance community engagement, and strengthen environmental protections.

Recommended changes

Reform industrial electricity tariffs and ratemaking

High electricity costs and limited electricity capacity inhibit industrial electrification, a key pillar of economic industrial decarbonization. Developing industrial electricity utility tariff structures to help confront these barriers and facilitate electrification can aid heavy industries in decarbonizing.

While large-load tariffs can vary widely by jurisdiction and have multiple structures, they have grown in popularity as a flexible tool for bringing new load onto the grid quickly without risking ratepayer protections. Furthermore, utilities accommodating increased electrification-related loads must balance costs to existing ratepayers without jeopardizing progress on clean energy goals. Differentiated large-load tariff rates may aid industries to decarbonize while insulating other customers from infrastructure costs. One example of such a structure can be found in Washington's Grant County Public Utility District's "evolving industries" rate class, which covers industries meeting certain criteria rather than identifying specific users.[66] In Ohio, meanwhile, a proposed tariff structure applies a new tariff to data centers while excluding electrified manufacturing facilities and residential consumers, ensuring that costs incurred from bringing these new loads onto the grid are properly allocated to the large-load customers,[67] insulating existing customers from large load–related infrastructure improvements.

Other changes related to Washington's broader electricity ratemaking structure may also help with industrial decarbonization.

For example, Washington's existing electricity ratemaking process is governed by the Utilities and Transportation Commission (UTC), which is currently engaged in a five-year review process over how it regulates utilities as part of a 2021 law.[68]

While a traditional cost-of-service ratemaking process, which calculates rates based on actual utility investments, remains a significant component of the regulatory landscape, the UTC will also evaluate performance-based ratemaking (PBR) and provide guidance on its use. PBR differs from traditional cost-of-service structures in that it compensates utilities for their performance rather than for additional electricity sales or infrastructure investments, potentially allowing for the alignment of a utility's profit motives with broader goals like decarbonization or a cleaner grid.[69]

Additionally, incentivizing the purchase of renewable energy certificates (RECs) or facilitating power purchase agreements for industrial customers can promote the use of clean energy. By offering supports like subsidies or tax incentives for these purchases, the state can promote cleaner electricity use by heavy industry. This can be especially true if those supports are structured to encourage industries to align their energy consumption with periods of high renewable energy availability, including via access to wholesale electricity market prices that incentivize low-cost, optimally timed charges and power injections for certain decarbonization technologies like thermal batteries.[70]

Utah's recent legislation SB 0132, which provides a framework for large-scale electrical service requests and exempts them from certain rate regulations, could serve as a legislative example that could be coupled with demand flexibility programs, including those related to heat-as-a-service (a model where customers pay for the heat they use rather than the energy required to generate it).[71] Additionally, programs like Duke Energy's Green Source Advantage can provide large business customers with flexible options to secure renewable energy.[72]

Update existing rules on oil refineries

As a result of a 2011 court case, *Washington Environmental Council v. Sturdevant*, Washington has an existing regulation to maintain above-average energy efficiency or reduce GHG emissions from oil refineries 10% from 2010 levels by 2025.[73] With the target broadly achieved and deadline expiring, Ecology may wish to update the regulation in accordance with the court's decision and the 2030, 2040, and 2050 economy-wide targets. Further, strengthened standards would complement the existing incentives embedded in the Cap-and-Invest program and other new policies described in this report to ensure economy-wide targets are met.

As described in this report and in RMI's *Oil Refinery Emissions Cut Points* report, research suggests that utilizing the reasonably available control technologies would enable greater emissions reductions than current operations.[74] Analysis indicates that requiring 10% reduction in absolute operational (Scope 1 and 2) GHGs by 2030, 20% reduction by 2035, and 30% reduction by 2040 versus the 2015–19 average baseline is achievable and in alignment with Washington's GHG targets — similar to timelines suggested as feasible by the Oil and Gas Climate Initiative's *Powering Up: Pathways to Decarbonize Refining* report.[75]

Consign EITE no-cost allowances beginning in the third compliance period (2031–34)

Rather than Ecology putting no-cost allowances directly into EITE accounts, it could sell the allowances at auction and give the EITEs the revenue. EITEs would then be free to use the revenue to invest in emissions-reducing equipment or purchase allowances for compliance at auction or the secondary market. Washington already requires some no-cost allowances for electric and natural gas utilities to be consigned for auction.[76] Consigning no-cost EITE allowances would increase transparency inside EITE firms, aid price discovery, and increase liquidity in the market. Beginning consignment of EITE no-cost allowances in the third compliance period (2031) provides enough lead time for EITEs and Ecology to adapt and plan accordingly. Consigning allowances would not change the percentage levels of no-cost allowances in EITEs' reduction schedule.

Require additional criteria to qualify as an EITE

Recognizing the amount of value in the form of no-cost allowances allocated to EITEs, the current EITE criteria could be strengthened to ensure they are taking measures to reduce emissions, complement other state efforts at decarbonization (e.g., the Clean Energy Transformation Act, Buy Clean and Buy Fair), and effectively prepare for a zero-carbon future.[77] Additional criteria to maintain EITE qualification could include:

- Sites must submit to Ecology a decarbonization plan by the beginning of the third compliance period (2031) describing measures already taken to reduce emissions and near-, middle-, and long-term measures planned to achieve near-zero emissions by 2050.
- Sites must use 100% of imported power from clean sources via PPAs or RECs matched monthly by 2030. More rigorous recommendations to be implemented by 2034 could include increased temporal and deliverability reporting requirements (hourly matching), use of contracts for power purchasing longer than five years, and using project-based GHG accounting to determine avoided emissions.
- Sites must prove natural gas is purchased with an upstream leak rate less than 0.2% by 2028 through independent certification of suppliers.
- Sites must show that the percent of total energy use from electricity, over a rolling four-year average, is rising every year at least 0.1%.
- Sites must prove that emissions intensity of products on a cradle-to-grave basis are better than the global average over the last four-year average.
- The industry sector must show that the total sales of fossil fuel–based products (primarily combusted in power, transport, or buildings), over a four-year average, is falling every year at least 0.1%, as expressed in million British thermal units. This incentivizes a pathway-agnostic method that could include bio-based products, end-use efficiency, and/or end-use electrification.

Set up an industrially focused green bank

A state-chartered green bank, a form of state energy financing institution focused on industrial decarbonization, could speed up emissions reductions at EITE facilities by providing financial services such as low-interest loans.[78] A green bank's core goal is to mobilize private capital by sharing risks and enabling projects that would not otherwise move forward, similar to Washington's experience with its revolving loan fund grants within the Clean Energy Fund.[79] States like California and Minnesota with similarly strong climate pollution targets have public financial institutions — the California Infrastructure and Economic Development Bank and the Minnesota Climate Innovation Finance Authority — that can assist industrial decarbonization projects.[xii]

Green bank loans are distinct because they fill financing gaps that private markets typically avoid (i.e., they are "additional"). For example, green banks can accept lower returns or take on higher risk (e.g., taking a junior position in the capital stack) to help attract more risk-averse private investors. Green banks can also provide loan guarantees and credit enhancements.

xii For more information on California's public financial institution, see **https://www.ibank.ca.gov/climate-financing/our-products/**. For more information on Minnesota's public financial institution, see **https://mn.gov/commerce/energy/consumer/energy-programs/climate-innovation.jsp**.

A one-time infusion of funds from Cap-and-Invest auction revenue — preliminarily estimated at $100 million to $200 million — can serve as startup capital for an industrially focused green bank. Services from an industrial green bank to EITEs would also strengthen the competitiveness of Washington-based industries, help stave off economic leakage, and attract new industries with decarbonization plans, strengthening the state's position as a hub for clean manufacturing. Green banks can take years to establish and it would be prudent for Washington to initiate and capitalize an industrially focused green bank by the late 2020s while auction proceeds are projected to be relatively high rather than in subsequent decades, when auction revenues will likely be lower.

In addition to new state legislation to charter and capitalize an industrially focused green bank, the bank will need to be structured in a way that clearly shows it will fulfill the public's interest in reducing pollution to not violate Washington's "Gift of Public Funds" doctrine.[80]

Increase funding and focus for the Hard-to-Decarbonize Sector Grants Program

The existing Hard-to-Decarbonize Sector Grants Program provided $20 million in grants in 2024, but the funding levels are too low for major industrial decarbonization projects.[81] Some EITEs, particularly smaller companies, lack the funds to invest in new technologies to reduce emissions. In addition, grants are important for kick-starting and attracting other sources of funding and financing, so increased funding for the grants program would have a multiplicative effect. In addition to increased funding, options to improve the grants program could include limiting grants to EITEs and smaller facilities that otherwise meet the requirements to qualify as an EITE, segmenting grants by industrial subsector to give all kinds of EITEs a chance for funding, funding the highest-impact projects designed to achieve reductions by 2034, or focusing on efficiency and electrification capital expenditures that reduce reliance on fossil fuels.

To improve its existing grant program, Washington can take cues from other states that offer a similar grant program such as:

- **Narrowing the scope of awardees:** Colorado's Clean Air Program grants are administered by the Colorado Energy Office to encourage facilities to adopt emissions-reducing technologies. The grant program is similar in size to Washington's, with $25 million available in funding; however, the program is smaller in scope and the state has focused on awarding funds to its heaviest-emitting facilities. A total of $5.6 million of the $7.1 million awarded to date fund projects to decarbonize a facility on the state's list of 18 priority facilities.[82] Washington can consider narrowing its scope to EITEs in its Hard-to-Decarbonize Grant Program.
- **Decreasing matching requirements for smaller manufacturers and create applicant "tracks":** Reducing Industrial Sector Emissions in Pennsylvania (RISE-PA) is a $400 million grant program funded by the DOE's Climate Pollution Reduction Grant to encourage industrial decarbonization in Pennsylvania.[83] Applicants follow different tracks, applying to small-, medium-, and large-scale program tracks. Washington can consider a similar tracked approach and decrease matching requirements for smaller facilities.
- **Awarding fewer grants with higher dollar amounts:** California's Industrial Decarbonization and Improvements to Grid Operation program is a competitive grants program with $46 million in funding for manufacturers and grid operators pursuing emissions reductions.[84] The minimum award is $4 million, highlighting that California's energy office is interested in funding fewer larger projects. Like California, Washington could focus on awarding larger dollar amount grants with higher emissions-reduction potential in EITE facilities.

Changes worth consideration

Introduce a clean heat standard

A clean heat standard (CHS) sets an emissions performance standard for industrial heat sources.[85] The policy seeks to reduce and regulate emissions from conventional fossil fuels, including natural gas, heating oil, and propane.

A CHS is analogous to renewable portfolio standards or energy efficiency resource standards. It imposes an obligation on market actors that is met by a bottom-up tallying of individual measures.[86] More specifically, it requires electricity, gas, heating oil, and propane suppliers to increase the uptake of low-emissions heat.

Low-emissions heat can be delivered by a variety of sources, such as renewable electricity, low-carbon hydrogen, and solar thermal. Other measures to achieve the CHS include installing heat pumps and energy-efficient equipment. To date, Massachusetts and Colorado have enacted CHS policies.[87]

In Washington, a CHS can incentivize electrification, energy efficiency, and fuel switching at EITE facilities. It can also encourage a transition among the most polluting industrial activities. For example, a CHS could move refined petroleum and coke production away from cokers and visbreakers, which use high heat, to noncombusted products.

Expand methane and full life-cycle emissions regulations

Methane regulations can mitigate upstream emissions from the electricity sector, the production of chemicals, refined petroleum, and coke, and other manufactured goods relying on natural gas. There is an increasing focus on understanding and regulating emissions associated with upstream and midstream natural gas. Under the EU methane regulations, all imported oil and gas will be required to meet a methane intensity standard by 2030.[88] And, beginning in 2025, all importers must provide detailed reporting on upstream methane emissions. If Washington wanted to better understand the upstream and midstream emissions associated with the natural gas consumed within the state, it could establish robust, measurement-based reporting requirements covering these emissions. As more information is understood about these emissions, Washington could also choose to impose standards on what natural gas can be consumed within the state.

Other states are beginning to consider how to design upstream reporting requirements. That includes Colorado, with its oil and gas GHG intensity program; California, where the Air Resources Board is working on implementing regulations under California's Climate Disclosure Laws; and New York, where the State Department of Environmental Conservation recently released its proposed Mandatory GHG Reporting Rule.[89] Meanwhile, industry leaders are working with an array of independent third parties that help them report on their emissions in a verifiable and trustworthy way. Examples include OGMP 2.0, the gas reporting and mitigation program of the UN Environment Programme, and MiQ, a not-for-profit that works with industry to certify methane emissions emitted from upstream and midstream operations[90]. In light of the data that Washington already collects from the natural gas industry, it would be well positioned to implement similar regulations.[91]

Similarly, Washington could strengthen its monitoring and control requirements for municipal solid waste landfills to better characterize — and minimize — the fugitive methane emissions associated with biomethane used within the state. In 2024, Ecology adopted new rules to curb landfill methane pollution, and in 2025, it awarded $9.6 million to 13 landfills to support compliance.[92] To build from these efforts and ensure that landfill gas collection and control strategies are working effectively, Washington could expand its methane monitoring efforts, leveraging readily available remote sensing technologies to detect, quantify, and address landfill methane leaks as they arise.[93] Direct measurement data could be used to develop a more accurate GHG inventory, guide and assess mitigation efforts, and inform future improvements to landfill methane regulations. Colorado and California are both pursuing remote sensing programs in the waste sector (notifying operators when large plumes are detected and requiring correct action), and New York is considering a direct measurement approach for landfills under its new GHG reporting framework.[94]

Allow facilities emitting less than 25,000 tCO_2e per year that otherwise meet EITE criteria to opt-in to the Cap-and-Invest program and receive no-cost allowances

Industrial facilities in Washington that emit more than 25,000 t of GHG per year are required to comply with the Cap-and-Invest program. Industrial facilities that emit at least 10,000 t of GHGs per year are required to report their emissions to Ecology as part of the state's mandatory GHG reporting program but are not regulated entities under Cap-and-Invest.[95]

Most direct emissions from facilities of this range come from the on-site combustion of methane gas, which are "covered" by the Cap-and-Invest program upstream of the point of combustion through the compliance obligation on natural gas suppliers. Natural gas suppliers pass on the cost of compliance with Cap-and-Invest down to their customers, of which industrial facilities are a subset.

Shifting the compliance burden downstream to opt-in facilities would allow those facilities more flexibility in how they reduce emissions. Compliance shifting to these opt-in facilities would mean they avoid the CCA fees coming from their natural gas suppliers but then would have to manage their own compliance. To ensure the number of no-cost allowances was not increased, and to avoid any double counting, no-cost allowances for opt-in facilities would be subtracted from the amount previously allocated to their natural gas supplier.

Develop additional offset protocols

Offsets are alternative compliance instruments within the Cap-and-Invest program. Emitters are limited in the percentage of offset credits they are allowed to use for compliance, and they must follow a specified protocol to qualify. Washington has four different protocols for offset projects: reforestation, avoided conversion, and improved management on US forest lands; planting trees in urban areas; capturing livestock methane; and destruction of ozone-depleting substances.[96]

Washington could develop one or more additional offset protocols for other types of high-quality CDR that apply to emissions not covered by the Cap-and-Invest program. CDR is defined by the Intergovernmental Panel on Climate Change as "anthropogenic activities removing carbon dioxide from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products."[97]

Washington already acknowledges the need for "negative emissions" to meet its climate targets, and identifies practices that increase carbon sequestration on natural and working lands, and storage of carbon in products.[98] These include practices with existing offset protocols such as afforestation, reforestation, and improved land management. There are dozens of different approaches to removing carbon dioxide from the atmosphere, many of which Washington is poised to deploy in-state.[99] The State CDR Atlas from RMI highlights the availability of plentiful biomass residue, which can be converted into inert stores of carbon (e.g., through biochar or bio-oil) and stored, as one of several potential pathways.[100] Geochemical approaches to CDR, which use reactive rock to mineralize carbon dioxide out of the atmosphere, are also very promising given Washington's favorable geology, particularly in the eastern part of the state.

Washington's pulp and paper industry may also present an opportunity for CDR deployment, as noted in the study *Toward a Net Zero Future in the Forest Products Industry*.[101] Currently, carbon dioxide emissions from biogenic sources are not covered by the Cap-and-Invest program. The vast majority of GHG emissions from the pulp and paper sector are from biogenic sources and so the sector lacks a strong incentive to reduce those emissions. An offset protocol that incentivizes point-source capture of CO_2 from pulp and paper mills for geologic sequestration would economically encourage the installation of CCS technology at pulp and paper and forest products facilities.

This list is not exhaustive, but in 2024, the state legislature commissioned a study of the potential for deploying CDR in the state as a tool for meeting climate targets and for economic development purposes. This study is expected to be released in summer 2025.

Augment technical assistance planning grants for decarbonization

Government-funded technical assistance (TA) can assist EITE facilities in planning for and executing a low-carbon transition. TA involves educating potential adopters on the benefits of complex technology as well as instruction on implementing technologies. It connects academics, consortia, and government experts with industry players. To that end, TA can assist in overcoming financial barriers to completing technical interventions due to their significant costs, and it is most valuable to facilities that are limited in personnel and experience.

Currently, Washington has two avenues for facilities to seek TA. First, the Northwest Onsite Energy Technical Assistance Program, funded by the DOE and headquartered at Washington State University, provides no-cost TA to industrial facilities considering on-site energy projects. This includes TA for battery storage, combined heat and power, industrial heat pumps, and fuel cells, among other projects.[102] Second, Ecology offers free TA to select small and medium-sized manufacturing and industrial plants. A sampling of the consulting team's services includes energy efficiency, lean manufacturing assistance, and solid waste reduction.[103]

The existing scope of current TA offerings leaves a gap in baseline knowledge needed for long-term transition planning. Decarbonization is a broad and daunting challenge for private sector actors.[104] Current offerings in Washington could be augmented, or new ones could be introduced, to provide more holistic support for EITE facilities that extend beyond energy efficiency. TA planning grants could be expanded for development of facility-level climate and resilience plans.

As an example, the National Renewable Energy Lab, in partnership with DOE, is executing the Advanced Energy and Manufacturing and Recycling Grants Program, which supports small and midsized manufacturers. The grant program awards can be used for feasibility analyses and planning, regulatory support, stakeholder identification and engagement, and other activities.[105]

Leverage state procurement to encourage low-carbon manufacturing

Robust “Buy Clean” procurement requirements that set clear standards for the carbon intensity of products can help leverage the purchasing power of the government to create a consistent market for clean, locally produced products.[106]

Washington signed its existing Buy Clean and Buy Fair act into law in 2024. The law requires state agencies and higher education institutions to report on the environmental impacts of select concrete, wood, and steel materials used in the construction or renovation of large state-owned buildings, but does not require covered materials purchased by state institutions to meet minimum environmental thresholds.[107] In 2022, the state government spent approximately $2.2 billion in capital outlay on construction, according to US Census Bureau data.[108]

Establishing a comprehensive clean material procurement requirement could aid in decarbonizing Washington’s heavy industries, including some EITEs. California, for example, has a Buy Clean California Act requiring state agencies to publish the maximum acceptable GWP limit for four eligible construction materials and mandating that those materials used in public works projects not exceed established GWP limits.[109] A similar bill was introduced in Washington’s 2022 session.[110] Other states, like Oregon and Colorado, have laws that include language more specifically targeting procurement by select agencies like transportation departments.[111]

Furthermore, by establishing and extending a clean procurement requirement to additional construction materials like asphalt, Washington could incentivize additional sectors to innovate and invest in cleaner production technologies, thereby reducing overall emissions associated with construction materials.

Introduce state-level tax credits for emissions-reducing equipment.

State-level tax credits for industrial decarbonization can ease the cost differential between legacy fossil equipment and lower-carbon-intensity and electrified equipment. Cost is the major determinant of whether a facility adopts new technologies, and currently electrified process heating sources for manufacturing make financial sense in only a handful of applications, typically in lower-temperature processes with lower heat duties.

A state industrial decarbonization credit can help cover that difference and make the financial case for a wider range of applications.

The federal version of this tax credit, 48C, was heavily oversubscribed, with applications in the first round totaling $42 billion worth of projects — over 10 times the available funding.[112] This highlights that many firms are ambitious enough to adopt new, clean technologies if there is an additional incentive to do so. Two Washington-based firms succeeded in obtaining 48C funding.[113]

Colorado is an example of a state that has adopted its own version of 48C, called the Colorado Industrial Tax Credit Offering (CITCO).

CITCO is a competitively awarded, refundable tax credit with $168 million of funding through 2032. CITCO is offered to all manufacturers including Greenhouse Gas Emissions and Energy Management for Manufacturing (GEMM) 1 and 2 rule regulated facilities, a program that mandates emissions reductions for high-emitting facilities in Colorado's industrial sector specifically.[114] Colorado therefore offers both a carrot and a stick for industrial decarbonization, by first mandating emissions reductions, and then rewarding first movers by subsidizing their associated compliance costs. CITCO covers a whole host of decarbonization projects, from purchasing electric equipment like heat pumps, to conducting industrial studies, to adding economizers and waste-heat recovery mechanisms to existing machinery.

In Washington's case, the state can pursue either a discretionary or a statutory tax credit for industrial decarbonization projects.

Both 48C and CITCO are discretionary, refundable tax credits and involve administrative capacity to review and approve industrial decarbonization projects. By going this route, Washington can ensure it is awarding projects that align with predetermined state criteria, but would need to dedicate staff time to the administration of credits and review periods.

Alternatively, Washington could offer a statutory, capped tax credit to be credited against the business and occupation tax. This statutory tax credit would require a more limited and clearly defined scope of projects. For example, the state could offer credit for manufacturers of a certain size, and only for adoption of certain technologies like heat pumps, e-boilers, and clean-fuel-compatible equipment. This would ease the application process for both manufacturers and state personnel but would require the legislature and the state revenue department to promulgate clear regulations to prevent the offering being co-opted for applications that do not meet emissions-reduction goals.

Introduce state-level tax credits for clean manufacturing production

A clean manufacturing production tax credit is a fiscal incentive that can help producers of high-emitting products switch to cleaner modes of production. Unlike an investment tax credit for emissions-reducing equipment, a clean manufacturing production tax credit would be claimed by a business year after year and help cover higher operating costs associated with less-carbon-intense production methods. Washington can encourage high-emitting industries like steel and cement to decarbonize by providing a production tax credit for every ton of green steel or green cement that is produced in the state.

A policy like this does not exist at the federal or state level in the United States and would require further research on the in-state per ton cost differential between green and conventional material production methods. It would also require an assessment of green steel and cement demand from the state's Buy Clean and Buy Fair program, and evaluate corporate willingness to pay for a green product to meet Scope 3 emissions targets. A production tax credit would take those factors into account — the cost differential between conventional and green production, public demand for green products, and corporate willingness to pay — to determine a fair price per ton of green product to offer to steel and cement manufacturers. For industries already considering making the switch to green production, a clean manufacturing production tax credit could make the difference, especially for plants that are at the end of equipment life cycles and can switch to cleaner production methods without stranded assets.

Alternatively, the state could expand its existing solar manufacturing tax credit to cover more cleantech manufacturing industries that would enable decarbonization in the industrial sector.[115] As Washington pushes manufacturers toward cleaner production methods, the state could consider where this enabling equipment is manufactured and whether it could be manufactured in-state. If facilities need to switch to industrial heat pumps or hydrogen fuels, for example, the state could focus on expanding its solar component tax credit to include industrial heat pumps, electrolyzers, and other technologies that will enable industrial decarbonization at scale.

Invest in common carrier infrastructure, such as pipelines, for the transport of green hydrogen

Transitioning to green hydrogen as a fuel source requires the availability of robust and resilient quality infrastructure.[116] The infrastructure includes the pipelines, liquification plants, storage facilities, and other equipment involved in the storage and delivery of green hydrogen to an industrial facility. As of 2024, Washington has three miles of intrastate hydrogen pipelines and no interstate hydrogen pipelines.[117]

Building a hydrogen delivery network, including assessing compatibility of existing pipelines with hydrogen, optimizing design, and demonstrating efficient delivery, will take between 5 and 12 years. To that end, Washington would benefit from consulting with its industrial facilities and establishing a plan to invest in and build the required common carrier infrastructure and establish the appropriate regulatory authorities.

Incentivize safe, sensible, and proactive full transitions of refineries to other functions

While our core suggestions seek to retool existing refineries to keep fossil-based transport fuels as their primary products for most sites, current market trends may drive site closures, such as those recently announced in California (Wilmington, Benicia[118]) and Texas (Houston[119]). Economic implications of shutdowns were recently studied by the Washington Department of Commerce against a set of other most common historical refinery adaptation pathways.[120] If future shutdowns occur, policies can support more novel methods to minimize economic disruptions while maintaining emissions reductions such as:

- Accelerating new low-carbon housing builds at former refinery sites. This can be either directly (e.g., Victoria by the Bay, California[121]) or indirectly by siting new commercial and light industrial facilities so existing older buildings can be converted (e.g., Philadelphia, Pennsylvania[122]).
- Developing new carbon-free energy hubs. This could be more structured industry–academia–government collaborations (e.g., Yamaguchi, Japan[123]) or more open-ended financial backing of bids for preapproved redevelopment pathways (e.g., Grangemouth, Scotland[124]).

Because of the relative size of Washington's refineries compared to other sources of industrial GHG pollution, the impact of a refinery shutdown on overall industrial emissions and the allowance market would be significant.

Conclusion

Washington's Cap-and-Invest program is a popular and powerful tool for reducing climate pollution, but faces challenges in how the industrial sector participates in decarbonization. Our report has detailed the technical pathways that would significantly decrease industrial pollution by the mid-2030s and lead to deep decarbonization by 2050. Implementing those pathways in a fair and cost-effective manner while meeting CCA targets will require new legislation, dedicated funding for industry, and changes to regulations to reduce industrial allowances over time and enable deployment of upgraded and new technologies.

The overall CCA targets are achievable if they are treated as shared goals and shared burdens between industry, government, and the public. With smart policy to support implementation of the technical pathways, not only can industrial economic and emissions leakage be avoided, but new clean industries can also be attracted to Washington, thereby supporting the twin goals of economic vitality and reduced pollution. Washington really can be a world leader in the clean industrial economy. As noted on the Choose Washington website, "If it's difficult we do it immediately. If it looks impossible, it may take a bit longer."[125]

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Technical Appendices

Opportunities for Industrial Modernization in Washington: Technical Pathways, Investments, Policy, and Decarbonizing Options for Emission-Intensive, Trade-Exposed Industries

June 2025

Table of Contents

Appendix A: Stakeholder interviews

RMI spoke with stakeholders across more than two dozen different entities while developing this report. Through interviews, we spoke with a majority of the members of the Washington Department of Ecology Cap-and-Invest EITE Industries Advisory Group and the Cap-and-Invest EITE Policy Advisory Group, although some stakeholders we spoke to were not included in either of these groups. Organizational members of each group are listed in Exhibit A1.

Exhibit A1

Organizational Members of the EITE Industries Advisory Group	**Organizational Members of the EITE Policy Advisory Group**
Nutrien	Climate Solutions
Alliance of Western Energy Consumers	Washington Public Ports Association
Kaiser Aluminum	United Steelworkers Union - Local 338
Nippon Dynawave Packaging	The Nature Conservancy
Glass Packaging Institute	IAM 751
HF Sinclair	Clean and Prosperous
Collins Aerospace	Puget Sound Energy
Par Pacific and U.S. Oil and Refining	Washington Conservation Action
Cardinal FG Company	SEI Fuel Services (7-Eleven)
Northwest Pulp & Paper Association	Cowlitz Public Utility District No. 1
Lamb Weston	
Western States Petroleum Association	
bP America	
Association of Western Pulp and Paper Workers	
CRH Americas Materials/Ash Grove Cement	
Boeing	
Food Northwest	
Nucor Steel Seattle	
Packaging Corporation of America	
J.R Simplot Company	
TSMC Washington	
Phillips 66 Company	
Matheson Tri Gas	

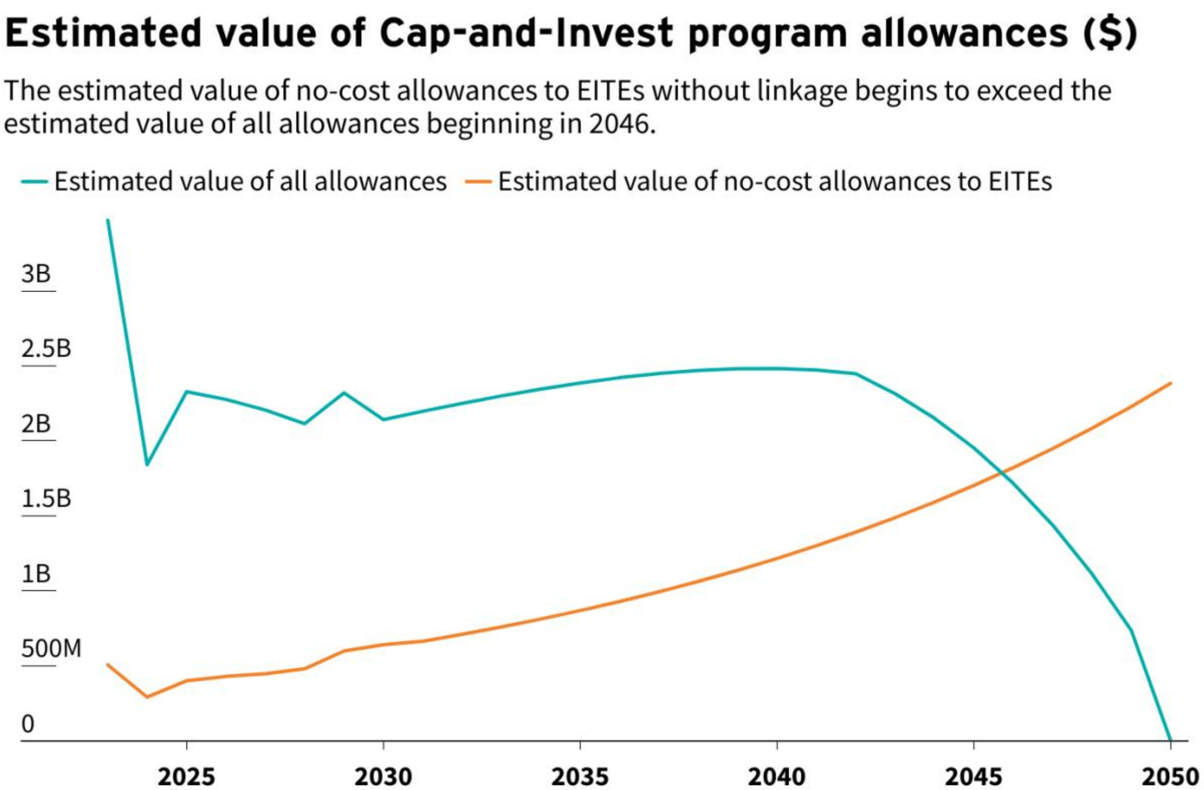
Interviews — conducted between November 2024 and April 2025 — were oriented around topics including:

- Feedback on RMI's proposed decarbonization pathways, including technology feasibility, costs, and implementation timelines
- Washington facilities' priorities for industrial decarbonization
- Perspectives on the structure of the Cap-and-Invest program, uses of the revenue generated through the program, and the future of no-cost allowance allocations
- The largest barriers to and opportunities for industrial decarbonization, including issues like clean electricity availability and state permitting procedures.

Where relevant, RMI has attempted to take interviewee feedback into account throughout the report.

Appendix B: Value of EITE no-cost allowances, no linkage scenario

Exhibit B1



Allowance prices based on historical sale prices for 2023–24. Price estimates for 2025–29 based on average of Washington Department of Ecology baseline auction price forecasts (excluding APCR, ECR, & ceiling prices) for auctions held in a calendar year. Prices for 2030–50 based on historical and baseline price forecast average annual percent change. Overall level of allowances and allowances to EITEs based on RMI estimates from statutory annual cap levels and reductions relative to existing baseline, and excludes no-cost allowances to electric and natural gas utilities.

Chart: RMI • **Source:** Washington Department of Ecology.

To estimate the 2023-2025 values of EITE no-cost allowances, Exhibit 2 relies on an average of annual no-cost allowance allocations to EITEs as published by the Washington Department of Ecology to determine the volume of no-cost allowances allocated to EITEs over that period. Volumes of EITE no-cost allowance allocations between 2026 and 2050, assuming no linkage and with no change to no-cost allowances post-2034, were determined using the reduction schedule as outlined in the Washington Administrative Code.

To determine the volume of all allowances, which was then used to estimate the value of all allowances between 2023 and 2025, this analysis used total Cap-and-Invest program baseline and total Cap-and-Invest program information as published in Washington's Administrative Code.

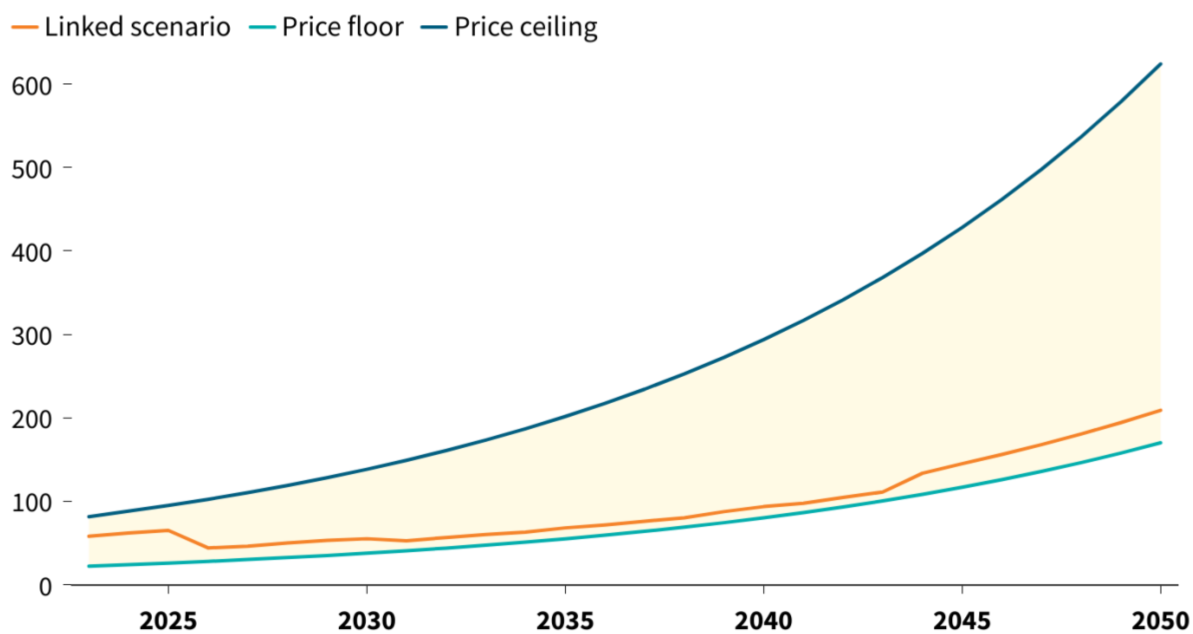
Average annual vintage auction prices as published by the Washington Department of Ecology were used for 2023 and 2024 prices and were multiplied by the volumes as determined above to derive allowance values for those years. Estimates derived from the Washington Department of Ecology's price forecasts were used to estimate annual prices between 2025 and -2029, and average rates of change were used to estimate prices thereafter, through 2050.

Appendix C: Modeled allowance prices under linkage scenario

Exhibit C1

Modeled Cap-and-Invest program allowance prices under linkage scenario beginning 2026 ($)

If Washington links its Cap-and-Invest program to the California and Québec carbon markets ("linked scenario") beginning in 2026, forecast linked prices are between forecast price ceiling and price floor amounts through 2050.



Linked scenario values use modeled frontloaded allowance prices for 2023–25 and estimated modeled linked prices for 2026–30 from Vivid Economics. Estimated modeled linked prices for 2031–45 from Resources for the Future (RFF). Estimated modeled linked prices for 2046–50 calculated by RMI from RFF estimated changes. 2023–25 price floor and ceiling values from historical auction prices published by Washington Department of Ecology. Price ceiling and floor values for 2026–50 calculated by RMI from estimated adjustment factor based on state statute.

Chart: RMI • **Source:** Vivid Economics, Resources for the Future, Washington State Department of Ecology, and RMI.

The inputs used to produce the 2023-2045 "linked scenario" values in Exhibit C1 are derived from a study Vivid Economics conducted for the Washington Department of Ecology in 2022 and from a study Resources for the Future (RFF) published in 2025. Linked scenario values for 2045-2050 were estimated based on the average annual rate of change from RFF's estimates.

The price floor and ceiling values for 2023-2025 were derived from historical auction prices published by the Washington Department of Ecology. For price ceiling and floor values between 2026 and 2050, RMI estimated those values based on the Washington Administrative Code's language that ceiling and floor prices are the ceiling or floor price for the prior calendar year, increased annually by 5% plus the rate of inflation based on the most recently available 12 months of the consumer price index for all urban consumers (CPI-U). RMI then determined the 10-year average annual CPI-U rate of change and applied it, in conjunction with the specified 5% annual increase, to the most recent historical price floor and ceiling values through 2050.

Appendix D: Technical pathways methodology

To estimate the decarbonization potential of Washington's EITE sectors, the analysis integrates facility-level emissions data with sector-wide applicable relative emissions reductions for each of the selected technologies modeling. The goal is to quantify realistic, cost-effective emissions reduction opportunities through 2050, using consistent baseline assumptions and technology performance parameters.

The evaluation draws on published academic literature, industry case studies, conducted interviews, and modeling reports to assess a range of decarbonization technologies. Each option was characterized by its expected relative GHG emissions savings per site, capital expenditure and marginal abatement cost, and estimated implementation timeframe. Relative reduction values were primarily sourced from peer-reviewed studies such as those from the Journal of Cleaner Production, as well as US DOE and EU industrial transition reports and RMI research and modeling. These percentages were applied to each facility's baseline emissions (average for 2015–2019 reported emissions) to estimate total achievable reductions in a comparable and consistent manner by 2035 and 2050 respectively.

Marginal abatement costs and gross Capex estimates were obtained from real-world project documentation, industry databases, and synthesis studies on industrial decarbonization economics including DOE reports. Sources included documented pilot projects (e.g., electrified boilers, CCUS retrofits) and aggregated reviews of capital and operating expenditures across industrial decarbonization pathways. Where ranges were given, midpoints or conservative values were used to derive cost-efficiency ratios ($/ton CO_2e reduced annually). Additionally, following our stakeholder interviews, we adjusted both capital expenditure and marginal abatement cost estimates to reflect real-world constraints. For example, several food-sector operators confirmed that while full electrification remains a technically feasible long-term pathway, the steep up-front investment and integration challenges with existing steam systems made it impractical within our 2050 cost-optimization framework. Consequently, full-scale electrification was excluded from the final emissions reduction portfolio for this sector (while remaining possible given technological breakthroughs and significant cost reductions), and its potential was instead captured implicitly through partial electrification measures with lower capital expenditure and more favorable marginal costs.

Estimated implementation timelines were drawn from project development cycles observed in commercial deployments and construction benchmarks cited in existing literature and case studies. Technologies were grouped into near-term, medium-term and long-term categories based on technical readiness level, infrastructure requirements, permitting complexity, costs, and emission reductions potential. For example, measures like fugitive methane control and rate adjustments have shorter lead times, while large retrofits like green hydrogen integration and FCC gas carbon capture require multi-year planning and investment.

To translate facility-level decarbonization pathways into a sector-wide emissions reduction potential and to derive the sector's total abatement cost we follow a structured, transparent, and replicable procedure:

1. Compile baseline emissions by sector
   - Gather reported 2015–2019 CO_2e for each of the facilities reporting GHG emissions and calculate average emissions (E_i)
2. Select and characterize decarbonization technologies
   - For each facility, identify feasible options (e.g., electrification of boilers, FCC CCU, biorefinery retrofit, hydrogen fuel switching).
   - For each technology j at facility i, collect:
     - Relative reduction factor (r_{ij}, % of E_i)
     - Marginal abatement cost (MAC_{ij}, \$/tCO_2e) from case-study data and peer-reviewed literature and DOE reports
3. Compute technology-level absolute reductions

   For each facility-technology pair:

   $\Delta E_{ij} = r_{ij} \times E_i$

   Example: A 20% reduction at a 1.0 MtCO_2e facility yields 0.2 MtCO_2e/y abatement.
4. Calculate total abatement cost per technology
   - Use literature and case study MAC values rather than deriving from capital costs due to limited data availability.
   - Compute $cost_{ij} = MAC_{ij} \times \Delta E_{ij}$

   (e.g., \$50/t × 0.2 Mt = \$10 M).
5. Sequence and adjust for overlap
   - Order technologies in operational sequence (e.g., efficiency → electrification → CCU).
6. Aggregate to facility and sector totals
   - Sum absolute abatements at each facility: $\Delta E_{i,total} = \Sigma_j \Delta E_{ij}$
   - Sum costs across all technologies and all facilities: $Cost\_sector = \Sigma_{ij} cost_{ij}$
   - Sum total abatement: $\Delta E\_sector = \Sigma_i \Delta E_{i,total}$
7. Calculate emissions reduction potential for 2035 and 2050
   - Projected business-as-usual emissions: Estimate total sector emissions for target years 2035 (E_2035) and 2050 (E_2050) using industry growth forecasts, policy scenarios, and assumed technology adoption rates.
   - Absolute Reduction Potential: Calculate the difference between the baseline sector emissions (E_baseline) and projected emissions:
     – ΔE_2035 = E_baseline − E_2035
     – ΔE_2050 = E_baseline − E_2050
   - Relative Reduction Potential: Express ΔE_2035 and ΔE_2050 as a percentage of the baseline emissions to facilitate cross-sector comparisons.

Appendix E: Additional technical decarbonization pathway information

Exhibit E1

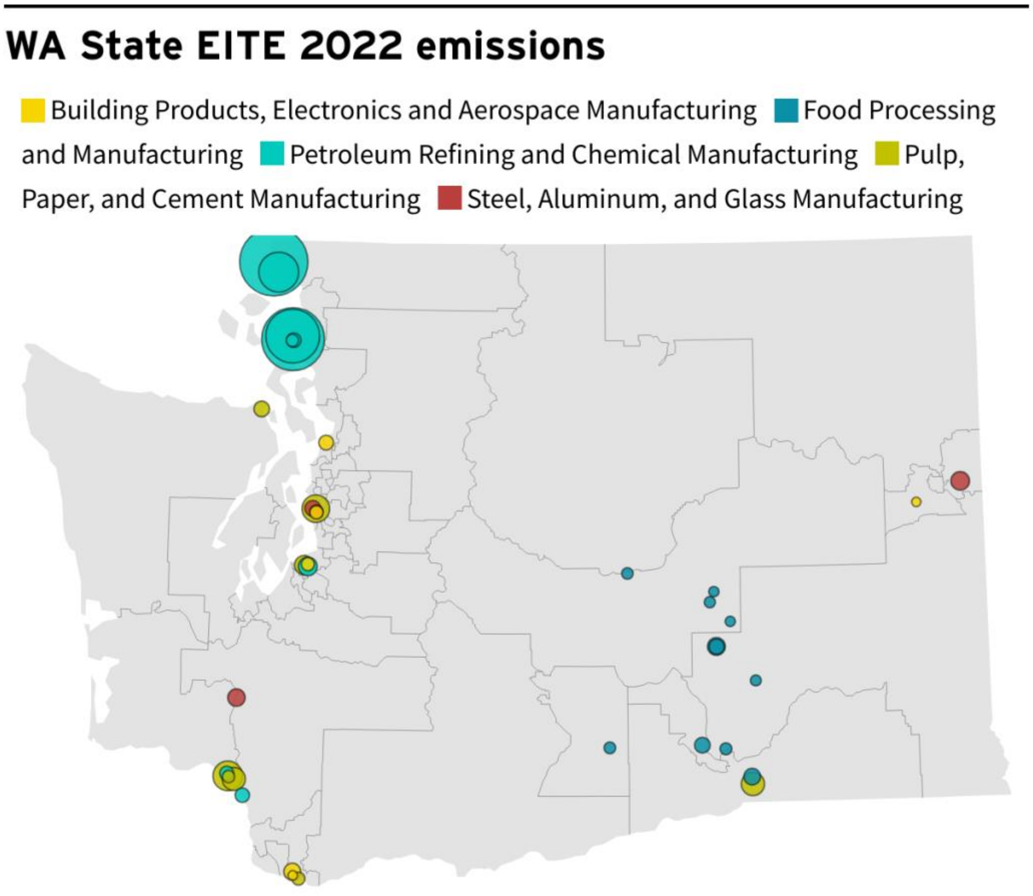
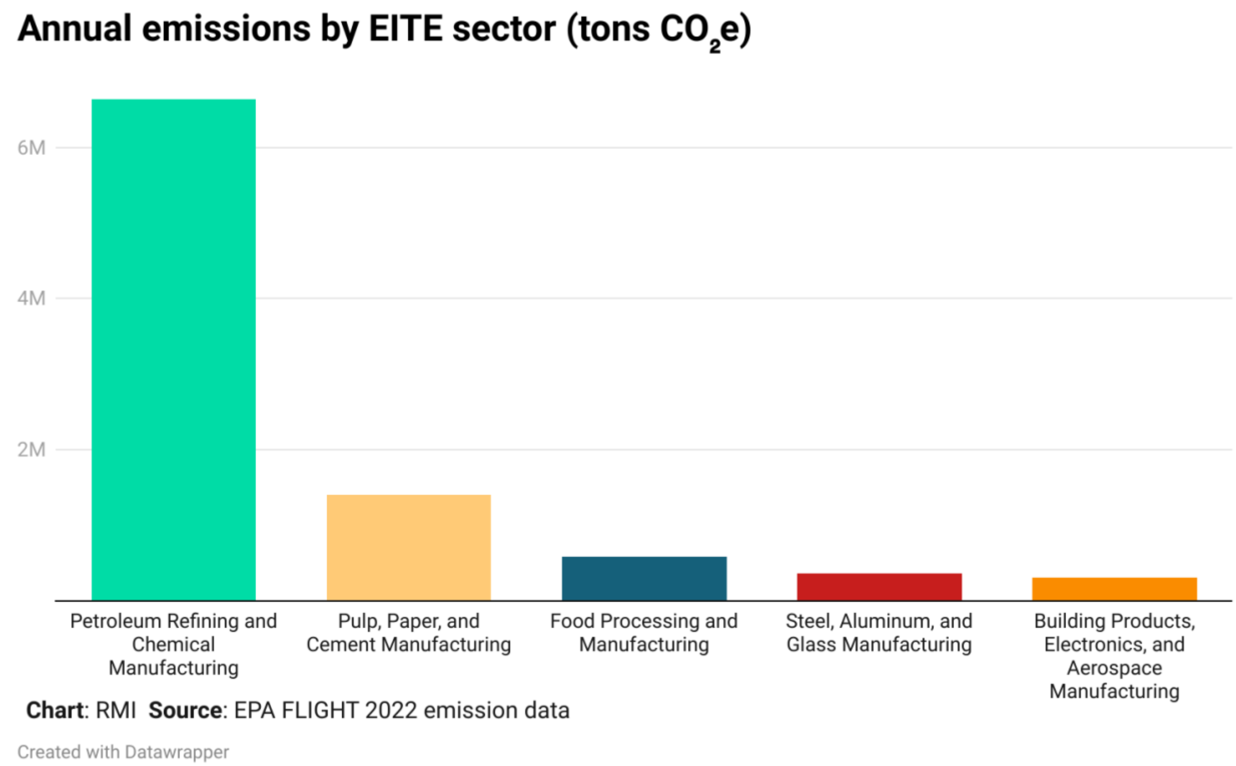


Exhibit E2



Annual emissions by EITE sector (tons CO2e)
6M
4M
2M
Petroleum Refining and Chemical Manufacturing
Pulp, Paper, and Cement Manufacturing
Food Processing and Manufacturing
Steel, Aluminum, and Glass Manufacturing
Building Products, Electronics, and Aerospace Manufacturing
Chart: RMI Source: EPA FLIGHT 2022 emission data
Created with Datawrapper

Exhibit E3


Refineries
Sector snapshot
Lower tech & permit risk, GHG cuts
Higher tech & permit risk, GHG cuts
Marginal Optimization and Efficiencies
Lowering emissions without major capital investments. Options could include lighter and/or lower sulfur crudes, HEFA biofeed co-processing (S3)*, targeted equipment upgrades, better maintenance, automation, and less fugitives and flaring
Electrification
Replacing fossil fuel-based systems with electric technologies, focusing primarily on condensing/venting steam turbines (e.g., pumps and compressors) and process heating (e.g., boilers and fired heaters).
Gasoline Unit & Fuel-Grade Coker Shutdowns
Shutting down key processing units can reduce emissions as road fuel demand drops. Naphtha (paraffinic or aromatic) and short resid can be repurposed as a higher-sulfur non-fuel feedstock for other industries, preserving some product value.
Biorefinery Conversion
Includes conversion of smaller refineries or select secondary units to produce biofuels like Sustainable Aviation Fuel (SAF). Ideal for lower-capacity sites like U.S. Oil/PAR Pacific in Tacoma.
Low-Intensity Hydrogen
Production of green hydrogen via electrolysis (preferred) or "turquoise" via methane pyrolysis. Green can be eligible for 45V tax credits for dedicated processing.
The wide range of WA refinery sizes (>5x) can support commercial scale-up of these technologies.
Fluid Catalytic Cracking Waste Gas Carbon Capture
Captures CO_2 from FCC waste gas, potentially converting it to methanol. Eligible for 45Q tax credits, this method provides a bridge to cleaner production options - particularly relevant in the long-term for advanced SAF and low-emissions chems.
5 facilities, 6.4 MMt CO_2e p.a.
Emission reduction potential (2035/2050): 2.3 MMt CO_2e/5.96 MMt CO_2e
Cumulative cost (2035/2050): $1.61 B/$10.3 B
Electricity demand increase (2030/2050): 4,639 GWh/5,522 GWh

Exhibit E4

Pulp and paper

Sector snapshot

Exhibit E5

Cement

Sector snapshot

Short term | **Mid term** | **Long term**

Supplementary cementitious materials (SCMs)

Include materials like fly ash, steel blast furnace slag, or calcined clays that partially replace Portland cement during the blending or grinding phase. Given Washington's access to local sources of fly ash and other SCMs, this substitution can be implemented effectively to lower overall carbon intensity.

Energy Efficiency/ Waste Heat Recovery (WHR)

EE applicable at all stages of production - upgrading process control systems to improve kiln operation stability, reducing fuel consumption, and using more efficient grinding systems to reduce energy use during the finish milling process. WHR can be applied during clinker cooling and the kiln phases to capture excess heat and convert it into usable energy.

Low Carbon Fuels

Include alternative fuels, such as biomass or waste-derived fuels, that can be used to reduce the carbon footprint of the high-heat requirements of cement manufacturing.

Carbon Capture Utilization and Storage

Can be implemented during the kiln phase to capture carbon dioxide generated during the production of clinker.

- 1 facility, 0.39 MMt CO_2e p.a,
- Emission reduction potential (2035/2050): 0.17 MMt CO_2e/0.36 MMt CO_2e
- Cumulative cost (2035/2050): $0.07 B/$0.68 B
- Electricity demand increase (2030/2050): 278 GWh/931 GWh

Exhibit E6

Glass production

Sector snapshot

Short term — Mid term — Long term

Material Efficiency and Recycling

Includes increasing the use of recycled glass (cullet), which has a lower melting temperature compared to raw materials, thus requiring less process heat. Utilizing cullet also avoids both energy-related and process CO_2 emissions.

Energy Efficiency/ Waste Heat Recovery

Efficiency measures, such as the use of oxyfuel furnaces, reduce energy consumption by optimizing combustion in the glass melting process - widely applied in the U.S. due to low capital cost and ease of retrofit, used alongside with WHR from the exhaust gases for preheating the combustion air.

Electrification

Includes electrifying specific heating processes using electric melting furnace technologies, such as submerged electrodes, microwaves, and plasma.

Low Carbon Fuels / Hydrogen

Replacing fossil fuels with low-carbon alternatives, such as biogas, synthetic methane, biomass, or green hydrogen. This substitution can provide the high temperatures needed for melting glass materials while significantly reducing carbon emissions

Carbon Capture Utilization and Storage

CCUS technologies to capture and store CO_2 emissions from the melting process. Feasibility for the glass industry remains uncertain due to challenges such as the presence of acidic compounds and high cost.

- 2 facilities, 0.178 MMt CO_2e p.a,
- Emission reduction potential (2035/2050): 0.09 MMt CO_2e /0.16 MMt CO_2e
- Cumulative cost (2035/2050): $0.05 B/$0.41 B
- Electricity demand increase (2030/2050): 163 GWh/526 GWh

Exhibit E7

Food processing

Sector snapshot

Short term — **Mid term** — **Long term**

Material Efficiency

Includes optimizing the use of raw materials, reducing waste, and maximizing product yield, e.g., reducing waste in peeling (steam pealing, optical peeling control systems), sorting, and blanching (counter-flow) steps can significantly cut energy use and emissions.

Energy Efficiency/Waste Heat Recovery

Incudes efficient lighting, chillers, freezers, fryers with advanced control systems, variable speed drives for washing and peeling processing. Heat recovery from fryers, water vapors, steam peelers can be used to e.g., pre-heat blanching water, air or heating.

Electrification

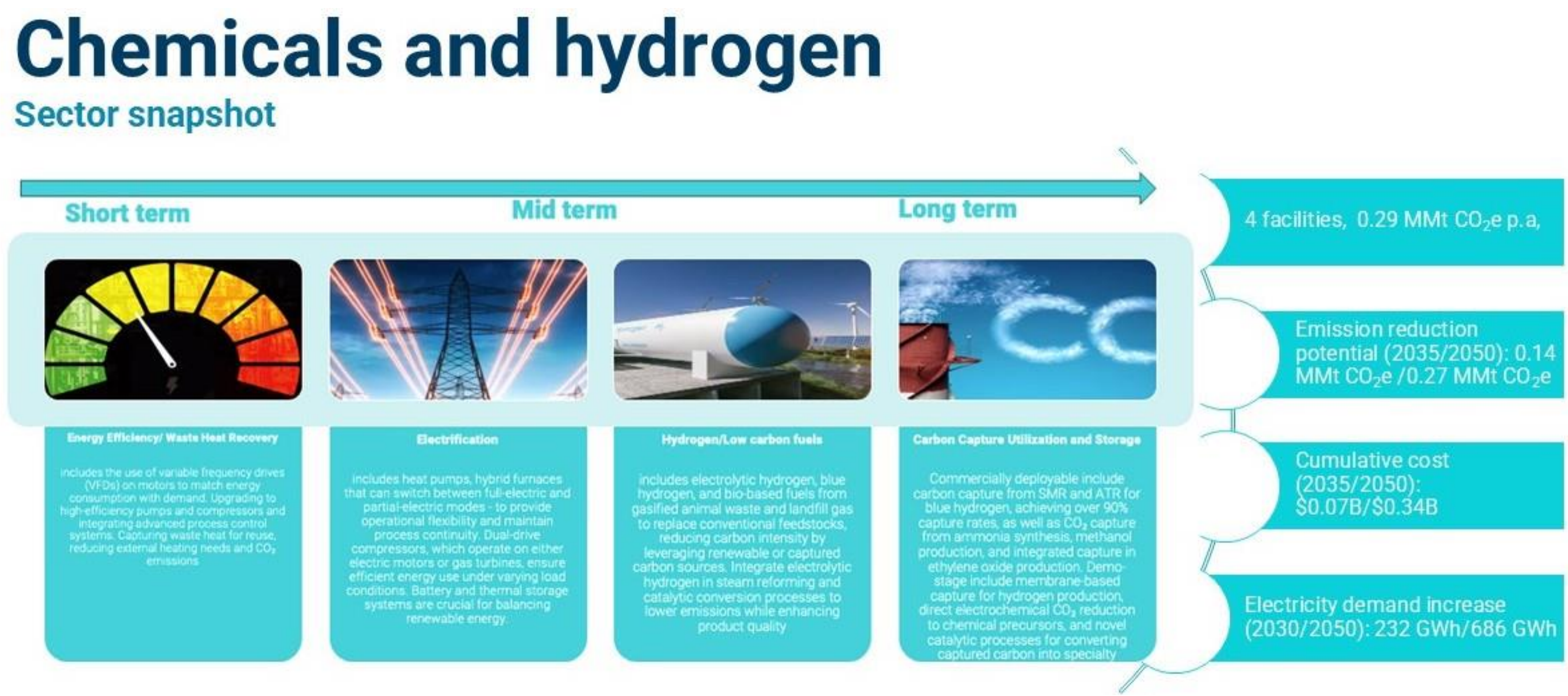
Involves replacing gas-fired boilers or fryers with electric ones. Heat pumps can be used to electrify the provision of low- to medium-temperature (up to 200°C) heat for preheating and drying.

Low Carbon Fuels/ Hydrogen

Includes switching from conventional fossil fuels to low carbon alternatives, such as biogas, biomethane, or renewable natural gas for high-temperature processes (e.g., frying, roasting, drying). Hydrogen can also be used as a fuel for steam boilers and burners, replacing natural gas.

- 10 facilities, 0.74 MMt CO_2e p.a,
- Emission reduction potential (2035/2050): 0.3 MMt CO_2e /0.52 MMt CO_2e
- Cumulative cost (2035/2050): $0.06 B/$0.26 B
- Electricity demand increase (2030/2050): 625 GWh/1,704 GWh

Exhibit E8



Chemicals and hydrogen
Sector snapshot
Short term
Mid term
Long term
Energy Efficiency/ Waste Heat Recovery
includes the use of variable frequency drives (VFDs) on motors to match energy consumption with demand. Upgrading to high-efficiency pumps and compressors and integrating advanced process control systems. Capturing waste heat for reuse, reducing external heating needs and CO_2 emissions
Electrification
includes heat pumps, hybrid furnaces that can switch between full-electric and partial-electric modes - to provide operational flexibility and maintain process continuity. Dual-drive compressors, which operate on either electric motors or gas turbines, ensure efficient energy use under varying load conditions. Battery and thermal storage systems are crucial for balancing renewable energy.
Hydrogen/Low carbon fuels
includes electrolytic hydrogen, blue hydrogen, and bio-based fuels from gasified animal waste and landfill gas to replace conventional feedstocks, reducing carbon intensity by leveraging renewable or captured carbon sources. Integrate electrolytic hydrogen in steam reforming and catalytic conversion processes to lower emissions while enhancing product quality
Carbon Capture Utilization and Storage
Commercially deployable include carbon capture from SMR and ATR for blue hydrogen, achieving over 90% capture rates, as well as CO_2 capture from ammonia synthesis, methanol production, and integrated capture in ethylene oxide production. Demo-stage include membrane-based capture for hydrogen production, direct electrochemical CO_2 reduction to chemical precursors, and novel catalytic processes for converting captured carbon into specialty
4 facilities, 0.29 MMt CO_2e p.a,
Emission reduction potential (2035/2050): 0.14 MMt CO_2e /0.27 MMt CO_2e
Cumulative cost (2035/2050): $0.07B/$0.34B
Electricity demand increase (2030/2050): 232 GWh/686 GWh

Exhibit E9

Iron and steel

Sector snapshot

Short term | **Mid term** | **Long term**

Material efficiency

includes maximizing the use of high-quality prime scrap minimizing the need for energy-intensive primary iron production. By optimizing the charge mix with low-carbon DRI/HBI as a supplement, mills can overcome limitations in scrap availability while maintaining production quality. Adopting advanced sorting and recycling techniques help preserve material purity

Electrification

includes Electric Arc Furnace to melt and refine iron. Integrating onsite renewable energy sources, such as solar or wind power, along with energy storage solutions, ensures a stable and clean power supply, while smart process controls and waste heat recovery systems further enhance operational efficiency and sustainability.

Hydrogen

Green hydrogen used as a reducing agent in the direct reduction of iron ore (DRI) process. Instead of relying on carbon-based fuels like natural gas, hydrogen reacts with iron ore to produce direct-reduced iron while generating water as a byproduct also includes electrolytic hydrogen for rolling and casting

Carbon Capture Utilization and Storage

Primarily beneficial for Blast Furnace – Basic Oxygen Furnace (BF-BOF) mills– due to their high CO_2 emissions from coke combustion,, the technology is also being investigated for integration into natural gas-based DRI/HBI. In the EAF route, CCS may be applied to off-gas streams or to residual emissions from DRI production

- 1 steel facility, 0.33 MMt CO_2e p.a,
- Emission reduction potential (2035/2050): 0.15 MMt CO_2e /0.3 MMt CO_2e
- Cumulative cost (2035/2050): $0.1 B/$0.49 B
- Electricity demand increase (2030/2050): 224 GWh/683 GWh

Exhibit E10

Electronics

Sector snapshot

Appendix F: New electricity demand and pathway implementation costs from analysis

Exhibit F1

	Annual additional electricity demand in 2030 (GWh)	Annual additional electricity demand in 2050 (GWh)	2035 Cost $M	2050 Cost $M
Refineries	4639.5	5522.6	$1,61	$10,284
Pulp and paper	1242.4	3574.1	$978	$5,010
Cement *	278.1	931.0	$70	$681
Glass *	163.9	526.2	$51	$414
Food processing	625.5	1704.4	$58	$260
Chemicals and hydrogen	232.1	686.8	$69	$344
Iron & steel	224.7	683.1	$99	$487
Electronics	161.6	347.0	$4	$20
Total additional electricity demand in 2030	7567.8			
Total additional electricity demand in 2050		13975.2		
Total cost by 2035			$2.94B	
Total cost by 2050				$17.5B

*Baseline loads for glass and cement sectors were estimated, while all other sectors are based on actual data.

Appendix G: Permitting and siting

The Washington State Departments of Ecology and Commerce produced the *Low-Carbon Energy Project Siting Improvement Report* which made 73 recommendations related to permitting and siting. Subsequently, the Washington legislature passed H.B. 1216 relating to permitting and siting. RMI evaluated H.B 1216 against the recommendations from Ecology and Commerce. When evaluating H.B. 1216 against the recommendations in *Low-Carbon Energy Project Siting Improvement Report*, we found the following goals were fully addressed: EJ-4, EJ-6, Tribal-1, Tribal-2, Tribal-3, Tribal-4, Tribal 5, Tribal-10, Tribal-13, Tribal-17, Local-3, Local-7, Local-8, EE-1, EE-2, EE-7, Plan-2, Assist-10, Coord-2, State-1. Exhibit 15 below includes the recommendations we consider to be partially addressed or unaddressed by H.B. 1216.

Exhibit G1

Goal ID	Recommendation	How it is addressed
EJ-1	Develop detailed guidelines for agencies and local governments to engage overburdened communities as part of planning processes in equitable and accessible ways	Partially addressed — engagement encouraged, but detailed guidelines not mandated.
EJ-2	Consider how local government could coordinate with communities to develop guidelines on how best to engage with representative organizations.	Unaddressed — no requirement for local governments to develop engagement guidelines with communities.
EJ-3	Coordinate with communities on options to provide longer timelines for review and comment on permits.	Partially addressed in Section 303(2) — some flexibility implied, but extensions not mandated.
EJ-5	Consider providing funding for local governments, Tribes, and communities to provide information and training directly to developers on meaningful engagement.	Unaddressed — no funding provisions created.
EJ-7	Require environmental justice impact analysis be conducted as part of a state environmental review process or other related review process.	Partially addressed — nonproject reviews require EJ consideration, but no universal project-level EJ analysis.
EJ-8	Consider developing guidance and best practices for conducting impact analysis for overburdened communities.	Partially addressed — analysis in nonproject reviews, but no general guidance issued.
EJ-9	Incorporate equity consideration in requests for proposals for consumer-owned utility projects, similar to Washington Utilities and Transportation Commission requirements.	Unaddressed — utility RFP requirements not updated.
EJ-10	Agencies not covered by the HEAL Act should review the benefits of opting in.	Unaddressed — no directives to opt into HEAL Act participation.
EJ-11	Opt-in agencies with a nexus to clean energy siting or permitting should consider participating in the HEAL Interagency Work Group.	Unaddressed — no references to expanding HEAL Interagency Work Group participation.

TRIBAL-6	When assessing Tribal lands and interests that may be directly, indirectly, or cumulatively affected by a project, the evaluation should include Tribal treaty reserved rights, Tribal reservations, off-reservation rights, Trust lands, other Tribal-owned land and other areas of significance to Tribes.	Addressed in Sections 209(1) and 302(3)(a) — impacts considered, but cumulative effects not fully addressed and trust lands and other areas of significance not mentioned.
TRIBAL-7	Fund and request individual Tribes to self-identify their areas of interest.	Unaddressed — no funding mechanism provided.
TRIBAL-8	Develop map layers for routes of migratory species, vessel traffic routes or other information of interest to Tribes.	Partially addressed in Section 302(6) — Mapping mentioned, but as a final nonproject environmental review document, not a comprehensive mapping project, and species/vessel layers not explicitly required.
TRIBAL-9	Consider creating high-level map layers where a Tribe could self-identify areas of interest and provide contact information for early communication regarding potential projects.	Partially addressed — Mapping tools are required for projects but no self-identified tribal interest layer is mandated.
TRIBAL-11	Require ongoing monitoring of facilities for impacts to treaty resources.	Unaddressed — Monitoring encouraged but not required.
TRIBAL-12	Consider options to provide state funding for Tribal staff for clean energy planning and project reviews.	Unaddressed — No funding mechanism created.
TRIBAL-14	Support sufficient federal funding for Tribal staff to meet federal requirements for project reviews.	Unaddressed — Federal coordination not addressed in the law.
TRIBAL-15	Consider how the state could assist Tribes to develop clean energy projects.	Unaddressed — Focus is on project permitting, not Tribal project development.
TRIBAL-16	Consider how to provide additional funding and staffing to state agencies and Tribal Historic Preservation Officers to support Tribal consultation and engagement work related to clean energy projects.	Partially addressed — Coordination supported but no funding mechanism included.
LOCAL-1	Consider how to assist counties and cities in updating local codes for emerging clean energy technology by providing template language that could be modified locally.	Partially addressed — Coordinated permitting helps, but no code templates or planning guidance are provided.
LOCAL-2	Expand training opportunities for local governments on clean energy processes and regulations, emerging technologies and on Tribal affairs and relations.	Partially addressed in Section 102(1)(g) — Developer training is included, but local governments may not be included in developer trainings.
LOCAL-4	Consider how to assist local government in accessing federal funding for clean energy.	Unaddressed — The law does not direct technical or grant support for federal funding applications.
LOCAL-5	Consider developing GMA guidance on land conversion for clean energy projects, including for rural and resource lands.	Partially addressed in Section 307 — Commerce's rural clean energy report may inform this, but guidance is not required.
LOCAL-6	Update the Rural Element Guidebook.	Unaddressed — No mention of or requirement to revise the Rural Element Guidebook.
EE-3	Consider options for workforce development opportunities, including understanding workforce availability and opportunities for training, apprenticeships and high-quality jobs.	Partially addressed — The bill supports good jobs in intent, but does not fund or require workforce programs.

EE-4	Consider how to include labor standards, workforce agreements and local hiring provisions for clean energy projects.	Unaddressed — Labor agreements or standards are not required or incentivized.
EE-5	State agencies develop rural clean energy economy roadmaps in collaboration with local governments.	Partially addressed in Section 307 — Commerce must consult rural stakeholders and publish a rural energy report, but not a roadmap per se.
EE-6	Consider incentives to develop projects at sites identified through least-conflict studies or through planned actions or programmatic EISs to avoid or minimize impacts.	Partially addressed in Section 302(7) — Preferred zones may be designated in the future, but incentives are not included.
EE-8	Consider statutory change to strengthen requirements that communities receive benefits when new energy resources are developed.	Unaddressed — CBAs are voluntary; there's no statutory obligation to provide community benefits.
EE-9	Consider how to incentivize use of already developed industrial areas, infrastructure and brownfields, including opportunities to overcome financing barriers.	Unaddressed — No incentives or redevelopment tools for brownfield reuse are provided.
EE-10	Provide assistance to local governments related to documentation required for utilizing brownfield or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites for clean energy projects.	Unaddressed — Technical assistance for brownfield reuse is not included.
EE-11	Provide funding and technical assistance for cleanup activities and reuse planning for siting on contaminated brownfields.	Unaddressed — No funds or grants are created for this purpose.
EE-12	Consider modifications or revisions to tax language to address different or concurrent uses of land, such as when land could be used for agricultural purposes and also for clean energy purposes.	Unaddressed — No tax provisions are updated or created.
EE-13	Consider developing guidelines for county assessors about how the income capitalization approach could be used to value clean energy facilities to avoid shifting tax burden due to depreciating assets.	Unaddressed — Tax assessment or valuation reform is not addressed.
EE-14	Develop information on tax incentive options for local government, developers and Tribes.	Unaddressed — No central incentive resource is created or mandated.
EE-15	Consider and explore financial tools for mitigating impacts of clean energy facilities.	Partially addressed — Section 206(8) allows mitigation through CBAs, but broader financial tools (e.g., impact fees) are not created.
PLAN-1	Conduct additional least-conflict mapping for specific geographic areas or energy types.	Partially addressed in Section 302 — Applies to solar only (WSU study); no requirement for other sectors or geographies.
PLAN-3	Provide funding for local governments, Tribes, agencies and communities for early planning.	Partially addressed — Tribes and stakeholders are consulted (302, 102), but no dedicated planning funds are provided.
PLAN-4	Develop guidance on how local governments can utilize least-conflict processes and upfront planning to provide information and reduce timelines for review and permitting of projects.	Unaddressed — No guidance or planning support tools provided to local governments.
ASSIST-1	State agencies should consider developing publicly accessible roadmaps for specific types of energy projects.	Unaddressed — No roadmaps or project-specific permitting timelines are developed.

ASSIST-2	Develop pre-application guidance for developers to consider when designing and siting clean energy projects.	Partially addressed in Sections 204–206 — Ecology's initial assessment informs applicants, but no standard guidance is issued.
ASSIST-3	Provide greater clarity about state agency, local government, and Tribal government roles and responsibilities, and processes for making siting, review and permitting decisions.	Partially addressed — Roles are described in permitting sections (204–209), but no formal role summary or handbook exists.
ASSIST-4	Conduct internal process improvement analysis for state agency permitting processes.	Unaddressed — No agency evaluations or Lean/efficiency reviews are required.
ASSIST-5	Agencies should consider developing lessons learned for the public about the review and permitting processes for projects.	Unaddressed — No post-project analysis or reporting is mandated.
ASSIST-6	Develop guidance on the type of information needed for environmental reviews and permitting.	Partially addressed — Section 302 defines what nonproject reviews must include, but project-level requirements are not clarified.
ASSIST-7	Build state-level expertise on clean energy facilities and impacts to provide technical assistance for reviews and permitting.	Partially addressed in Sections 102 & 204 — Interagency council provides limited coordination, but technical expert roles not established.
ASSIST-8	Conduct studies and develop guidance to provide updated data and information for use by state agencies, local governments, Tribes and developers in environmental assessments.	Partially addressed in Section 302(3) — Requires impact and mitigation analysis, but no new studies are directly funded.
ASSIST-9	Develop tools to support consistent policies, standards and guidance on mitigation of impacts.	Partially addressed in Section 302(3)(b) — Mitigation must be identified in nonproject EISs, but no tools or frameworks are developed.
COORD-1	Develop landscape-level plan for federal lands that includes impact analysis and mitigation with state and federal agencies to be used for permitting of projects.	Unaddressed — No coordination or planning effort for federal lands is required in the bill.
COORD-3	Consider the development of standard MOUs or cooperative agreements to establish consistent federal and state coordination for environmental reviews.	Partially addressed in Section 206(3)(b)(i) — Ecology is tasked with inviting federal participation, but no template or MOU structure is mandated.
STATE-2	Develop a dashboard to provide one stop for information on proposed clean energy projects.	Unaddressed — No dashboard, tracking system, or project database is mentioned in the law.
STATE-3	Establish "clean energy navigators" at a state agency to provide guidance and expertise on state agency processes.	Partially addressed in Sections 204–206 — Ecology serves as lead coordinator, but no dedicated navigator role is created.
STATE-4	State agencies should assess current project-level interagency coordination for potential improvements to siting, environmental review and permitting roles and actions.	Unaddressed — No mandate for reviewing or reforming current coordination systems.
STATE-5	State agencies assess needs for staff dedicated to working on clean energy projects, planning and providing technical assistance.	Partially addressed in Section 102(3) — The council may recommend resource needs, but no formal capacity assessments required of agencies.