ENVIRONMENTAL JUSTICE AND ECONOMIC/MARKET INFORMATION ON EMISSIONS-INTENSIVE, TRADE-EXPOSED (EITES) FACILITIES IN WASHINGTON

FINAL REPORT

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Executive Summary

This report was prepared by ERG to provide information and analysis to support the Washington State Department of Ecology's development of a report to the legislature on the allocation of no-cost allowances to Emissions Intensive, Trade Exposed (EITE) facilities under the Cap-and-Invest Program from 2035-2050. The report presents information and analysis of the environmental justice and economic impacts of EITE facilities on the communities where they are located as well as applicable statewide impacts, and some projections of the impacts of the policies in the Cap-and-Invest Program.

The primary findings of the report include:

Emissions: EITEs were responsible for 13.3 percent of total reported greenhouse gas emissions in Washington in 2023 and 14 percent of total emissions covered under the Cap-and-Invest Program. For criteria air pollutants, emissions from EITEs accounted for the highest proportion of total state emissions for sulfur dioxide (20.9 percent) and nitric oxide (8.6 percent). For hazardous air pollutants, EITEs accounted for 0.4 percent of total combustion related emissions in the state in 2022.

Air Quality: Available air quality monitoring data in counties where EITEs are located show no instances of air quality standards being exceeded for carbon monoxide and nitrogen dioxide in 2020-23. Several EITE host counties had 8-hour rolling ozone concentration averages greater than 70 ppb between 2020-23. Statewide, the number of monitoring sites with hazardous air pollutant-related cancer risk greater than or equal to one-in-a-million has trended down between 2008 and 2023. The number of annual ambient HAP averages greater than or equal to acceptable source impact levels values was zero in King and Pierce Counties in 2023.

Health benefits: The potential health benefits from a scenario involving a six percent reduction in emissions of criteria air pollutants from EITEs in 2034 include substantial statewide reductions in total asthma symptoms (1,050 fewer cases), minor restricted activity days (543 fewer days) and school loss days (493 days). The six percent reduction in emissions of criteria air pollutants is based on the assumption that these emissions will be reduced at the same rate as reductions in no cost allowances to EITEs in 2034. The associated value of health benefits is estimated to be between $34.4 to $50.2 million. King County would have the greatest health benefits from the reduction in criteria air pollutant emissions, based on the high population in the county.

Social Cost of Carbon: The value of reduced impacts from a scenario involving a six percent reduction in GHG emissions from EITEs, in line with reductions in no cost allowances to EITEs in 2034, on society (including agricultural productivity, changes in energy costs, human health and damages from increase flooding) is estimated to be $2.6 billion.

Economic Impacts: EITEs currently contribute over $73 billion in output, over 85 thousand jobs and over $5 billion in tax revenues to the state economy, including direct, indirect and induced effects.[1] The estimated cumulative impacts of current no-cost allowances allocation policy on EITEs through 2034 are reductions of between $255 and $273 million in output, 248 and 646 jobs and $17 and $25 million in tax revenues, depending on assumptions about the ability of EITEs to passthrough estimated compliance costs.

[1] Direct impacts refer to primary effects on production or costs. Induced impacts are related to impacts on the supply chain. Induced impacts are related to employee spending.

Demographics and Overburdened Communities: Twenty EITEs are located within overburdened communities in Washington State[i] and 10 EITEs are located within overburdened communities highly impacted by air pollution, as defined by the Department of Ecology.[ii] Seven EITEs are located in or near Tribal Lands.[iii]

Case Studies: In counties with higher numbers of EITE facilities (e.g., Cowlitz, King and Skagit), EITE facilities contribute a substantial proportion of total county reported GHG emissions excluding non-point sources (between 46-79 percent). Overall, EITEs in these three counties do not produce the majority of CAP emissions except in the case of Cowlitz County, where EITEs produced over 80 percent of the County's SO2. EITEs contribute only a small portion of county HAP emissions (ranging from about 10 percent in Cowlitz County to less than one percent in King County).

Industry Profiles: The contribution to Washington State's GDP in 2023 from the sectors that the EITEs belong to ranged from 0.15 to 3.69 percent, with metals manufacturing having the lowest contribution and aerospace manufacturing having the highest contribution. Washington State's 2024 exports from the sectors that the EITEs belong to ranged from $0.07 billion to $17.5 billion, with glass manufacturing having the lowest export value and aerospace manufacturing having the largest export value. Most competitors of EITEs domestically and internationally have either a lower average carbon price than Washington or no carbon pricing policy. Competitors with carbon pricing policies typically have carbon leakage mitigation policies for their EITEs.

Introduction

The Climate Commitment Act (CCA) requires the Washington State Department of Ecology (Ecology) to prepare a report to the Washington State Legislature that offers information and recommendations on an approach for allocating no-cost allowances to emissions-intensive, trade-exposed industries (EITEs) for 2035-2050 under the Cap-and-Invest Program. The Ecology report to the legislature will include information and analysis of alternative approaches for allocating allowances to EITEs, including a preliminary environmental justice evaluation.

This report is intended to inform the development of Ecology's report to the Legislature on the allocation of no-cost allowances to EITEs under the Cap-and-Invest Program through to 2050. We provide information and analysis of environmental justice and economic impacts of EITE facilities on the communities where they are located as well as applicable statewide impacts, and how those impacts may change over time as a result of the policies in the Cap-and-Invest Program.

The objectives of this report include:

- Compiling data and identifying the relative contribution of EITE facilities on air quality, health, and environmental impacts on communities, including comparisons with other emission sources/sectors;
- Compiling data and identifying economic impacts of EITE facilities;
- Identifying the market structure and competitive dynamics for selected EITEs in Washington State; and
- Providing data and/or analysis on how those impacts may change over time as a result of the policies in the Cap-and-Invest Program.

As of January 2025, there were 39 active EITE facilities in the Cap-and-Invest Program who received vintage 2025 no-cost allowances as issued by Ecology in October 2024. These 39 facilities are the primary focus of this report. In addition, we present some analysis of emissions for other sources covered under the CCA, and industry-level market analysis.

The analysis presented in this report is based on currently available information on emissions, air quality, economic conditions, demographic information, and policies. Factors that may influence EITE emissions in the future include the potential linkage between Washington State's Cap-and-Invest program and the linked California-Quebec market[iv], which is not considered here. In addition, changes in state and federal air pollution regulations will also impact emissions pathways for relevant facilities.

Emissions

The CCA caps and reduces greenhouse gas emissions from Washington's largest emitting sources and industries. EITEs are given no-cost allowances each year, based on their baseline emissions. EITEs can have either a carbon-intensity baseline based on average emissions per unit of production from 2015 to 2019, or a mass-based baseline based on their average emissions from 2015 to 2019. EITEs with carbon-intensity baselines receive more allowances if their output increases, and fewer allowances if output decreases. EITEs are eligible to receive allowances equivalent to 100 percent of their baseline emissions for 2023-26, 97 percent of baseline emissions for 2027-2030 and 94 percent of baseline emissions for 2031-34.

In addition to greenhouse gases, EITEs also emit criteria air pollutants (CAPs) and hazardous air pollutants (HAPs). Table 1 provides an overview of these different air pollutant categories. Below, we present available data on GHG, CAP and HAP emissions for EITEs, other covered sources and statewide totals.

Table 1. Pollutant categories

Air pollutant category	Category Definition	Gases
Greenhouse Gases (GHG)	Gases that trap heat in the atmosphere	• Carbon dioxide (CO2) • Methane (CH4) • Nitrous oxide (N2O) • Fluorinated gases

Criteria Air Pollutants (CAPs)	Six commonly found air pollutants with National Ambient Air Quality Standards (NAAQS)	• Carbon Monoxide (CO)
		• Lead (Lb)
		• Sulfur Dioxide (SO2)
		• Ozone (O3): Precursors to O3 include volatile organic compounds (VOCs)
		• Particulate Matter
		  • Particulates 2.5 micrometers in diameter (PM2.5)
		  • 10 micrometers in diameter (PM10)
		  • Ammonia (NH3) can mix with other gases such as NOX and SO2 to form particulate matter
		• Nitrogen oxides (NOX): Also a precursor to O3

Hazardous Air Pollutants (HAPs)	Pollutants that are known or suspected to cause cancer or other serious health effects.	Washington state regulates over 430 toxic air pollutants from industrial and commercial sources. Examples include benzene, carbon tetrachloride, and formaldehyde.[v]

Greenhouse Gas Emissions

Washington State's Greenhouse Gas Reporting Program requires businesses within Washington State that emit over 10,000 metric tons of carbon dioxide-equivalent (MTCO2e) per year to report their emissions.[vi] In 2023, there were 270 reporters that reported a total of 90.8 million MTCO2e.[vii] The program requires reporting on carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), fluorinated gases[2] and biogenic carbon emissions. Biogenic emissions are emissions from organic sources. The Cap-and-Invest Program requires most businesses that emit 25,000 metric tons of CO2 equivalent a year to obtain allowances equal to their covered emissions. The Cap-and-Invest Program exempts certain types of greenhouse gas emissions. This includes fuels used for agricultural purposes, aviation fuels, marine fuels combusted outside of Washington, and the combustion of biomass or biofuels, among others. Therefore, total reported emissions are higher than total covered emissions.

In 2023, there were 39 EITEs operating in 15 counties. These facilities were responsible for 13.3 percent of the total reported greenhouse gases and 14 percent of the covered emissions. The CCA covers 134 entities (including EITEs), which are responsible for 89 percent of the state's total reported greenhouse

[2] Fluorinated gases include hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

gases. Figure 1 presents a map of Washington State EITEs and other covered entities, excluding those associated with mobile sources and imported electricity. Each dot represents an EITE facility, with a dot that is proportional to metric tons of GHG emissions it produced in 2023. Many of the largest emitters are located near the northern Puget Sound. (See Appendix A for reported GHG emissions by EITE facilities.)

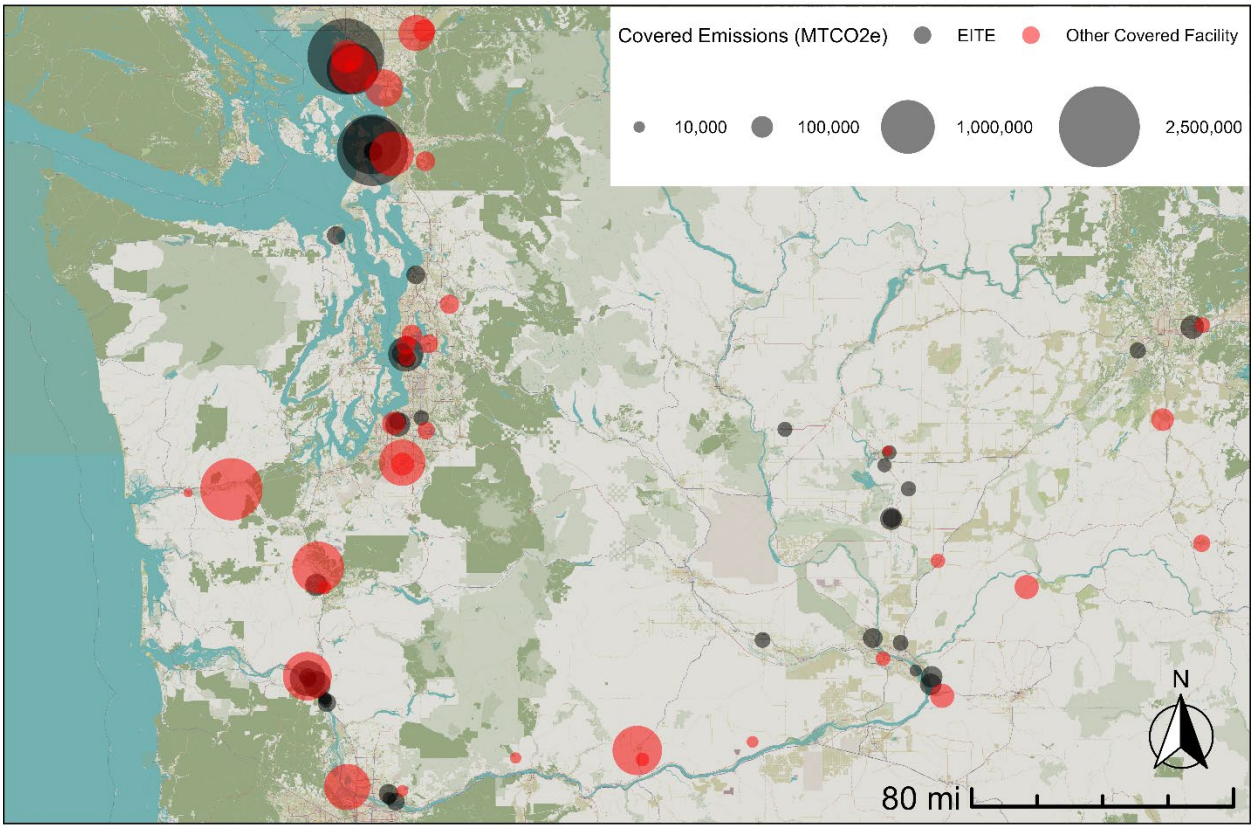

Figure 1. Map of EITE and other covered facilities by 2023 GHG emissions[3]

Criteria Air Pollutants

Facilities with an air operating permit are report their air pollutants and toxics emissions through the Washington Emissions Inventory Reporting System (WEIRS) or to a local clean air agency .[viii] The data is compiled into an air emissions inventory, which lists quantities of emissions (criteria, precursor, and hazardous air pollutants) from various sources.

The Air Emissions Reporting Rule (AERR) at 40 CFR Part 51, Subpart A requires states to inventory emissions sources and report emissions data to the U.S. EPA. The AERR requires states to report emissions of SO2, VOC, NOX, CO, lead, primary PM2.5, primary PM10, and NH3 triennially for all sources and annually for large point sources that meet the thresholds defined in Table 1 to Appendix A of 40 CFR Part 51, Subpart A. States may voluntarily report hazardous air pollutants, and they may report facilities below the AERR thresholds as point sources if the data are available. Local air agencies may submit

[3] Map does not include sources without geographic coordinates.

inventory data to the U.S. EPA. The U.S. EPA uses this data in developing National Emissions Inventories (NEI) and special modeling inventories such as the 2022 Emissions Modeling Platform.

Below, we present reported CAP emissions for EITEs, covered sources as well as statewide, for the following pollutants:

- Carbon monoxide (CO)
- Ammonia (NH3)
- Nitrous oxides (NOX)
- Particulate matter 2.5 (PM2.5)
- Particulate matter 10 (PM10)
- Sulfur dioxide (SO2)
- Volatile organic compounds (VOC)

Table 2 summarizes the statewide CAP emissions by pollutant. EITE emissions contribute between 0.4 percent for PM10 to 20.9 percent for SO2 of state total emissions. (See Appendix B for CAP emissions by EITE facilities.)

Table 2. 2022 Statewide CAP emissions[4]

Pollutant	EITE Total (tons)	CCA Covered Total (tons)	State Total (tons)	EITE % of State	CCA Covered % of State
CO	7,108	588,959	1,446,622	0.5%	40.7%
NH3	268	5,197	36,022	0.7%	14.4%
NOX	12,483	127,542	145,209	8.6%	87.8%
PM10-Primary[5]	1,468	12,278	352,868	0.4%	3.5%
PM2.5-Primary	1,191	8,680	145,444	0.8%	6.0%
SO2	2,657	5,953	12,716	20.9%	46.8%
VOC	4,494	56,088	349,882	1.3%	16.0%

Table 3 provides emissions by county and the EITE percentage of the county total for select CAP emissions. EITE proportion of county total ranges widely. While there are several instances of EITEs contributing less than one percent of a county's total CAP emissions, there are some instances where EITEs are a major contributor (e.g., Jefferson and Cowlitz counties for SO2).

Table 3. 2022 County level CAP emissions for select pollutants

	CO		NOX		SO2	
County[6]	County Total (tons)	EITE % of Total	County Total (tons)	EITE % of Total	County Total (tons)	EITE % of Total
Adams	4,939	0.9%	2,156	3.2%	--	--
Benton	16,926	0.0%	4,097	1.0%	28	0.0%
Clark	54,545	0.3%	5,813	0.2%	228	1.1%

[4] CAP emissions data were compiled from the Washington State Air Emissions Inventory and EPA's National Emissions Inventory. Facility level data from Washington emissions inventory was used where available, and was supplemented with EPA data, including comprehensive inventory data from the EPA for 2022.

[5] Primary is filterable plus condensable.

[6] Only counties with EITE facilities active in 2022 are included in this table.

	CO		NOX		SO2	
County[6]	County Total (tons)	EITE % of Total	County Total (tons)	EITE % of Total	County Total (tons)	EITE % of Total
Cowlitz	20,846	10.8%	6,669	47.2%	746	87.5%
Franklin	7,913	0.2%	2,578	0.9%	--	--
Grant	12,864	0.8%	2,750	3.0%	39	0.4%
Jefferson	6,546	9.6%	1,722	26.1%	111	74.8%
King	291,145	0.4%	29,628	3.6%	1,527	3.0%
Lewis	65,623	0.5%	7,155	11.2%	1,639	3.3%
Pierce	77,659	0.1%	11,358	1.8%	632	0.6%
Skagit	68,457	1.6%	7,662	41.9%	958	30.7%
Snohomish	108,014	0.0%	9,984	0.7%	409	0.0%
Spokane	50,280	0.2%	7,898	1.5%	127	0.6%
Walla Walla	7,526	8.7%	2,263	30.9%	652	96.4%
Whatcom	112,477	0.5%	6,859	36.6%	1,761	50.6%

Hazardous Air Pollutants

Table 4 summarizes statewide combustion related HAP emissions for 2022. Overall, EITE and other covered facilities contribute less than one percent of the state's total HAP emissions. (See Appendix B for combustion related HAP emissions by EITE facility.)

Table 4. 2022 Statewide HAP emissions[7]

	EITE Total (tons)	CCA Covered Total (tons)	State Total (tons)	EITE % of State	CCA Covered % of State
Total HAP emissions	84.4	165.1	23,284.8	0.4%	0.7%

Table 5 presents 2022 HAP combustion by county.

Table 5. 2022 County level HAP emissions

County[8]	County Total (tons)	EITE Total (tons)	EITE % of County Total
Adams	107	--	--
Benton	467	0.004	<0.005%
Clark	1,382	3.29	0.24%
Cowlitz	529	43.84	8.29%
Franklin	241	--	--
Grant	380	--	--

[7] HAP emissions data were compiled from the EPA Special Inventory for the 2022 Emissions Modeling Platform.

[8] Only counties with EITE facility data for 2022 are included in this table.

County[8]	County Total (tons)	EITE Total (tons)	EITE % of County Total
Jefferson	246	20.42	8.30%
King	4,709	0.80	0.02%
Lewis	444	0.00001	<0.005%
Pierce	2,230	0.59	0.03%
Skagit	564	6.81	1.21%
Snohomish	2,657	1.29	0.05%
Spokane	1,502	0.22	0.01%
Walla Walla	218	1.92	0.88%
Whatcom	718	5.23	0.73%

Air Quality Monitoring

Ambient air quality data for monitoring sites across Washington were obtained from EPA's Air Quality System (AQS)[ix] for criteria air pollutants (CAPs), and from EPA's Ambient Monitoring Archive for Hazardous Air Pollutants (AMA for HAPs).[x] Figure 2, Figure 3, Figure 4, and Figure 5 present the locations of monitoring sites in relation to the locations of EITEs and the monitoring sites for CO, HAP, NO2 and O3, respectively.

It is important to note that each of the monitoring sites plotted in the following figures do not measure the same pollutants and were not measured continuously over the study period. Many sites sampled selected hazardous air pollutants for short-term duration studies (e.g. 1-to-3 years). The figures also include historic sites that may no longer be operational. Information on current monitoring sites for Washington can be found at: https://enviwa.ecology.wa.gov.

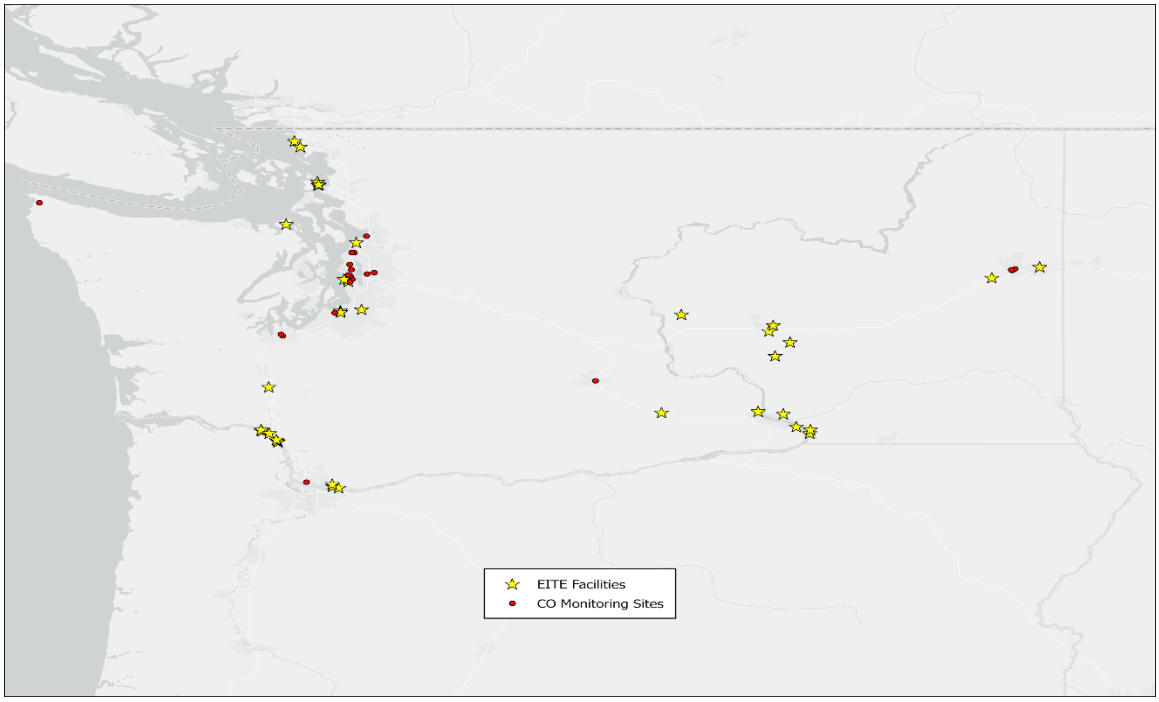

Figure 2. CO Ambient Air Quality Monitoring Sites and EITE Locations

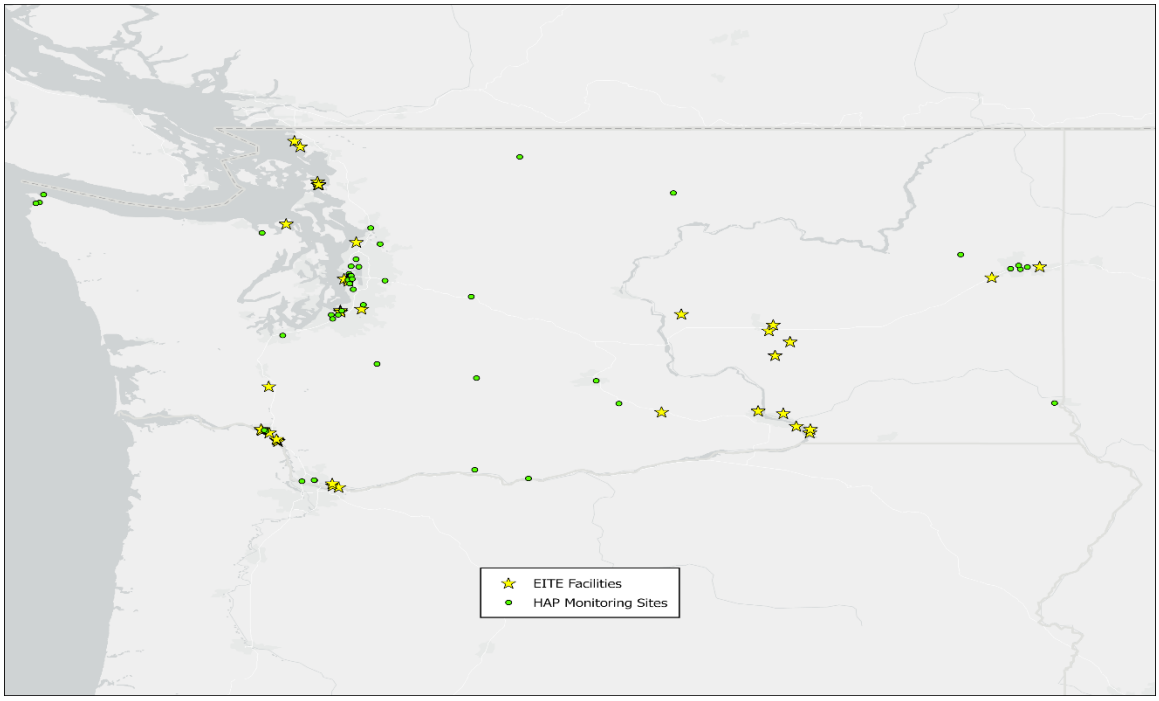

Figure 3. HAP Ambient Air Quality Monitoring Sites and EITE Locations

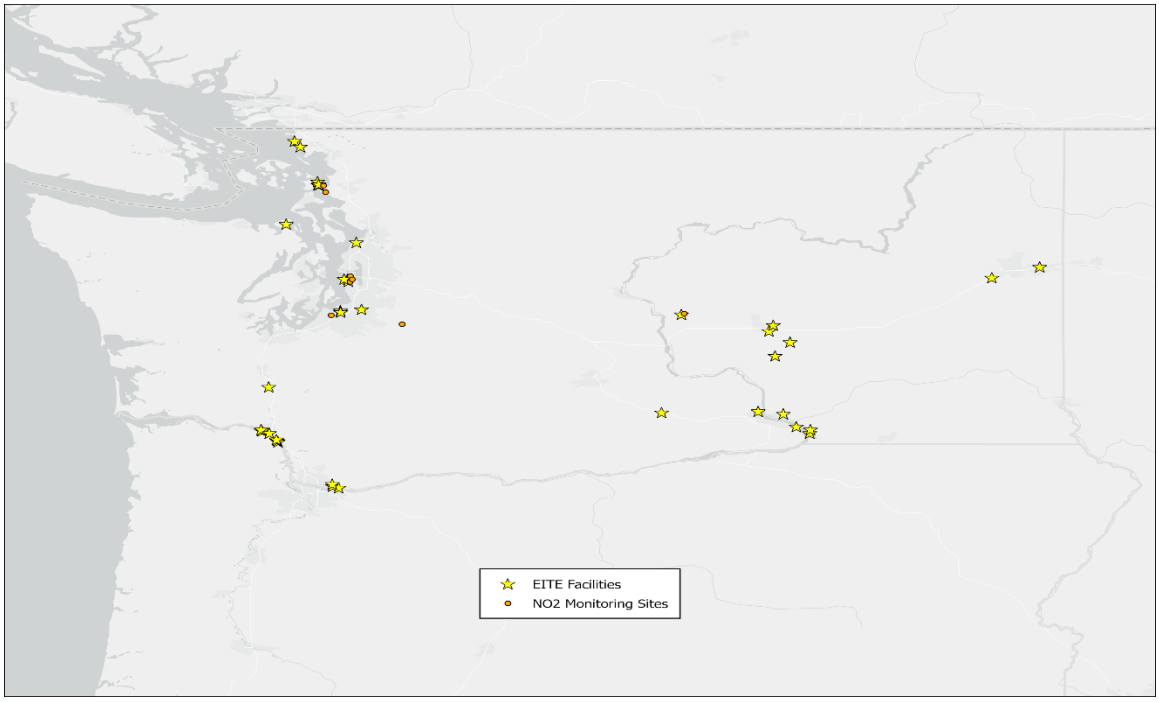

Figure 4. NO2 Ambient Air Quality Monitoring Sites and EITE Locations

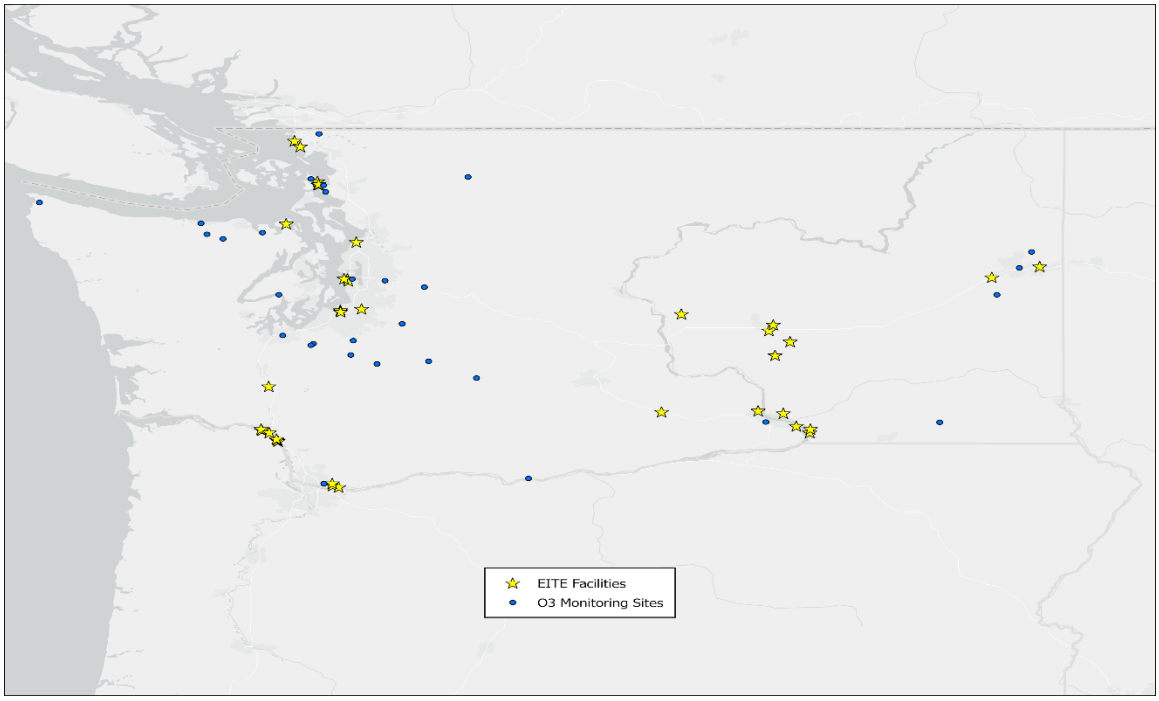

Figure 5. O3 Ambient Air Quality Monitoring Sites and EITE Locations

Criteria Air Pollutants

Table 6 presents a summary of ambient air quality monitoring data for criteria air pollutants (CAPs) in relation to comparison values based on National Ambient Air Quality Standards (NAAQS) concentrations and 3-year design values, relevant to EITE locations for 2020 through 2023. The CAP analysis for CO and NO2 all ambient air concentrations were below the comparison threshold. Three counties reported 3-year design values for CO and NO2. Clallum and King counties reported design values for CO. The county design values were compared to the maximum annual ambient concentrations. Both counties reported at least one ambient hourly concentration above their CO design values in 2022. Pierce and King counties reported NO2 Design Values. A similar comparison with maximum annual ambient NO2 concentrations showed both counties reported at least one ambient hourly concentration above their respective design value. Whatcom County recorded three hourly SO2 concentrations in 2020 that were higher than the comparison value. This monitoring site is close to the Intalco aluminum smelter, which emits large quantities of SO2. Benton, Clark, King, Skagit and Spokane had instances where the 8-hour rolling average O3 concentrations were higher than the comparison values between 2020 to 2023, all but Clark and Skagit had design values.

Table 6. Criteria Air Pollutant Air Quality Monitoring Data Summary,

County	Comparison Value[9]	Monitoring Years	Monitoring Site *(AQS Site ID)* (includes regulatory and non-regulatory monitors)	# Pollutant Concentrations ≥ Comparison value[10]	3-Year Design Value (ppb)[11,12]	# County-level Monitoring Records[13]
Clallam	CO (1 HR)≥ 35 ppm	2020	Cheeka Peak (530090013)	0	1,900	6113
King	CO (1 HR)≥ 35 ppm	2020	Seattle-10th & Weller (530330030)	0	1,500	11803
King	CO (1 HR)≥ 35 ppm	2020	Seattle - Beacon Hill (530330080)	0	1,800	11803
Clallam	CO (1 HR)≥ 35 ppm	2021	Cheeka Peak (530090013)	0	1,900	7217

[9] Comparison values were based on NAAQS standards but definitions for an "exceedance" were not applied. Instead the number of times the concentration average was equal to or greater than the comparison value was noted and summed to annual totals.

[10] With the exception of ozone, the sampling durations for all pollutants was 1 hour. Ozone concentrations were averaged to 8-hour rolling values.

[11] For CO, SO2 and NO2, the design value is the highest annual average 1-hour concentration during the most recent two years. Design values are computed using FRM or equivalent. SLT agencies flagged concentrations as having been affected by an exceptional event with approval of EPAR offices are not included in the calculations. Source: U.S. Environmental Protection Agency, 2025, *Air Quality Design Values*, https://www.epa.gov/air-trends/air-quality-design-values

[12] For O3, the design value is computed as a three-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration.

[13] The datasets used for analysis were at or above 75 percent completeness for CO, NO2 and SO2 based on annual total records. For O3 8-hr rolling averages, 75 percent completeness was based on daily total records.

County	Comparison Value[9]	Monitoring Years	Monitoring Site *(AQS Site ID)* (includes regulatory and non-regulatory monitors)	# Pollutant Concentrations ≥ Comparison value[10]	3-Year Design Value (ppb)[11,12]	# County-level Monitoring Records[13]
King	CO (1 HR)≥ 35 ppm	2021	Seattle-10th & Weller (530330030)	0	1,500	16612
King	CO (1 HR)≥ 35 ppm	2021	Seattle - Beacon Hill (530330080)	0	1,800	16612
Clallam	CO (1 HR)≥ 35 ppm	2022	Cheeka Peak (530090013)	0	800	7042
King	CO (1 HR)≥ 35 ppm	2022	Seattle-10th & Weller (530330030)	0	1,500	15864
King	CO (1 HR)≥ 35 ppm	2022	Seattle - Beacon Hill (530330080)	0	1,600	15864
Callum	CO (1 HR)≥ 35 ppm	2023	Cheeka Peak (530090013)	0	800	7307
King	CO (1 HR)≥ 35 ppm	2023	Seattle-10th & Weller (530330030)	0	1,600	15492
King	CO (1 HR)≥ 35 ppm	2023	Seattle - Beacon Hill (530330080)	0	1,500	15492
King	NO2>100 ppb	2020	Seattle-10th & Weller (530330030)	0	59	17568
King	NO2>100 ppb	2020	Seattle - Beacon Hill (530330080)	0	42	17568
Pierce	NO2>100 ppb	2020	Tacoma-S 36th St (530530024)	0	42	8784
King	NO2>100 ppb	2021	Seattle-10th & Weller (530330030)	0	54	17519
King	NO2>100 ppb	2021	Seattle - Beacon Hill (530330080)	0	41	17519
Pierce	NO2>100 ppb	2021	Tacoma-S 36th St (530530024)	0	39	8758
King	NO2>100 ppb	2022	Seattle-10th & Weller (530330030)	0	53	17520
King	NO2>100 ppb	2022	Seattle - Beacon Hill (530330080)	0	41	17520
Pierce	NO2>100 ppb	2022	Tacoma-S 36th St (530530024)	0	39	8757
King	NO2>100 ppb	2023	Seattle-10th & Weller (530330030)	0	51	17514
Pierce	NO2>100 ppb	2023	Seattle - Beacon Hill (530330080)	0	42	17514

County	Comparison Value[9]	Monitoring Years	Monitoring Site *(AQS Site ID)* (includes regulatory and non-regulatory monitors)	# Pollutant Concentrations ≥ Comparison value[10]	3-Year Design Value (ppb)[11,12]	# County-level Monitoring Records[13]
Pierce	NO2>100 ppb	2023	Tacoma-S 36th St (530530024)	0	38	8605
Whatcom	SO2 (1 HR) ≥ 75 ppb	2020	Ferndale-Kickerville St (530730013)	2	68	15,872
Whatcom	SO2 (1 HR) ≥ 75 ppb	2020	Ferndale-Mountain View Rd (530730017)	1	89	15,872
Benton	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	Kennewick_S Clodfelter Rd (530050003)	13	63	3,918
Clark	O3 (8-HR Rolling Avg) ≥ 70 ppb	2023	Vancouver-Blairmont Dr (530110011)	7	NA	3,525
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2020	ENUMCLAW - Mud Mtn (Army Corp of Engineers) (530330023)	3	63	18,069
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	North Bend - North Bend Way (530330017)	3	53	15,734
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	ENUMCLAW - Mud Mtn (Army Corp of Engineers) (530330023)	24	64	15,734
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	Seattle - Beacon Hill (530330080)	3	50	15,734
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2022	Issaquah - Lake Sammamish (530330010)	4	NA	19,372
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2022	ENUMCLAW - Mud Mtn (Army Corp of Engineers) (530330023)	29	70	19,372
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2023	North Bend - North Bend Way (530330017)	7	62	19,289
King	O3 (8-HR Rolling Avg) ≥ 70 ppb	2023	ENUMCLAW - Mud Mtn (Army Corp of Engineers) (530330023)	11	73	19,289

County	Comparison Value[9]	Monitoring Years	Monitoring Site *(AQS Site ID)* (includes regulatory and non-regulatory monitors)	# Pollutant Concentrations ≥ Comparison value[10]	3-Year Design Value (ppb)[11,12]	# County-level Monitoring Records[13]
Skagit	O3 (8-HR Rolling Avg) ≥ 70 ppb	2022	Anacortes-202 Ave (530570011)	4[14]	NA	5,510
Spokane	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	Cheney -Turnbull (530630001)	5	58	7,932
Spokane	O3 (8-HR Rolling Avg) ≥ 70 ppb	2021	Spokane-Greenbluff (530630046)	16	60	7,932

Note: NA = Not available

[14] There were four 8-hour rolling averages calculated on 4/1/2022 at this site. The averages were based on eight hourly ozone concentrations of 0.071 ppmv on 4/1/2022 from 3am-10am. These data were not flagged in AQS for any quality issues.

Hazardous Air Pollutants

Summaries of air quality monitoring data for hazardous air pollutants are present in the following tables. Importantly, there are only a small number of air toxics monitors in WA and only a few of the existing 188 HAPs have ever been monitored. Additionally, it is important to note that the monitoring sites have not measured continuously over the study period (2008-2023), with many sites sampling select HAPs for short-term (1-to-3 years) duration studies. Table 7 shows the number of sites where monitoring data indicate a greater than 1 in a million cancer risk for the specified pollutant. The cancer risk summary shows the number of monitoring sites with annual averages of HAP concentrations greater or equal to 1 in a million cancer risk from 2008 to 2023. Of the 10 counties with high annual concentrations of cancer-causing HAPs in 2008, only 3 counties remain in 2023 (King, Pierce and Yakima). King, Pierce and Yakima all reported Cadmium (PM2.5) concentrations above the cancer risk in 2023. King County has had the highest number of cancer-causing HAPs in WA state but only 3 HAPS (Cadmium (PM2.5), Naphthalene and Arsenic (PM10 LC) above the cancer risk threshold.

Table 7. Cancer Risk in 1 Million for Monitoring Years 2008-2023[15]

Rank	County	AQS Parameter	Number of Years with ≥ 1-in-a-million cancer risk (based on valid annual averages)	Number of Sites with ≥ 1-in-a-million cancer risk (based on valid annual averages)															Number of Pollutant Monitors with ≥ 1-in-a-million cancer risk (based on valid annual averages)
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
1	King	1,3-Butadiene	13	1	2	1	1	1	1	1	-	1	4	1	1	-	1	1	-	166
		Acetaldehyde	14	1	2	1	1	1	1	1	1	1	4	1	1	-	1	1	-	
		Arsenic (PM2.5)	13	2	2	2	2	1	2	2	3	3	3	2	1	-	-	1	-	
		Arsenic (Pm10)	5	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Benzene	13	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Cadmium (PM2.5)	14	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	

[15] U.S. Environmental Protection Agency, 2024, *Ambient Monitoring Archive for HAPs.* https://www.epa.gov/amtic/amtic-ambient-monitoring-archive-haps

Rank	County	AQS Parameter	Number of Years with ≥ 1-in-a-million cancer risk (based on valid annual averages)	Number of Sites with ≥ 1-in-a-million cancer risk (based on valid annual averages)															Number of Pollutant Monitors with ≥ 1-in-a-million cancer risk (based on valid annual averages)
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
		Carbon tetrachloride	13	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Ethylbenzene	12	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Formaldehyde	14	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Naphthalene (total tsp & vapor)	15	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Nickel (PM2.5)	12	2	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	
		Nickel (Pm10)	5	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
		Ethylene dichloride	10	-	-	-	1	1	1	1	-	1	2	1	1	-	1	1	-	
		Arsenic Pm10 Lc	5	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	1	
		Cadmium Pm10 Lc	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	
		Nickel Pm10 Lc	3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	
		Ethylene oxide	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	
		Arsenic (PM2.5)	11	2	3	3	2	1	2	2	2	1	1	1	-	-	-	-	-	
		Cadmium (PM2.5)	14	1	2	2	2	-	1	1	1	1	1	1	2	-	2	1	1	
		Nickel (PM2.5)	5	1	2	1	1	-	-	-	-	-	-	-	1	-	-	-	-	
2	Pierce	1,3-Butadiene	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40
		2-Chloro-1,3-butadiene	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Acetaldehyde	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Acrylonitrile	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Rank	County	AQS Parameter	Number of Years with ≥ 1-in-a-million cancer risk (based on valid annual averages)	Number of Sites with ≥ 1-in-a-million cancer risk (based on valid annual averages)																Number of Pollutant Monitors with ≥ 1-in-a-million cancer risk (based on valid annual averages)
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
		Benzene	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Carbon tetrachloride	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Ethylbenzene	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Formaldehyde	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Naphthalene (total tsp & vapor)	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Trichloroethylene	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
3	Yakima	Arsenic (PM2.5)	8	-	-	-	1	-	1	1	1	1	1	1	-	-	-	-	-	21
		Cadmium (PM2.5)	13	-	-	-	1	-	1	1	1	1	1	1	1	1	1	1	1	
4	Clark	Arsenic (PM2.5)	5	-	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	10
		Cadmium (PM2.5)	5	-	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	
	Snohomish	Arsenic (PM2.5)	5	-	-	1	1	-	1	1	-	-	-	-	-	-	-	-	-	10
		Cadmium (PM2.5)	5	-	-	1	1	-	1	1	-	-	-	-	-	-	-	-	-	
5	Clallam	Arsenic (PM2.5)	5	3	3	3	-	-	1	-	1	-	-	-	-	-	-	-	-	8
		Nickel (PM2.5)	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Klickitat	Arsenic (PM2.5)	4	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	4
6	Thurston	1,3-Butadiene	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4
		Benzene	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	

Rank	County	AQS Parameter	Number of Years with ≥ 1-in-a-million cancer risk (based on valid annual averages)	Number of Sites with ≥ 1-in-a-million cancer risk (based on valid annual averages)																Number of Pollutant Monitors with ≥ 1-in-a-million cancer risk (based on valid annual averages)
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
		Carbon tetrachloride	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	
		Ethylene dichloride	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	
	Kittitas	Arsenic (PM2.5)	3	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3
7	Spokane	Arsenic (PM2.5)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
		Cadmium (PM2.5)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Nickel (PM2.5)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Annual number of Pollutant Monitors ≥ 1-in-a-million cancer risk (based on valid annual averages)		*28*	*59*	*30*	*27*	*20*	*24*	*25*	*17*	*19*	*34*	*18*	*24*	*1*	*14*	*13*	*5*	

Note: Cancer Risk was calculated with the equation: Cancer Risk = (Annual Average Concentration (ug/m3 Local Conditions) * Cancer URE * 1,000,000) . Cancer URE Ratios ≥ 1 were defined as areas with a Cancer Risk ≥ 1-in-a-million (based on valid annual averages) over a lifetime exposure (.

Note: The source for EPA OAOPS Cancer risk assessment tables is U.S. Environmental Protection Agency, 2024, *Dose Response Assessment Tables*, https://www.epa.gov/fera/dose-response-assessment-tables

Note: Annual average concentrations had percentage completeness at or above 75 percent.

Table 8 shows the number of sites where monitoring data indicate the noncancer hazard quotient is greater than or equal to 1 for the specific pollutant. The noncancer hazard quotient summary shows the number of monitoring sites with annual average HAP concentrations greater or equal to 1, indicating an adverse health effect for long-term exposure. Three counties reported HAP concentrations above or equal the noncancer risk hazard quotient. Clallam and Pierce had Chloride PM2.5 concentrations and King county reported "Acrolein – verified" for multiple years including 2023.

Table 8. Noncancer Hazard Quotient ≥ 1 for Monitoring Years 2008-2023

County	AQS Parameter	Number of Years of Risk	Number of Years Risk by County	Number of Sites with Noncancer Hazard Quotient ≥ 1 (based on valid annual averages)															
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020[16]	2021	2022	2023
Clallam	Chlorine Pm2.5 Lc	15	16	1	1	1	1	1	1	1	1	1	1	NA	1	1	2	1	1
King	Acrolein - verified	13	19	NA	1	1	1	1	NA	2	2	2	2	1	1	NA	2	2	1
Pierce	Chlorine Pm2.5 Lc	8	8	1	1	1	1	NA	NA	1	1	NA	NA	NA	1	NA	NA	NA	1

Note: Noncancer Hazard Quotients were calculated using the equation: Noncancer Hazard Quotient = (Annual Average Concentration (µg/m3 Local Conditions)/Non-Cancer RFC/1000)

Note: The source for EPA OAOPS Cancer risk assessment tables is U.S. Environmental Protection Agency, 2024, *Dose Response Assessment Tables*, https://www.epa.gov/fera/dose-response-assessment-tables

Note: Annual average concentrations had percentage completeness at or above 75 percent.

Table 9 shows the number of sites where annual average ambient monitoring data are equal or greater to acceptable source impact levels (ASIL) for specified HAPs.

Table 9. Number of Annual Ambient HAP Averages Equal or Above ASIL values (µg/m3) to Annual Ambient Averages.

County	AQS Parameter	ASIL (µg/m3)	Number of Sites with Annual Averages ASIL (µg/m3)															
			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
King	1,3-Butadiene	0.033	1	2	1	1	1	1	1	-	1	4	1	1	-	1	1	-
	Acetaldehyde	0.37	1	2	1	1	1	1	1	1	1	4	1	1	-	1	1	-
	Acrylonitrile	0.0034	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-

[16] Covid stay-at-home orders hampered field-sample collection during 2020. The one monitor reporting was a PM2.5 monitor that did not require staff to interact.

	Benzene	0.13	1	2	1	1	1	1	1	-	1	4	1	1	-	1	1	-
	Carbon tetrachloride	0.17	1	2	1	1	1	1	1	-	1	2	1	1	-	1	1	-
	Chloroform	0.043	1	2	1	1	1	1	1	-	1	2	1	1	-	1	1	-
	Formaldehyde	0.17	1	2	1	1	1	1	1	1	1	4	1	1	-	1	1	-
	Tetrachloroethylene	0.16	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
	Ethylene dichloride	0.038	-	-	-	-	1	1	1	-	1	2	1	1	-	1	1	-
	Ethylbenzene	0.4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
	Ethylene oxide	0.0002	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-
Pierce	1,3-Butadiene	0.033	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acetaldehyde	0.37	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acrylonitrile	0.0034	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Benzene	0.13	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Carbon tetrachloride	0.17	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chloroform	0.043	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ethylbenzene	0.4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Formaldehyde	0.17	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tetrachloroethylene	0.16	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thurston	1,3-Butadiene	0.033	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
	Benzene	0.13	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
	Carbon tetrachloride	0.17	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
	Chloroform	0.043	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
	Ethylene dichloride	0.038	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Note: Acceptable Source Impact Levels (ASIL) Options (2019) table can be found at: Washington State Department of Ecology, 2019, *WAC 173-460-150 Draft Table of ASIL, SQER and de minimis emission values*, https://ecology.wa.gov/getattachment/651e0b34-2a86-4e3e-8f8f-011653306e0c/2019ASILSQERDemin03-04-19.pdf

Note: Valid annual average concentrations had a minimum percentage completeness at or above 75 percent for the calendar year.

Health Impacts

Background

Purpose

The following health section documents an illustrative scenario used to estimate the potential health benefits associated with EITE emission reductions in Washington. The analysis outlines the potential health benefits associated with a six percent reduction in criteria air pollutants (CAPs) from the 2023 baseline by 2034. This assumes the reduction in CAPs aligns with the GHG emission reductions.[17]

Adverse health effects from pollutants

A reduction of EITE emissions can mitigate precursor pollutants and CAPs that exacerbate respiratory symptoms, thereby improving health outcomes.[18] These outcomes include mitigating asthma onset and aggravation, cardiovascular disease, reduced lung function, and premature death. Adverse health impacts are especially harmful to vulnerable populations including older adults, children, and pregnant individuals.[xi]

Washington has one of the highest asthma prevalence rates in the United States with more than 600,000 people with asthma, and nearly 120,000 being children.[xii] In Washington, approximately 5,000 people with asthma are hospitalized each year.[xiii] Beyond hospitalizations, asthma can require routine checkups, medications, and missed work days, which can be costly to the individual and Washington's economy.[xiv] A study in California between 1993 and 2014 found that reductions in fine particulate matter and nitrogen dioxide could reduce the risk of incident asthma in children by up to 20 percent.[xv] Criteria and precursor pollutant reductions can yield health benefits that are economically quantifiable.

Estimated reduced incidence and valuation of health benefits

ERG input emissions changes, as described in Emission Inputs section, into EPA's Co-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool to assess the potential health benefits from a six percent reduction in CAPs.[xvi] Once emission changes are input, COBRA conducts multiple modeling steps to monetize health benefits and/or damages. COBRA uses the Source Receptor (S-R) Matrix, an air quality model, to estimate changes in total ambient concentrations of air pollutants that are known to be harmful to human health.[xvii] COBRA uses peer-reviewed epidemiological literature to estimate how changes in outdoor air quality affect the incidence of various health outcomes.[xviii] COBRA then multiplies the change in incidence by a monetary value associated with the health outcome, such as the average cost of an emergency room visit related to exacerbated asthma symptoms. Detailed descriptions of these monetization processes can be found in COBRA's User Manual.[xix]

[17] The correlations between EITE facility GHG emissions and CAP emissions between 2012 and 2023 are 0.698 for SO2, 0.868 for NOx and 0.588 for CO. However, for the purpose of this analysis, we assume a 1 to 1 relationship between reductions in GHG emissions and reductions in CAP emissions.

[18] Reduced emissions may be accomplished through emissions control technology, equipment upgrades and/or reduced production.

Modeling Approach

COBRA Description

COBRA can be utilized to better understand how changes in air pollution from clean energy and fuel programs can impact human health.[xx] ERG used the COBRA Desktop Edition version 5.1 and analyzed the potential health impacts of six percent reduction in CAPs in relation to the 2023 baseline. We ran COBRA for each EITE with tailored human population projections for 2034, as detailed in the Custom Population section, and analyzed the following four criteria pollutants across Washington: 1) particulate matter with diameters of 2.5 microns or less ($PM_{2.5}$), sulfur dioxide (SO_2), 3) nitrogen oxides (NO_x), and 4) volatile organic compounds (VOC). All results are presented in $2023 dollars using a discount rate of 2 percent.

Once we input the changes in pollutants, COBRA generates estimates changes in incidence and valuation of those changes for the following health outcome categories:

- Mortality [low and high estimates]
- Asthma
    - Symptoms
    - Asthma onset
- Emergency room visits
    - Respiratory
    - All cardiac outcomes
    - Asthma
- Hospital admittance
    - Respiratory
    - Cardio cerebral and peripheral vascular disease
    - Alzheimer's Disease
    - Parkinson's Disease
    - Stroke incidence
    - Out of hospital cardiac arrest incidence
- Onset
    - Hay fever/rhinitis incidence
    - Nonfatal heart attacks
    - Lung cancer incidence
- Other impacts
    - Minor restricted activity days
    - Work loss days
    - School loss days

Custom Population Projections

ERG imported custom population projections into COBRA to estimate the potential health benefits for 2034. EPA provides Environmental Benefits Mapping and Analysis Program (BenMAP) population datasets formatted for COBRA.[xxi] The BenMAP data is provided in five-year increments from 2030-2050. ERG utilized the BenMAP data because COBRA requires granular population data with projections for each age and county. However, BenMAP provides this granular data for each State, therefore, ERG made adjustments to more closely align estimates with Washington population projections.

ERG tailored the BenMAP data to align with the Washington State Office of Financial Management (OFM) data. The OFM data includes 2034 total Washington estimates for each age, and is further detailed in the Appendix. ERG adjusted the BenMAP data with the calculated proportions (OFM divided by BenMAP estimates). We inputted the customed 2034 population data into COBRA, with estimates for each age and each Washington county.

Health results are impacted by an aging population. According to OFM's forecast of Washington's population, the senior population (ages 65 and over) is expected to nearly double from 2020 to 2050.[xxii] The most elderly population (ages 85 and over) will experience the most significant growth, with the population expected to nearly quadruple from 2020 to 2050, increasing from approximately 130,00 in 2020 to 520,000 in 2050.[xxiii] This is particularly relevant to the health benefits because older adults are more susceptible to respiratory illness caused by criteria and precursor pollutants.

Population density within a county can also impact COBRA's health impacts, as there is a direct relationship with population density.[xxiv] EPA states that areas with a higher population density tends to see higher health benefits from reductions in emissions because there are more people breathing the cleaner air.[xxv] Appendix C provides additional detail and presents the adjusted 2034 population data ERG input into COBRA by county. King County makes up nearly 30 percent of Washington's population, suggesting that emission reductions for EITEs in or near King County will have high health benefits.

Emission Inputs

COBRA prompts the user to select a location, sector, and then input changes in emissions per pollutant. For source location, we selected the county that corresponds with each EITE location. We selected the emissions sector corresponding to each NAICS description and high-level industrial sector description. For example, the EITE, Air Liquide, has a NAICS definition of "Industrial gas manufacturing" and a description of "Chemical manufacturing". Given these descriptions, we selected the "Chemical and Allied Product Manufacturing" sector in COBRA. For each EITE, ERG used six percent of the 2023 baseline emissions as the COBRA emission inputs. These emission values were provided by Ecology. The COBRA inputs by county, sector, and pollutant are further detailed in Appendix C.

Adjusting Monetary Values

COBRA uses national values to monetize the modeled incidence changes. To make these estimates more aligned with Washington, ERG adjusted the expenditure estimates by the relative healthcare price index, and the Willing to Pay (WTP) estimates by a relative household income index. EPA's BenMAP valuation data indicated the monetization method used for each health outcomes. These methods were either cost of illness (COI) or WTP. The COI methods translated to expenditures, and thus the relative healthcare price index were used. For Washington, the relative care prices per capita are $9,265, with the national being $10,191, resulting in a national health expenditure ratio of 0.91.[xxvi] [xxvii,xxviii] For the WTP methods, the household income ratio is 1.21 because the median household income from 2019 to 2023 in Washington is $94,952, and is $78,538 nationally.[xxix] ERG applied these ratios to the corresponding health outcomes. For example, the total asthma symptoms category has five components: albuterol use, chest tightness, cough, shortness of breath, and wheeze. The COI method was used for the albuterol use category for the use of an inhaler, therefore 0.91 was applied to these outcomes. The other four categories corresponded to the WTP method, and ERG applied the 1.21 ratio.

Results

The following section outlines both source county and statewide results. The source county being the location of the EITE. Statewide results are present in counties without an EITE because emissions and pollutants can disperse across counties.

Incidence

The county and state level estimates of avoided incidence associated with the illustrative scenario where EITEs reduce CAP emissions by 6 percent in 2034[19] by health outcome is displayed in Table 10. The asthma symptoms category is the health outcome with the highest estimated avoided incidence of nearly 1,050 cases.

Table 10. Source County and Statewide Avoided Incidence by Health Outcome in 2034

Health Outcomes	Source County- Total Avoided Incidence	Statewide- Total Avoided Incidence
Total mortality (low estimate)	0.3	1.6
Total mortality (high estimate)	0.4	2.4
Total asthma symptoms	155.7	1,049.8
Total asthma onset	0.9	6.3
Total emergency room visits	0.4	2.5
Total hospital admittance	0.1	0.7
Total onset	6.3	43.2
Minor restricted activity days	101.0	542.9
Work loss days	66.9	92.0
School loss days	17.1	492.7

Monetary

The total health benefits are presented as a lower and upper bound estimate because COBRA has a low and high estimate for mortality. The low estimate is based on an evaluation of $PM_{2.5}$ impacts on mortality by the Harvard T.H. Chan School of Public Health.[xxx] The high estimate represents results based on a study from the Environmental Health Perspectives peer-reviewed journal.[xxxi] Presenting a range of low and high monetary benefits is EPA's standard practice.[xxxii] All other health outcomes in COBRA are reported as point estimates.

As shown in Table 11, the source county total health benefits in 2034 range from $5.5 million to $8.5 million, and the statewide total benefits range from over $34 million to $50 million.

Table 11. Source County and Statewide Total Health Benefits in 2034 (in millions $2023)

Location	Total Health Benefits (Lower Bound)	Total Health Benefits (Upper Bound)
Source County	$5.5	$8.5
Statewide	$34.4	$50.2

[19] As described above, we assume that EITE CAP emissions will be reduced as a similar rate as GHG emissions.

Table 12 provides a breakdown of health benefits by outcome. For both source county and statewide estimates, the low estimate of mortality makes up 94 percent of the total benefits (lower bound) and the high estimate of mortality makes up 96 percent of the total benefits (upper bound).

Table 12. Source County and Statewide Health Benefits by Outcome in 2034 (in millions $2023)

Health Outcomes	Source County- Total Health Benefits	Statewide- Total Health Benefits
Total mortality (low estimate)	$5,223,921	$32,220,385
Total mortality (high estimate)	$8,190,656	$47,982,549
Total asthma symptoms	$53,656	$396,835
Total asthma onset	$64,158	$438,194
Total emergency room visits	$672	$4,375
Total hospital admittance	$2,769	$15,648
Total onset	$16,161	$97,825
Minor restricted activity days	$17,091	$91,846
Work loss days	$7,368	$39,628
School loss days	$154,869	$1,139,803

For the purposes of the map, shown in Figure 6, the statewide total health benefits are presented as an average. Figure 6 illustrates the statewide total health benefits by county. King County has highest (average) statewide total health benefits of $9.8 million.

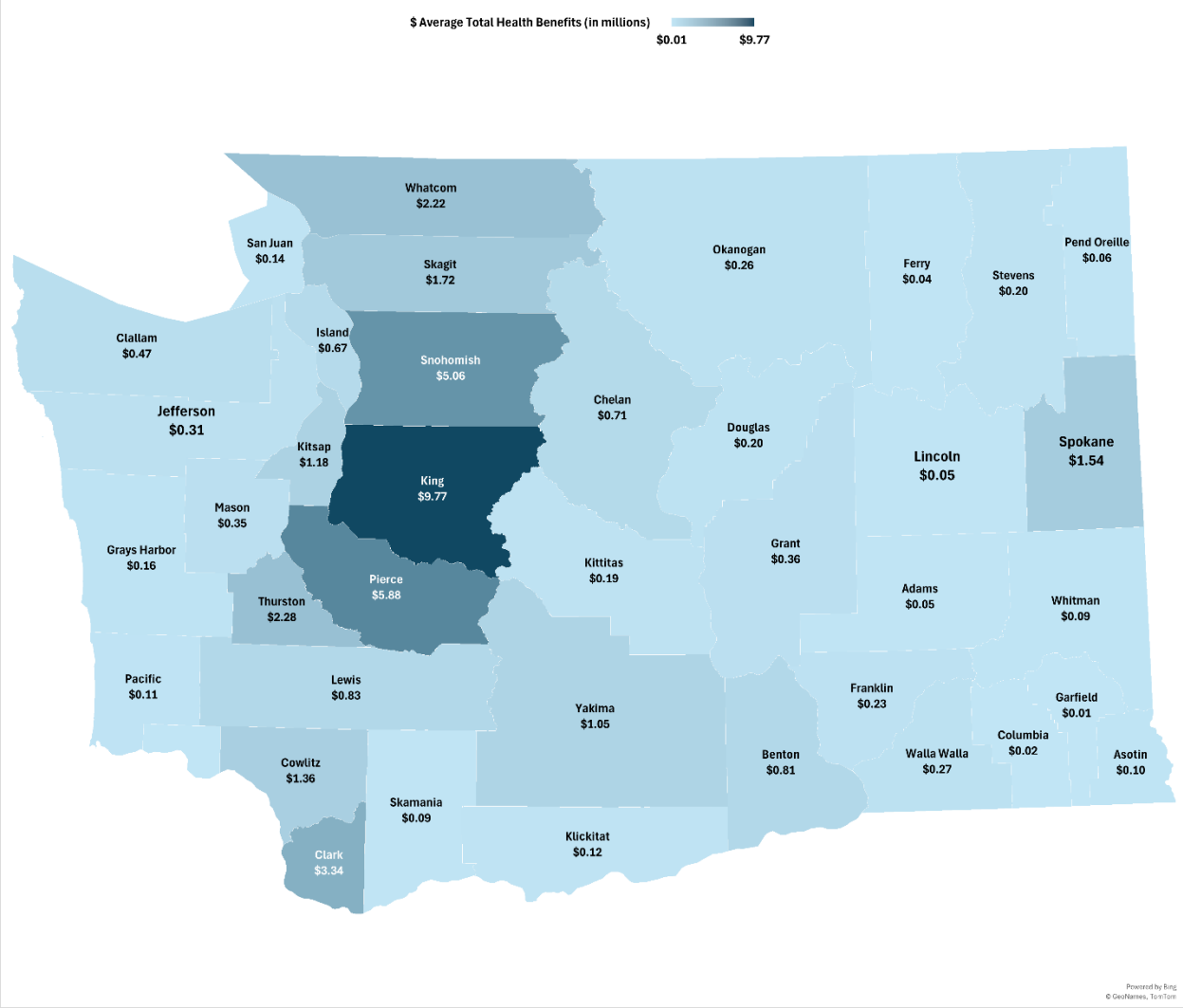

Figure 6. Map of Statewide Average Total Health Benefits (in millions $2023) by County

Social Cost of Carbon

The social cost of carbon (SCC) is an estimate of the cost of greenhouse gas emissions to society. The social cost of carbon attempts to capture the impacts associated with releasing an additional metric ton of CO2 into the atmosphere in terms of agricultural productivity, changes in energy costs, human health, and damages from increased flooding. The SCC increases each year because future emissions are expected to cause larger incremental damages as greater climatic change leads to more stressors on natural and economic systems. The U.S. Environmental Protection Agency (EPA) periodically provides estimates of the SCC. The most recent report, "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances", was published in 2023[xxxiii] and used for this analysis.[xxxiv]

Method

The SCC was used in this analysis to estimate the value of greenhouse gas emissions reductions for EITEs in 2034. Using the 2023 EPA report, we extrapolated the SCC for 2034 using the 2.0 percent discount rate. The extrapolated value assumes the SCC increases linearly between 2030 and 2040. Using the 2023 covered emissions as a baseline, we assumed a six percent reduction in covered greenhouse gas emissions by 2034, in line with the no-cost allocation for EITEs in 2034. The reduction in emissions was then multiplied by the SCC for 2034 to estimate the societal net benefit of emission reductions. The value was then converted from 2020 dollars to 2024 dollars using the Bureau of Economic Analysis Gross Domestic Product Deflator.

Results

An estimated $2.6 billion in global societal benefit will be gained by EITE greenhouse gas emission reductions in 2034. Results by industry are presented in Table 13. The largest benefit will come from petroleum refineries.

Table 13. Benefit of 2034 Reduction in Covered Greenhouse Gas Emissions

Industry	SCC of 2034 Reductions	Number of EITEs
Aerospace Manufacturing	$40,857,000	3
Building Materials Production	$137,779,000	3
Chemical Manufacturing	$35,989,000	3
Food Manufacturing	$153,310,000	10
Glass Manufacturing	$37,513,000	2
Steel and Aluminum	$65,772,000	3
Petroleum Refineries	$1,883,215,000	7
Pulp, Paper and Paperboard	$235,677,000	6
Semiconductor Manufacturing	$26,697,000	2
Total	**$2,616,810,000**	**39**

Economic Impact

To understand the relationships between EITEs and the economy of the host county and the state, we used IMPLAN, an Input-Output (I-O) software package, to estimate the current economic contribution of EITEs and to estimate the economic impact of projected compliance costs to EITEs.

Modeling Approach

We conducted two types of analyses in IMPLAN, described below:

Current Impacts

Industry Contribution Analysis (ICA)

- ICA is a method used to estimate the value that industries or firms contribute to the economy of a specified geographic area at their current levels of production.
- ICAs apply a constraint so that economic effects cannot exceed current conditions (e.g., petroleum refineries cannot support more jobs than currently exist in the industry).
- Results describe the magnitude of an existing industry or firm(s) within the study area.

Projected Impacts

Economic Impact Analysis (EIA)

- EIAs measure the economic effect of a shock to the economy in a specified geographic area.
- Unlike ICAs, constraints to economic effects are not applied, allowing new economic activity to occur within industry sectors (e.g., the addition of revenues to petroleum refineries may support more jobs in the sector than currently exist).
- Results describe the magnitude of a newly introduced economic shock within the study area.

Both ICAs and EIAs consider three core types of economic activity, listed below and illustrated in Figure 7:

- **Direct effects** from IMPLAN show the immediate impact of a change on its own sector.
- **Indirect effects** describe the impacts on the economic sectors that support the directly impacted sector.
- **Induced effects** show how changes in employee spending, due to direct and indirect employment impacts, ripple through the economy.

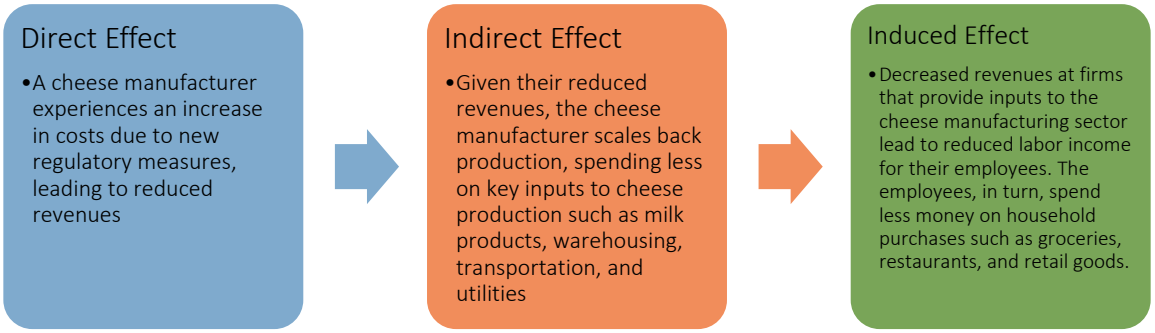

Figure 7. Example of IMPLAN Effects

IMPLAN estimates direct, indirect, and induced effects of market shocks on four key macroeconomic metrics:

More about IMPLAN

Basic overview of IMPLAN: The primary purpose of IMPLAN is to show how an existing firm or industry, or a change to the economy (e.g., an infusion of money, a new infrastructure project, the loss of a big business or entity), will impact all other industries in that economy within a selected region based on established relationships on how money ripples through the economy between industries.

More detailed overview of IMPLAN: IMPLAN is a powerful modeling tool that utilizes the following:

- Extensive economic and demographic databases*:* IMPLAN draws from a variety of raw data sources including the U.S. Census Bureau, U.S. Bureau of Economic Analysis (BEA), U.S. Bureau of Labor Statistics (BLS), and more.
- Economic multipliers: Multipliers measure the connectedness of industries to the wider local economy. They describe how a change in one sector impacts the overall economy (e.g., for every $1 spent in a sector, an additional $0.5 of economic output is generated locally). IMPLAN uses indirect multipliers, "Type I" multipliers, induced multipliers, and "Type SAM" (where SAM stands for Social Accounting Matrix) multipliers. Type I and SAM multipliers describe the total effect to all industries in a region per direct effect, considering input purchases only and input purchases, payments of wages and taxes, and other transactions, respectively.

IMPLAN conducts an input-output (I-O) analysis, an economic modeling method that examines inter-industry relationships within an economy. IMPLAN captures monetary market transactions between industries, transactions between industries and institutions, and transactions between institutions. The I-O model makes the following assumptions:

- Constant returns to scale: Same quantity of inputs is needed per unit of output.
- No supply constraints: No restrictions to employment and raw materials.
- Fixed input structure: No input substitution in response to a change in output.

- **Employment** refers to the number of individuals hired for a salary or compensation to work within a sector. IMPLAN follows job definitions from the Bureau of Economic Analysis (BEA), which include full-time, part-time, and seasonal positions. IMPLAN jobs are not Full-time Equivalent (FTE) positions.
- **Value added (also referred to as gross domestic product)** is the increase in a product or service's market value at each stage of production.
- **Economic output (also referred to as revenue)** refers to the total value of all goods and services produced in an economy.
- **Tax revenue** includes taxes remitted by businesses and households to local, state and federal governments.

We considered two sets of geographic areas for each analysis: (1) host counties and (2) the state of Washington. The methods used to assess effects to each area are described below:

Host County Effects: To estimate host county-level effects, we defined the geographic area for the analysis as including each county that hosts an EITE. We distributed data describing economic contributions of EITES or expected economic shocks to the respective counties where we expected them to occur in. This approach allows us to model county-level impacts at a relatively granular level, but it does not consider effects to counties that do not host EITE facilities. Effects to counties that do not host EITE facilities are captured in the analysis of statewide effects, described below.

Statewide Effects: To estimate statewide effects, we used our estimated host county effects in conjunction with a second analysis intended to estimate effects to counties that do not host EITEs which we will refer to as the non-host analysis. The non-host analysis considered two different geographic "regions": (1) the "host county region", that is, all counties that host EITEs combined into a single geographic region and (2) the "non-host region", that is, all counties that do not host EITEs, again, combined into a single geographic region.

In a departure from our methodology when measuring host county effects, we incorporated a Multi-Regional Input-Output (MRIO) analysis in IMPLAN when measuring non-host region effects. The MRIO analysis allows direct effects incurred in one region to trigger indirect effects and induced effects in economically linked regions. In the MRIO analysis, we distribute all economic contributions and expected economic shocks to the host county region as direct effects. No direct effects occur in the non-host region, however, the non-host region is impacted by indirect and induced effects given its economic links to the host county region. While this approach allows us to estimate impacts to the non-host region, it prevents us from preserving the precision of our initial assessment of host county effects (described above) since direct effects are distributed across the entire host county region instead of being specified at the county-level.

At the time of the analysis, IMPLAN software guidelines do not recommend the use of MRIO if more than ten geographic regions are considered in the analysis, preventing us from preserving the precision of our initial assessment of host county effects. Given this limitation when estimating host county effects, we decided to use the estimated effects to host counties from our initial (non-MRIO) model in combination with the non-host region effects estimated in our MRIO model. The MRIO model outputs were filtered to capture effects to the non-host region only, and added to estimated host county effects to estimate total statewide effects. We believe that this approach best preserves the precision of our model, while allowing us to consider effects to non-host counties.

Current Contribution of EITEs

As described above, our first analysis of the economic impacts of EITEs estimates focused on the current contribution of EITEs to the host counties and the broader statewide economy at current levels of production.

Model Inputs

In order to estimate the current contribution of EITEs, we began with the number of employees for each EITE. Employment information was gathered from available sources, including Dun and Bradstreet[xxxv], EITE air permits[xxxvi], US Census (county or state average for relevant industry)[xxxvii] or EITE facility provided employment estimates.

Table 14 shows the percentage of jobs in each host county that come directly from EITEs. In some counties, such as Yakima County and Pierce County, the direct employment contribution from EITEs is less than 0.1 percent. In other counties however, the direct employment contribution from EITEs is more substantial. Adams County, Cowlitz County, and Snohomish County receive more than five percent of their total employment directly from EITEs within their borders.

Table 14. Share of Host County Employment Directly from EITEs

County	Direct Jobs from EITEs	Total County Employment	% of Jobs Directly from EITEs
Adams	1,018	11,900	8.55%
Benton	713	125,089	0.57%

County	Direct Jobs from EITEs	Total County Employment	% of Jobs Directly from EITEs
Clark	1,334	268,539	0.50%
Cowlitz	2,944	53,364	5.52%
Franklin	725	47,860	1.51%
Grant	777	55,253	1.41%
Jefferson	300	15,693	1.91%
King	5,248	1,933,774	0.27%
Lewis	190	37,983	0.50%
Pierce	280	493,637	0.06%
Skagit	986	72,804	1.35%
Snohomish	32,500	423,913	7.67%
Spokane	482	336,258	0.14%
Walla Walla	1,344	39,298	3.42%
Whatcom	1,285	135,018	0.95%
Yakima	71	142,880	0.05%

To conduct an ICA in IMPLAN, model inputs must be entered as a change in industry output within a defined geographic region. To convert employment estimates into changes in industry outputs, we extracted data describing the estimated output generated per worker in each industry from IMPLAN and multiplied those values by total estimated employment at each EITE facility.

Results

Host County Effects

We estimate the current contribution of the 39 EITE facilities, as shown in detail below. The results of our analysis indicate that direct economic effects of those facilities account for over 49 thousand jobs and nearly 5 billion in output annually within the counties that host them. Direct economic effects of the 39 EITEs are summarized below in Table 15.

Table 15. Direct Effects of EITEs Current Contributions to Host County Economies

EITE sector	# of Facilities	Direct Jobs	Direct Impact to Tax Revenues ($ Millions)
Pulp and Paper	6	3,670	$404
Petroleum	7	2,819	$1,745
Aerospace	3	36,094	$2,325
Chemicals	3	474	$83
Food	10	3,702	$193
Metals	3	497	$62
Building Materials	3	743	$66
Semiconductors	2	1,206	$87
Glass	2	273	$17

EITEs contribute over 82 thousand total jobs across host counties annually. Across industries, the Aerospace sector contributes by far the greatest number of jobs across EITE host counties. Most (approximately 36 thousand) of those jobs result from direct impacts, though many (approximately 10 thousand) result from induced impacts as well. The Petroleum, Pulp and Paper, and Food Manufacturing sectors also contribute substantial numbers of jobs, accounting for, in total,

approximately 12 thousand, 8 thousand, and 7 thousand jobs, respectively. Employment effects of identified EITEs to host counties are summarized below in Figure 8.

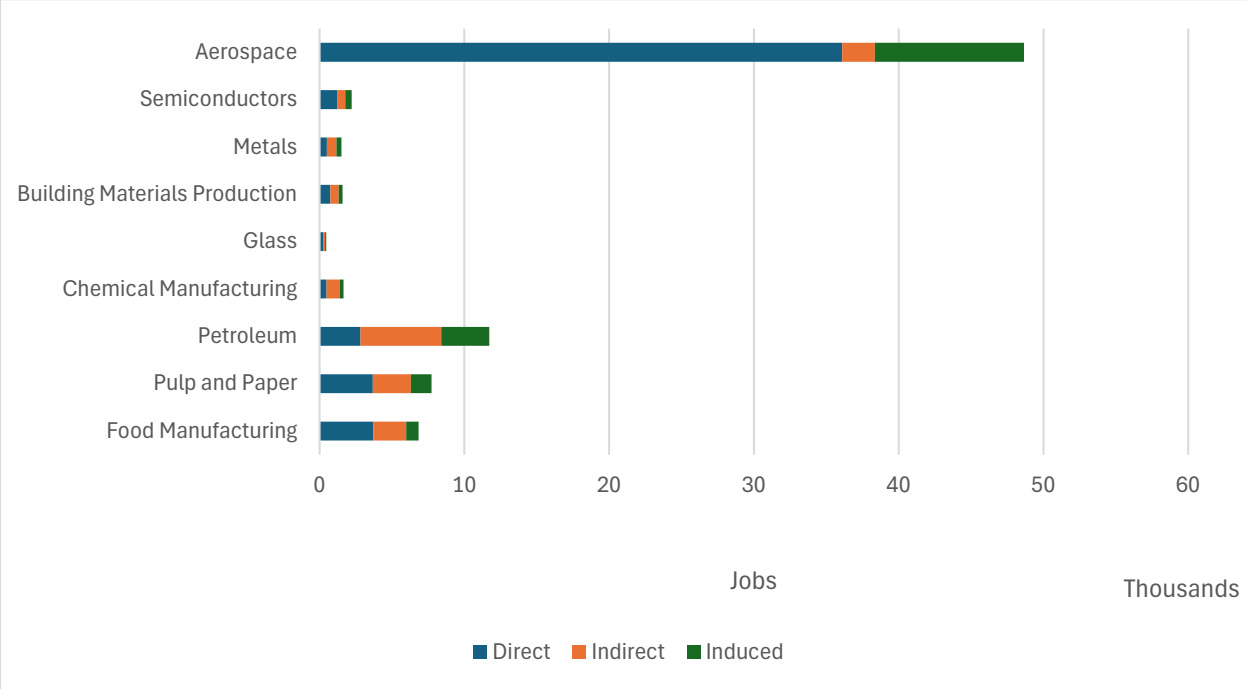

Figure 8. Employment Effects to Host Counties

Across host counties, EITEs contribute, in total, over $72 billion in economic output annually. The Petroleum sector contributes the greatest amount of economic output to EITE host counties, accounting for nearly $34 billion total in output. The Aerospace sector also contributes a substantial amount of economic output to EITE host counties, generating nearly $27 billion in economic output in total. Figure 9 summarizes output effects to counties that host EITE facilities.

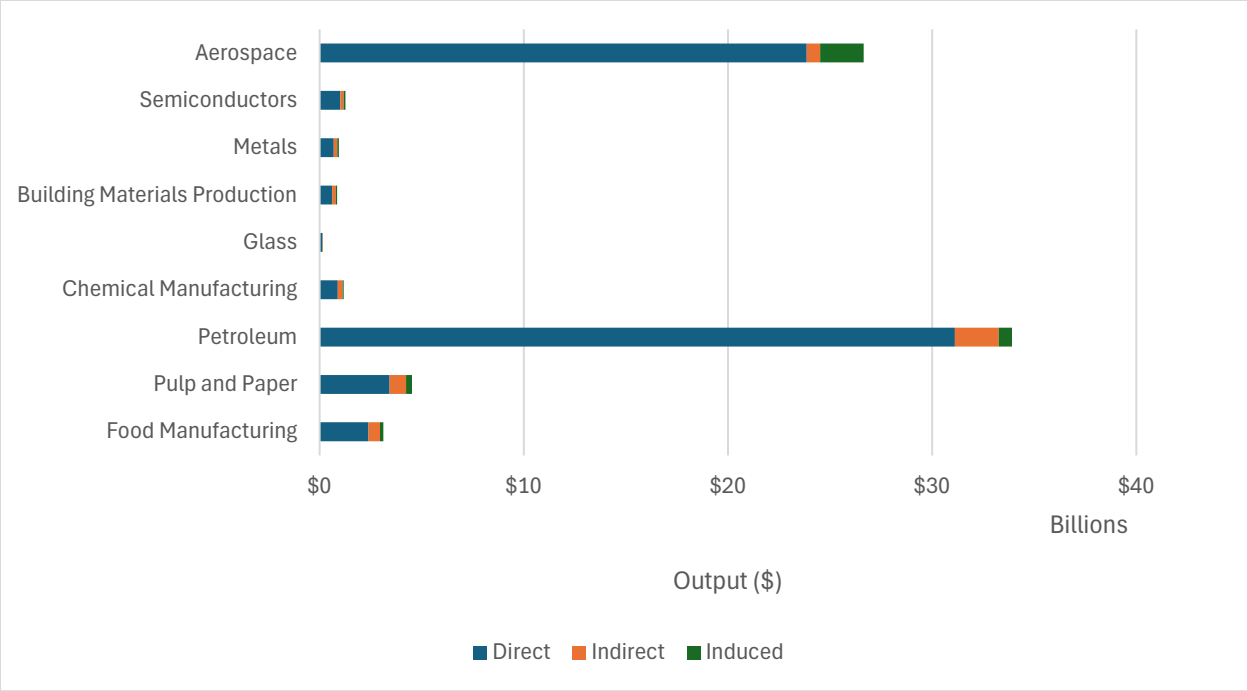

Figure 9. Output Effects to Host Counties

As seen in Figure 10, the largest indirect output impact from the EITEs to the host counties is in the wholesale of petroleum and petroleum products, generating $817 million in output. Other top indirect impacts from the EITEs include truck transportation ($343 million); maintenance and repair construction of nonresidential structures ($332 million); and electric power transmission and distribution ($309 million).

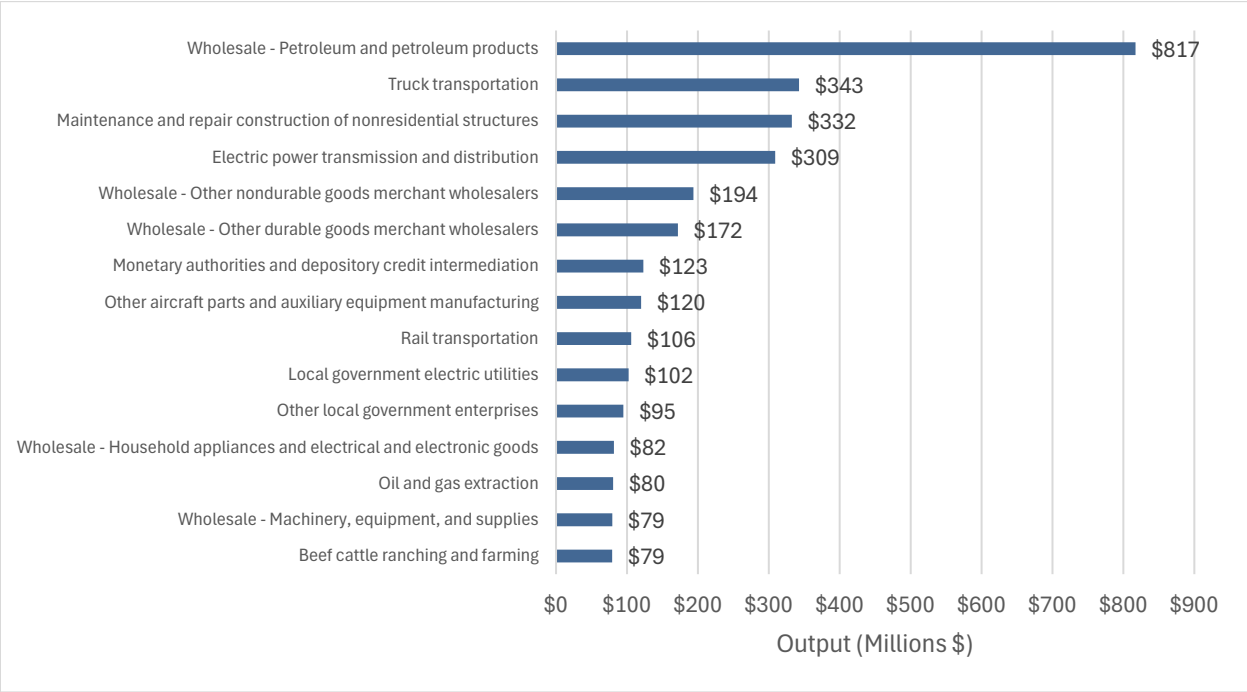

Figure 10. Top 15 Indirect Output Effects: Host Counties

EITEs contribute nearly $5 billion annually in tax revenues at the sub-county, county, state, and federal levels. Of those tax contributions, over $149 million and $1 billion in tax revenues are contributed at the county and state levels, respectively. EITEs additionally contribute nearly $4 billion in tax revenues to sub-county and federal governments (represented as "other" in the charts below). Figure 11 describes tax effects within EITE host counties.

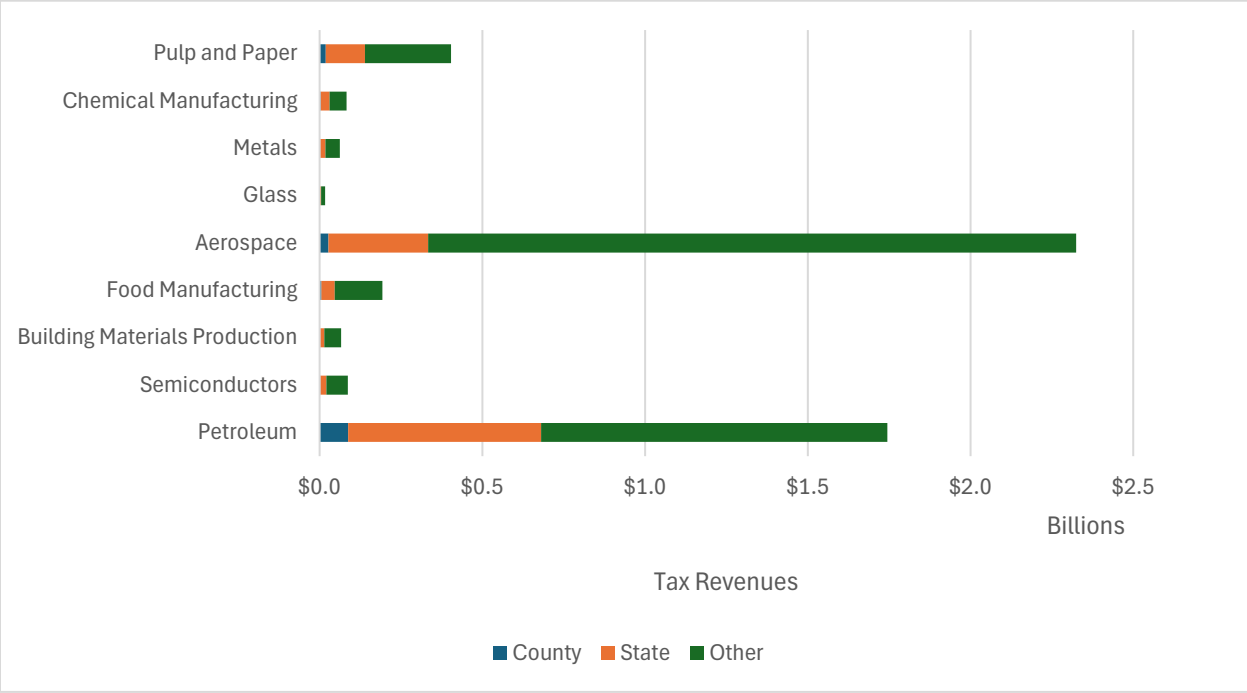

Figure 11. Tax Effects to Host Counties

Statewide Effects

We observe a relatively small increase in economic contributions of EITEs when considering effects to non-host counties in addition to host counties. Across the state, EITEs contribute, in total, over 85,000 jobs annually. Most of those jobs (over 49 thousand) are in the Aerospace sector. EITEs in the Petroleum, Pulp and Paper, and Food Manufacturing sectors also contribute a substantial number of jobs to the state, accounting for approximately 12, 8, and 8 thousand total jobs, respectively, across WA. Figure 12 describes employment effects in the state of WA.

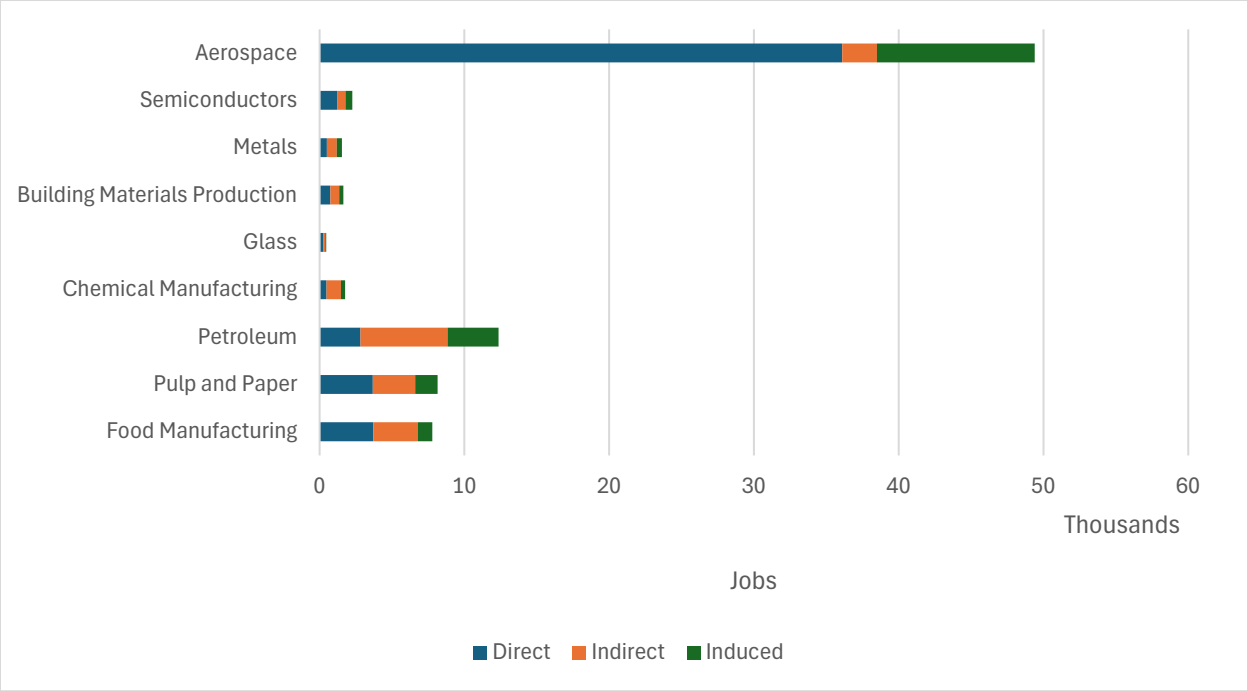

Figure 12. Statewide Employment Effects

EITEs contribute more than $73 billion to the state of WA's economy annually. The majority ($64 billion) of impacts are direct effects. The remaining $9 billion in generated output comes from indirect and induced effects. The Petroleum sector contributes over $34 billion in output to the state of WA annually. The Aerospace sector also contributes substantial output to the state economy, generating nearly $27 billion annually. Statewide output effects are described in Figure 13.

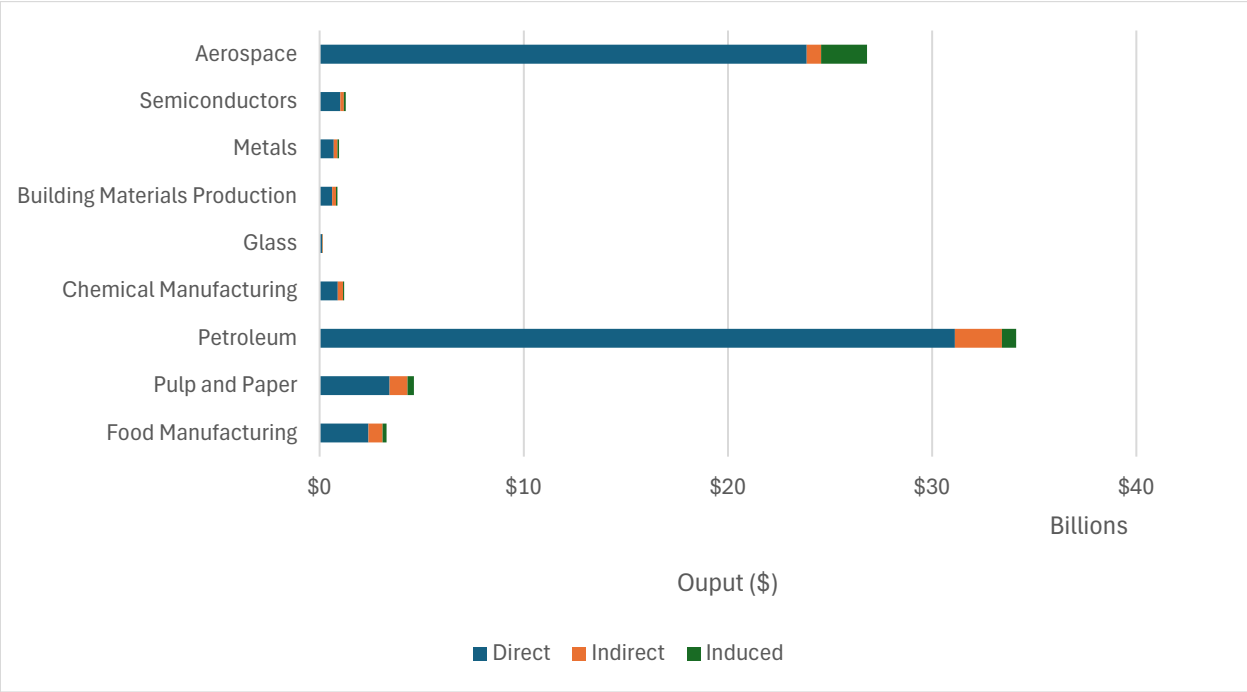

Figure 13. Statewide Output Effects

Figure 14 shows that, as with the host counties, the largest indirect impact from the EITEs to statewide output is in the wholesale of petroleum and petroleum products, generating $944 million in output. Truck transportation remains the second largest indirect impact, at $725 million. Other top indirect impacts include the management of companies and enterprises ($548 million); the wholesale of household appliances and electrical and electronic goods ($544 million); and oil and gas extraction ($522 million).

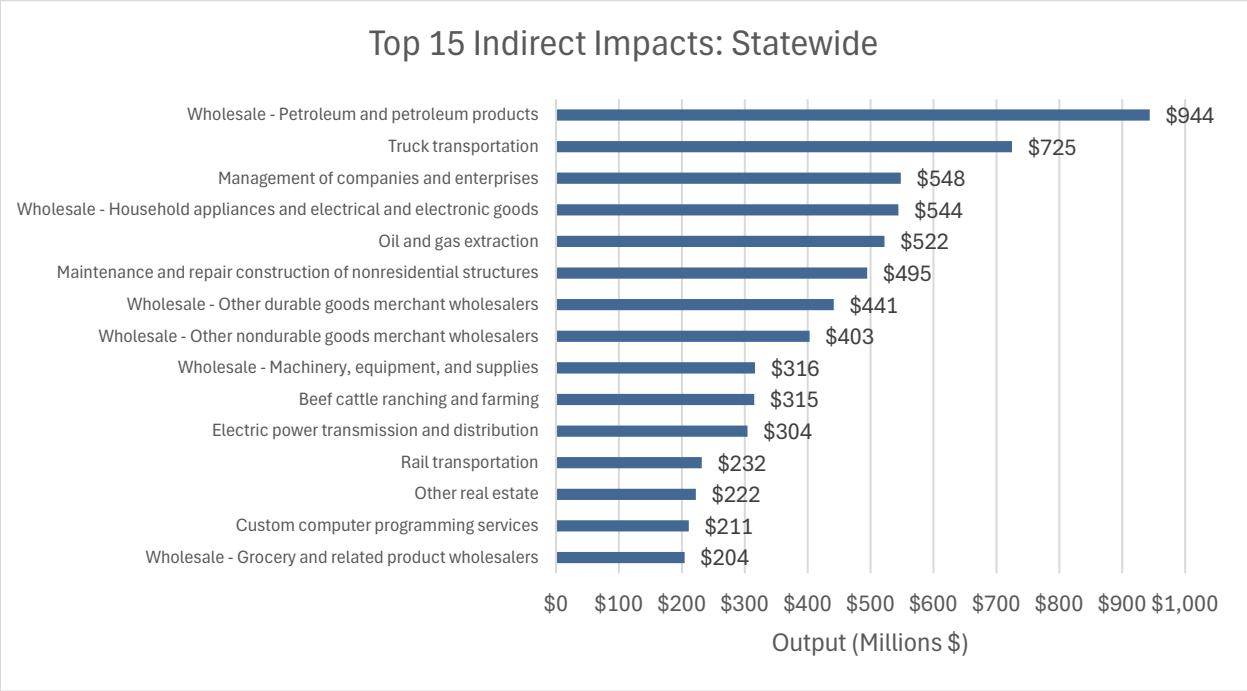

Figure 14. Top 15 Indirect Output Effects: Statewide

EITEs contribute over $5 billion annually in tax revenues at the sub-county, county, state, and federal levels. Of those tax contributions, over $153 million and $1 billion in tax revenues are contributed at the county and state levels, respectively. EITEs contribute an additional nearly $4 billion in tax revenues to sub-county and federal governments. Figure 15 portrays tax effects across the state of WA.

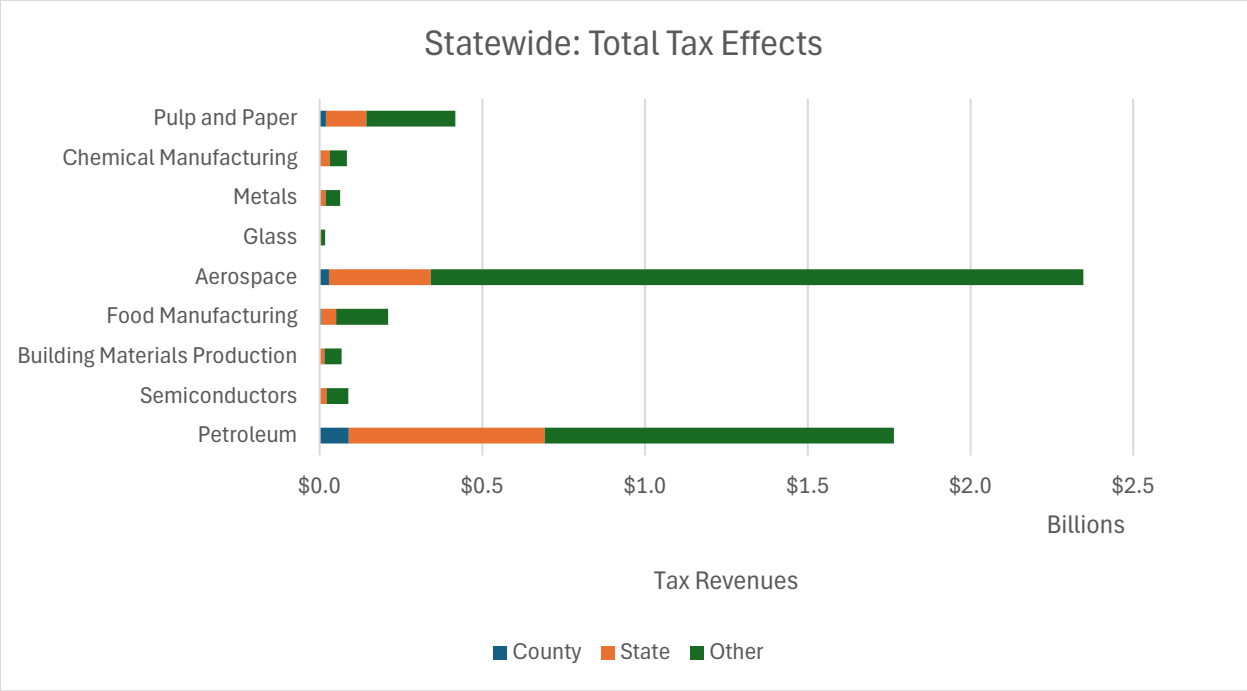

Figure 15. Statewide Tax Effects

Projected Economic Effects

Our second economic impact analysis is an estimate of the projected impacts of the current no-cost allowance allocation policy for EITEs through 2034. This estimate is intended to be illustrative, and represents a worst case scenario of the maximum impact on EITEs of reducing emissions by 3 percent from 2027-2030 and 6 percent from 2031-34 without any ability for cost passthrough. It is possible that EITEs could choose to achieve compliance by reducing the emissions intensity of production, however, reliable data are not available to accurately predict how EITEs would choose to mitigate emissions intensity across industries nor how much such mitigation measures might cost. Since EITEs are unlikely to adopt measures to reduce the emissions intensity of production that cost more than purchasing allowances to keep GHG emissions at baseline levels, our results hold as being representative of a worst-case scenario.

In our model results, we exclude findings related to fuels and sectors that are exempt from CCA compliance, including fuels used for agricultural purposes, aviation fuels, marine fuels combusted outside of Washington, and emissions from fuels exported out of Washington.

Model Inputs

Using 2023 EITE covered GHG emissions as a baseline, we calculated the allowance allocations each EITE facility would need to purchase between 2027 to 2034 to achieve compliance with the 3 percent and 6 percent reduction in no cost allowances. We multiplied each year's allocations by the respective

estimated price of carbon allowances in that year.[20] We entered expected costs to EITEs associated with allowance purchases into IMPLAN for each EITE facility.

Results

Host County Effects

The results of our analysis indicate that direct economic effects of the expected costs imposed on EITEs would result in a total loss of 100 jobs and a reduction in output of nearly $17 million, cumulatively, within the counties that host them. Direct economic effects are summarized below in Table 16.

Table 16. Direct Effects of Projected Costs to EITEs Within Host Counties

EITE sector	# of Facilities	Direct Jobs	Direct Jobs per Facility	Direct Impact to Tax Revenues
Pulp and Paper	6	22	4	$2,407,805
Petroleum	7	17	2	$9,566,231
Aerospace	3	8	3	$448,767
Chemicals	3	2	1	$320,407
Food	10	21	2	$1,113,461
Metals	3	4	1	$578,701
Building materials	3	15	5	$1,532,111
Semiconductors	2	3	2	$201,036
Glass	2	8	4	$473,237

Our analysis indicates that under this illustrative scenario the costs imposed on EITEs would result in a cumulative loss of approximately 236 jobs between 2027 and 2034 (about 34 jobs per year) across EITE host counties due to direct, indirect, and induced effects. The greatest share of jobs lost will be from the Petroleum sector, where we estimate a loss of 66 jobs. The Pulp and Paper, Food Manufacturing, and Building Materials Production sectors will also experience substantial job losses, with 46, 39, and 33 jobs lost in each sector, respectively. Cumulative employment effects are described below in Figure 16.

[20] The cost of GHG emissions allowances were based on Department of Ecology credit allowance projections through 2029, with an extrapolation through 2034. Source: Washington State Department of Ecology, 2024, *Cap-and-Invest Program Allowance Auction Revenue Forecast Summary: December 2024*, https://apps.ecology.wa.gov/publications/documents/2514002.pdf

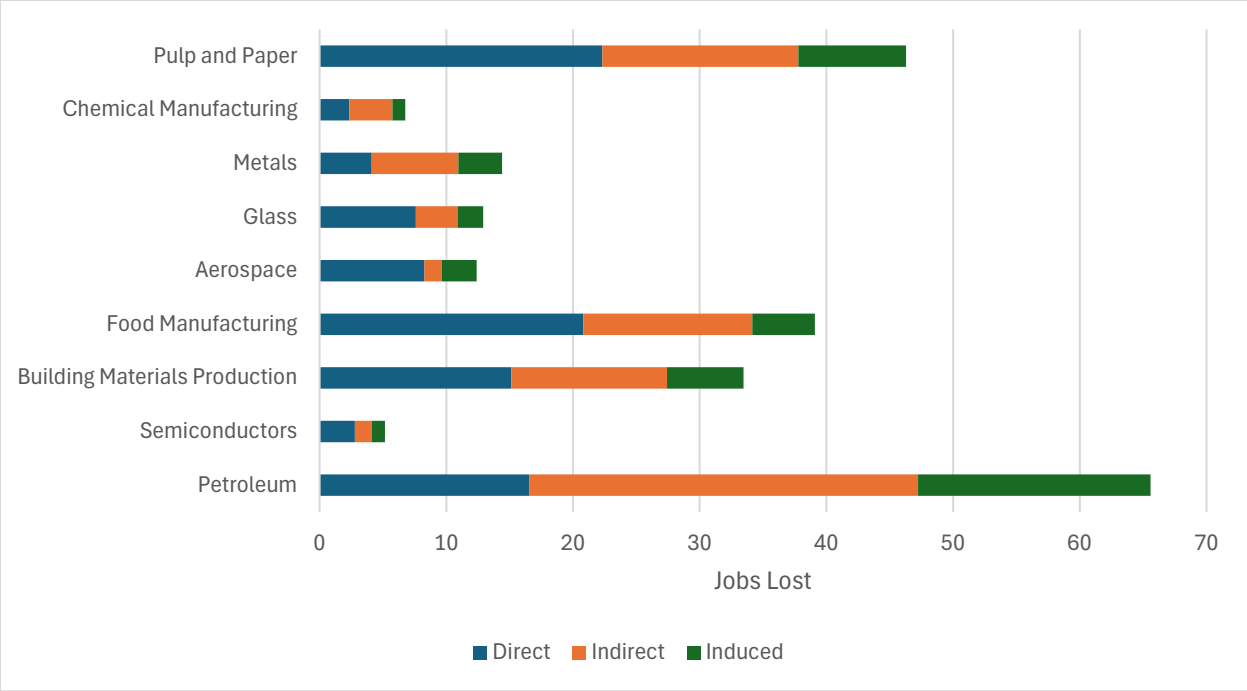

Figure 16. Cumulative Employment Effects to Host Counties

Cumulative direct, indirect, and induced output effects to host counties result in a contraction in output of approximately $270 million between 2027 and 2034 (about $39 million per year). Most of the losses to output occur in the Petroleum sector, where we expect to see cumulative contractions of approximately $182 million. Figure 17 describes cumulative output effects to host counties.

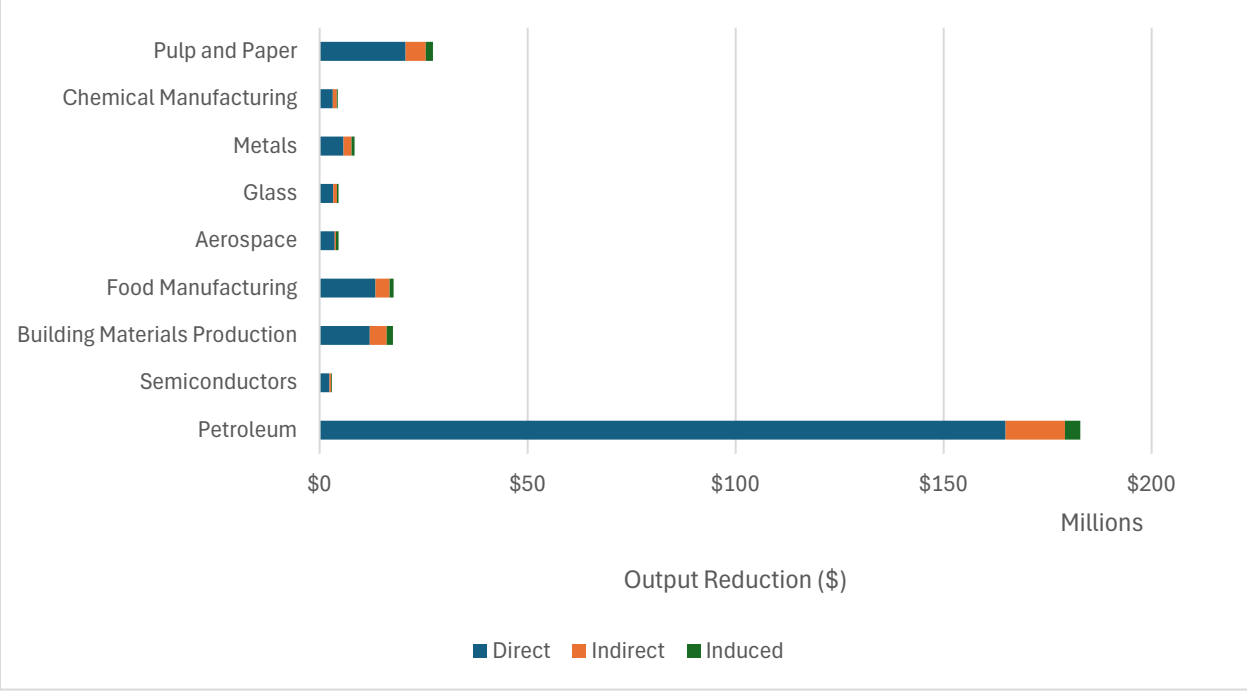

Figure 17. Cumulative Output Effects to Host Counties

Figure 18 shows the 15 industries in the host counties that would experience the largest declines in output due to indirect impacts. The industry most affected by indirect impacts would be the wholesale of petroleum and petroleum products, which would see a cumulative output decline of $4.4 million due to indirect impacts. Other top indirect impacts include electric power transmission and distribution ($2.7 million); petroleum refineries ($2.4 million); and truck transportation ($2.0 million).

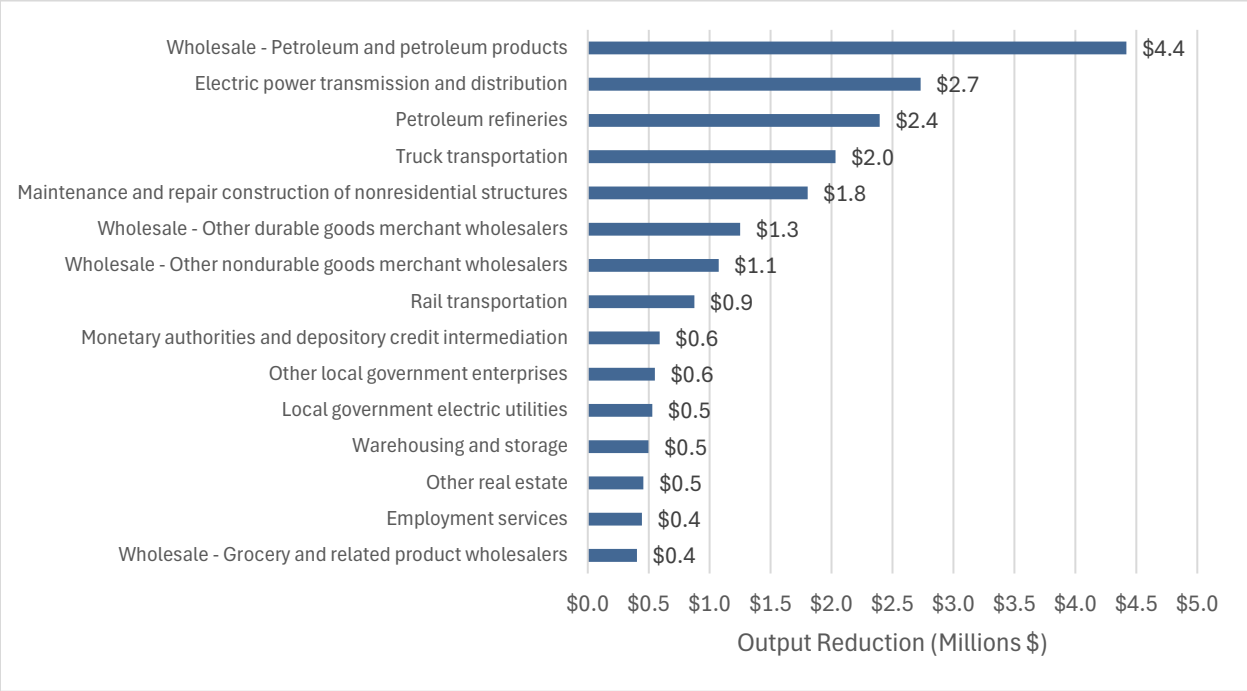

Figure 18. Indirect Output Effects, Top 15 Industries: Host Counties

The additional cost burden to EITEs will result in estimated reductions to county and state tax revenues of about $731 thousand and $5 million, respectively, across counties that host EITE facilities. Sub-county and federal governments will experience an additional reduction of $11 million in tax revenues. Figure 19 portrays cumulative tax effects across EITE host counties.

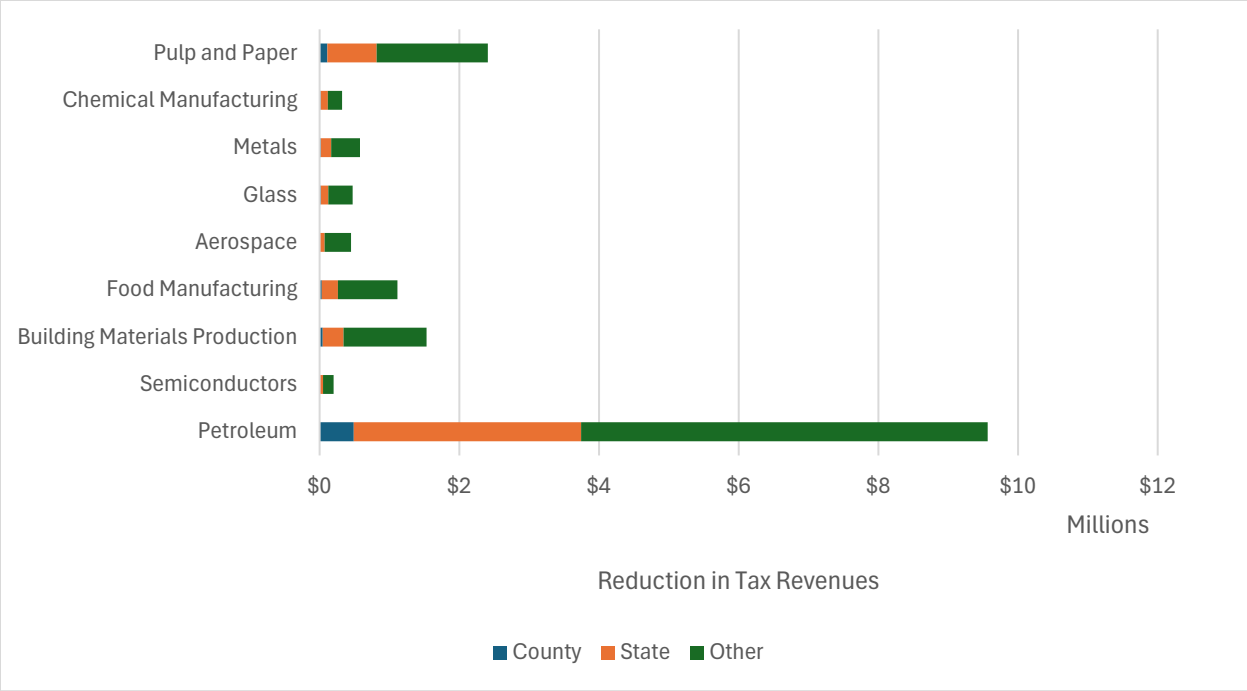

Figure 19. Cumulative Tax Effects to Host Counties

Statewide Effects

Across the state of Washington, our analysis indicates that costs imposed on EITEs will result in a cumulative loss of approximately 248 jobs between 2027 and 2034 (about 36 jobs per year) across the state of Washington due to direct, indirect, and induced effects. The greatest share of jobs lost will be from the Petroleum sector, where we estimate that 69 jobs will be lost. The Pulp and Paper, Food Manufacturing, and Building Materials Production sectors will also experience substantial job losses, with 48, 44, and 34 jobs lost in each sector, respectively. Cumulative employment effects are described below in Figure 20.

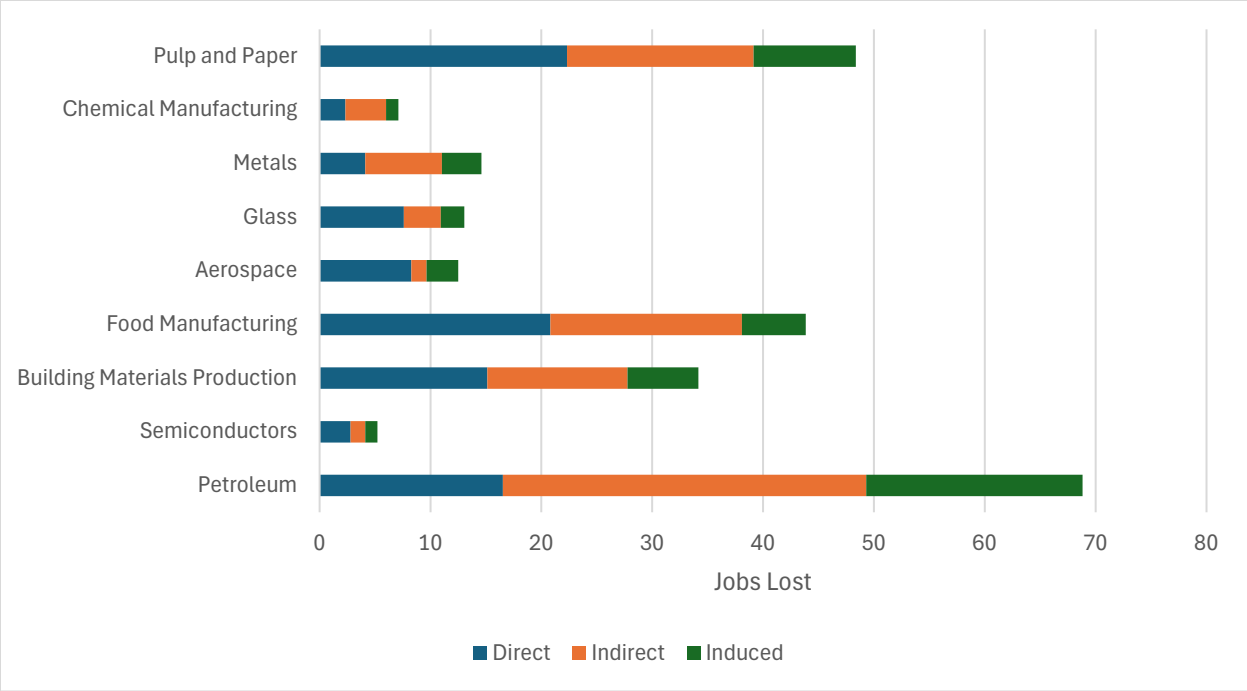

Figure 20. Statewide Cumulative Employment Effects

Our analysis estimates that, cumulatively, the state of Washington will experience a reduction in output of $273 million due to direct, indirect, and induced effects. Of that $273 million, the majority will occur within the Petroleum sector, which will contract by $184 million between 2027 and 2034 (approximately $39 million per year). Substantial contractions will also occur in the Pulp and Paper, Food Manufacturing, and Building Materials Production sectors which will experience cumulative output losses of $28, $19, and 18 million, respectively. Statewide output results are described in Figure 21.

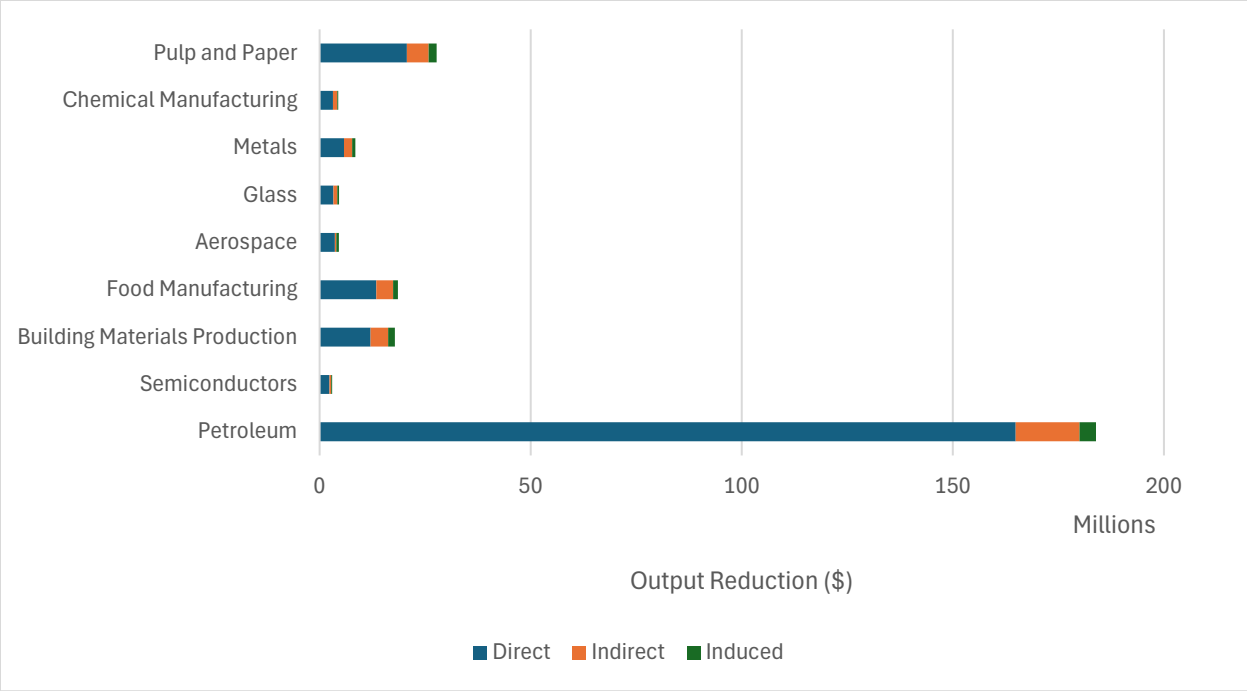

Figure 21. Statewide Cumulative Output Effects

Figure 22 shows the 15 industries statewide with the largest declines in output due to indirect impacts. The results are very similar to those seen in the host counties, with the wholesale of petroleum and petroleum products experiencing the largest cumulative decline in output from indirect impacts ($5.2 million). Petroleum refineries ($4.7 million) and truck transportation ($3.8 million) also remain near the top of the list of indirect impacts.

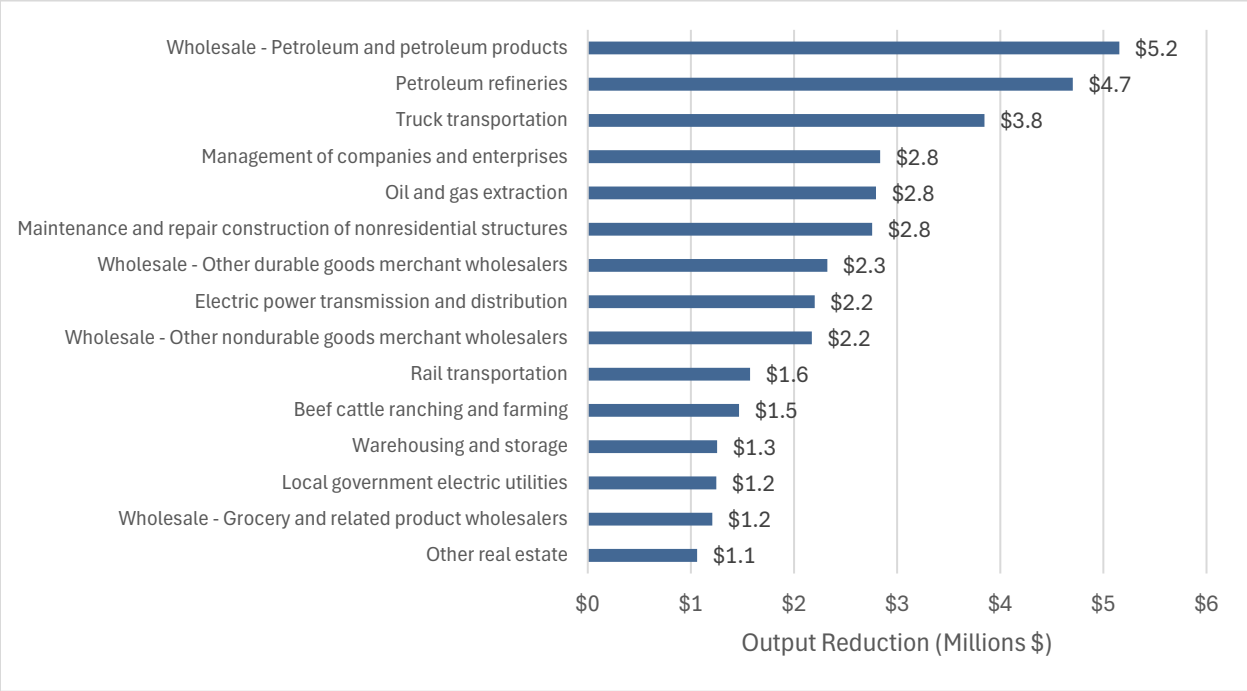

Figure 22. Indirect Output Effects, Top 15 Industries: Statewide

Between 2027 and 2034, our results suggest that, cumulatively, tax revenues will decrease by about $17 million across the state of Washington (approximately $2 million annually). Of those tax revenue losses, about $752 thousand will be experienced at the county level and $5 million will be experienced at the state level. An additional $11 million in tax revenues will be lost at the sub-county and federal levels, respectively. Figure 23 describes cumulative expected tax effects between 2027 and 2034.

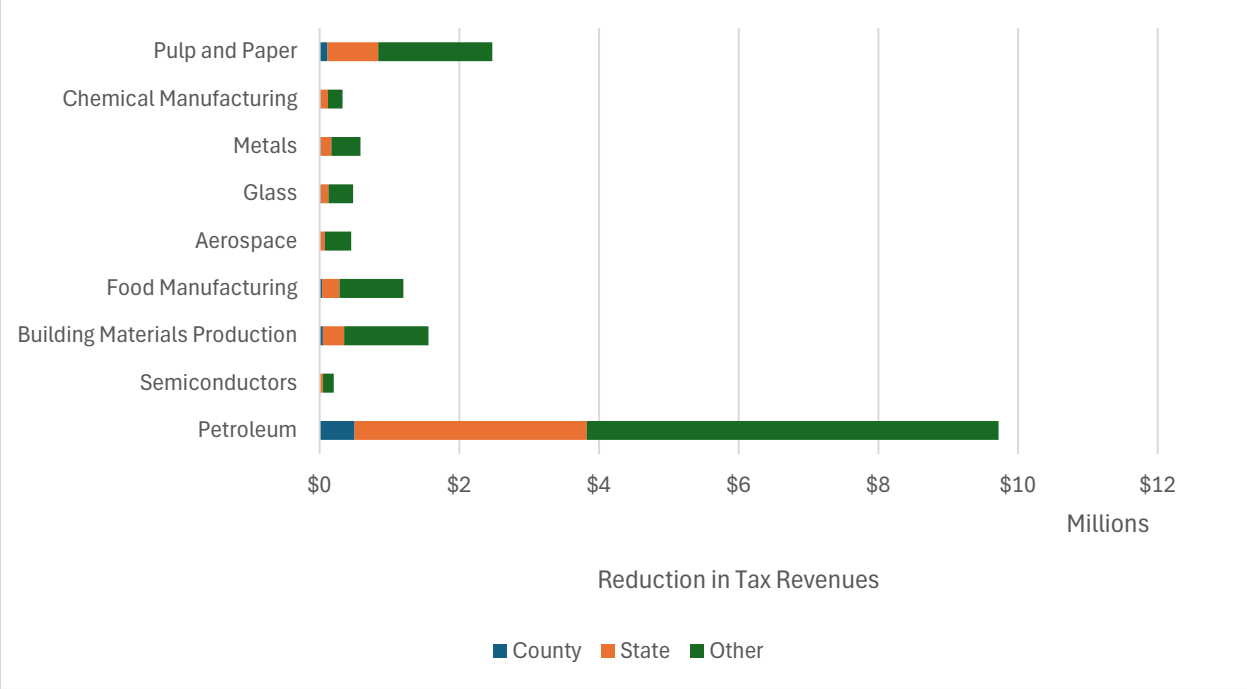

Figure 23. Statewide Cumulative Tax Effects

Sensitivity Analysis: Consumer Passthrough

The IMPLAN analyses presented above assume that 100 percent of compliance cost impacts are absorbed by industries within the WA economy. While this assumption may hold true for some industries, other industries may attempt to pass costs on to consumers, including households, industrial buyers, government institutions, and more, by raising prices. We examine the impact of redistribution of costs by evaluating economic effects at the statewide level when 50 percent of costs are passed through to consumers and 50 percent are retained by affected industries. As noted previously, our analysis examines a worst case scenario where costs of purchasing allowances to maintain GHG emissions at baseline levels.

Though most of modeling methodology remains consistent with the previously described methods employed to estimate statewide effects, there are some key differences. We redistributed half of our estimated costs to industry to consumers that we expect to be affected by increased costs. To accomplish this, we first used Washington make-use tables[xxxviii] to estimate the value of commodities purchased by consumers across industries, households, government institutions, and more. We then calculated the percentage of expenditures made in Washington, out of total U.S. expenditures, that each consumer group spent on commodities from the Washington industry groups that correspond to the EITEs, and then distributed consumer costs across industrial and institutional sectors accordingly.

Similar to the previously described statewide projected analysis, we entered impacts to industrial consumers as industry events. In some cases, multiple industrial consumers in IMPLAN corresponded to

the same consumer group in the make-use table. To account for this, ERG divided the cost for the consumer group in the make-use table equally between the corresponding industrial consumers in IMPLAN (excluding industrial consumers that do not exist in Washington). Impacts to institutional consumers were entered into IMPLAN as changes in institutional spending patterns. In lieu of data describing the distribution of cost impacts across households of varying income levels, we assumed that costs were distributed evenly across households regardless of income levels. Since our underlying data do not describe the geographic location of consumers beyond their being located in Washington, we define the geographic area that the costs are incurred in at the state level instead of allocating costs to specific counties.

Sensitivity Analysis Results

Under a 50 percent passthrough scenario, our analysis indicates that the cumulative loss of jobs would be approximately 627 jobs between 2027 and 2034 (about 78 jobs per year) across the state of Washington. This is much higher than estimated 248 jobs lost under the scenario where the EITEs fully absorb the compliance costs. While the total number of jobs lost related to the 50 percent of costs that are assumed to be absorbed by EITEs is smaller in the 50 percent pass through scenario (211 jobs), the pass through of compliance costs to consumers would have substantial impacts on other industries. In particular, a 50 percent pass through of compliance costs from just the petroleum sector would result in a cumulative loss of approximately 266 jobs statewide. The number of jobs lost due to costs passed to consumers[21] would total about 15 jobs from 2027 to 2034. Cumulative employment effects for the sensitivity analysis are shown below in Figure 24 and Figure 25.

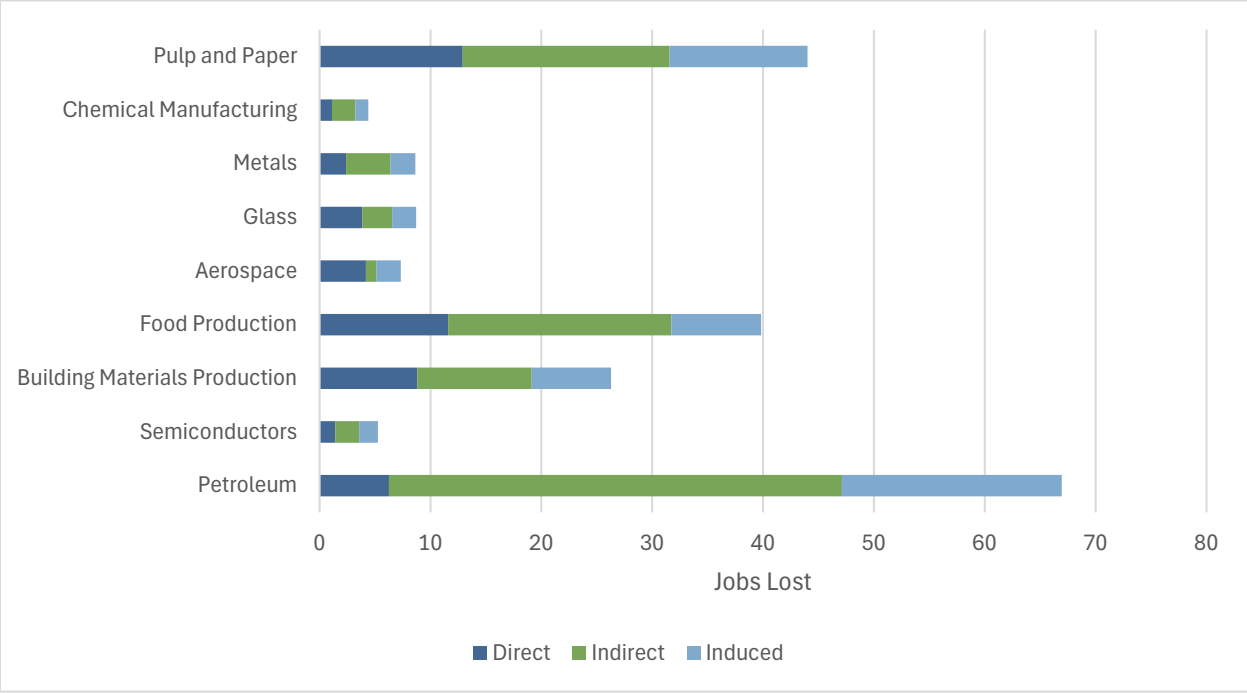

Figure 24. Statewide Cumulative Employment Effects, 50 Percent Absorbed: Sensitivity Analysis

[21] Costs passed to consumers is labeled as personal consumption in the corresponding figures, which represents the impact of higher costs for final purchases by consumers of goods and services (i.e., the consumption that counts towards GDP).

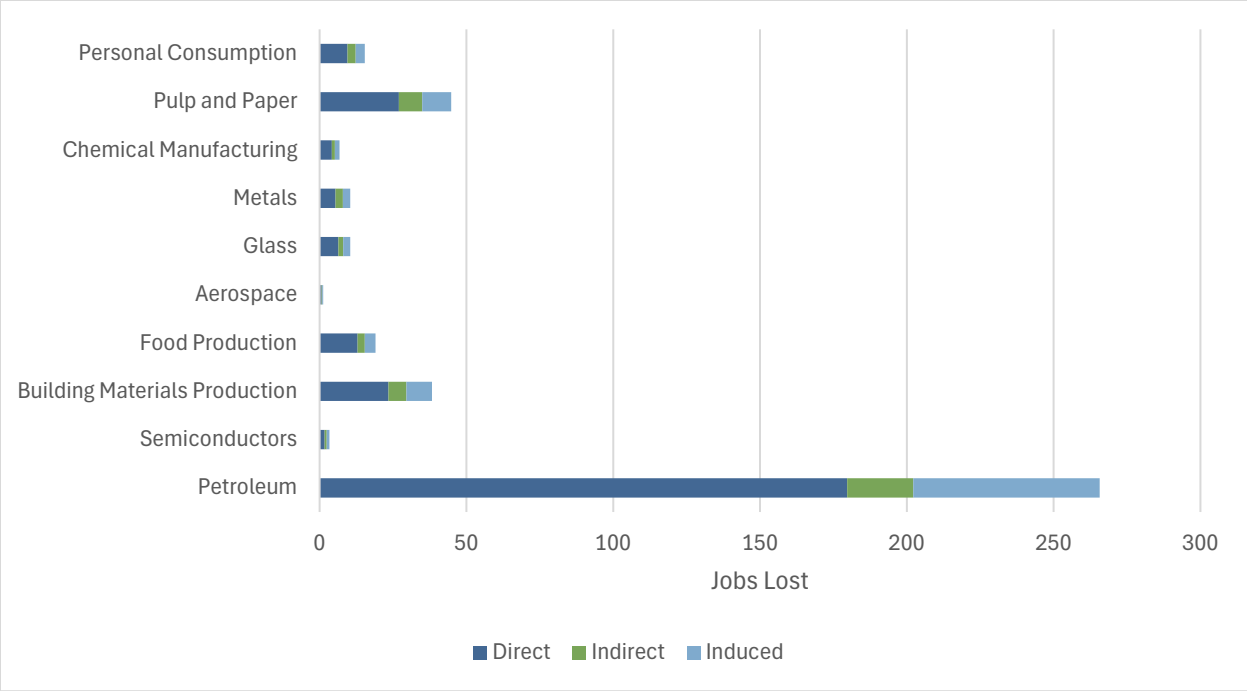

Figure 25. Statewide Cumulative Employment Effects, 50 Percent Pass Through: Sensitivity Analysis

The cumulative reduction in output under the 50 percent pass through scenario would be about $249 million, which is less than the $273 million cumulative reduction under the scenario where EITEs fully absorb the compliance costs. The majority of the reduction between 2027 and 2034 would still come from the petroleum sector, with a $106 million reduction in output due to costs absorbed by the sector and another $49 million reduction in output across the state's economy attributable to costs passed through by the petroleum sector. The loss in output from costs passed to consumers would be relatively small, totaling around $3.4 million from 2027 to 2034. Statewide output results for the 50 percent pass through scenario are shown in Figure 26 and Figure 27.

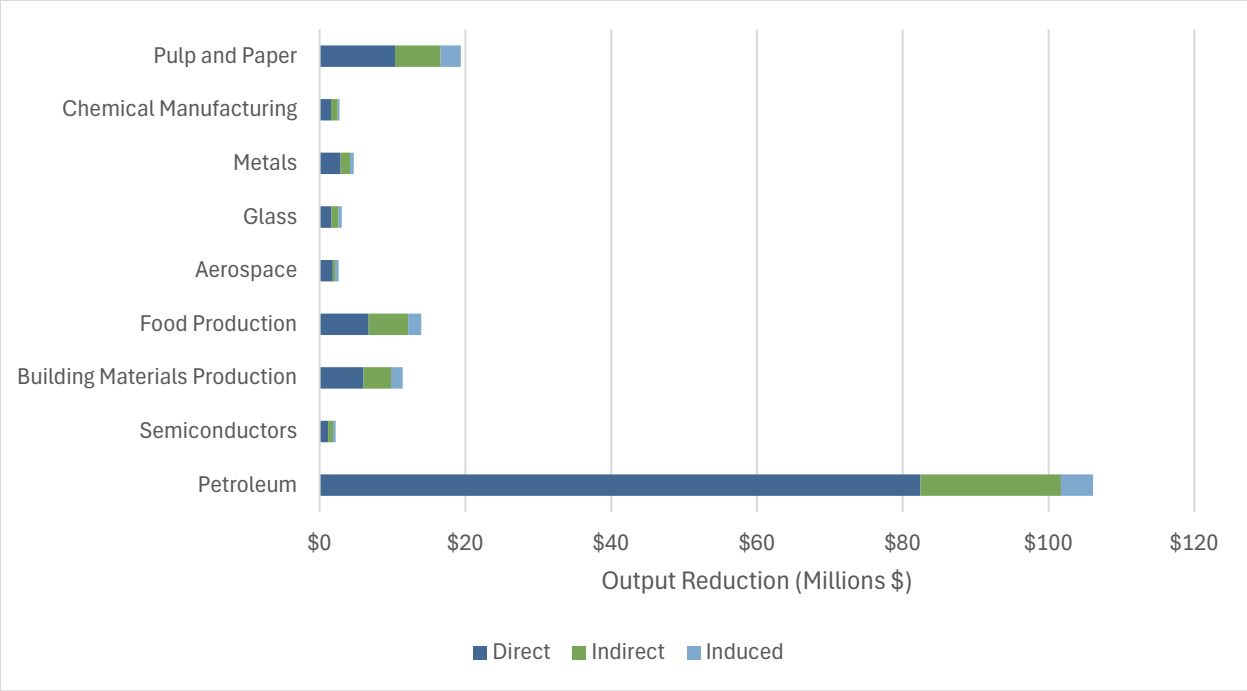

Figure 26. Statewide Cumulative Output Effects, 50 Percent Absorbed: Sensitivity Analysis

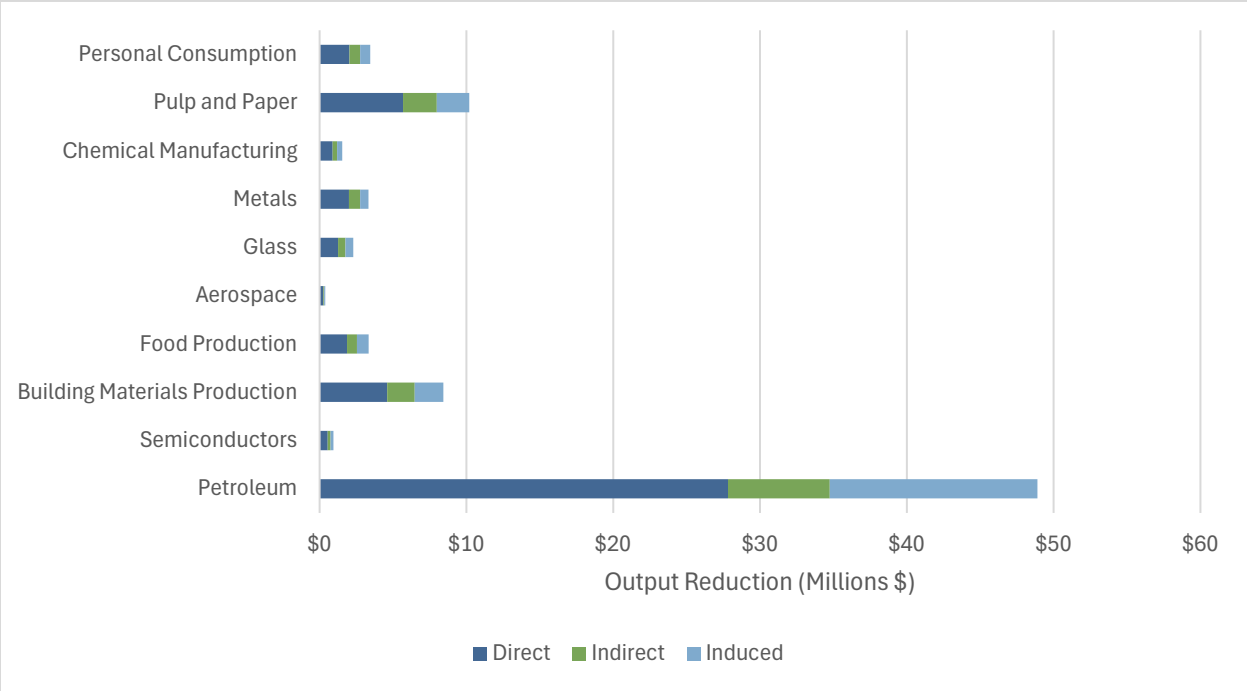

Figure 27. Statewide Cumulative Output Effects, 50 Percent Pass Through: Sensitivity Analysis

Figure 28 shows the 15 industries that would experience the largest indirect impacts to output under the 50 percent pass through scenario. Petroleum refineries would experience the largest indirect impacts, at $18.4 million. Paper mills ($4.7 million); frozen fruits, juices and vegetables manufacturing

($3.4 million); and cement manufacturing ($3.0 million) would experience smaller, but still notable indirect impacts.

Figure 29 shows the 15 industries that would experience the largest impacts from the 50 percent of compliance costs passed through by the EITEs. Truck transportation would be the most affected[22], with a modeled output reduction of $2.4 million from the costs passed through by the EITEs. Scenic and sightseeing transportation would have $1.2 million lower output, water transportation would have $1.1 million lower output, and various construction industries would experience around $1 million in reduced output each.

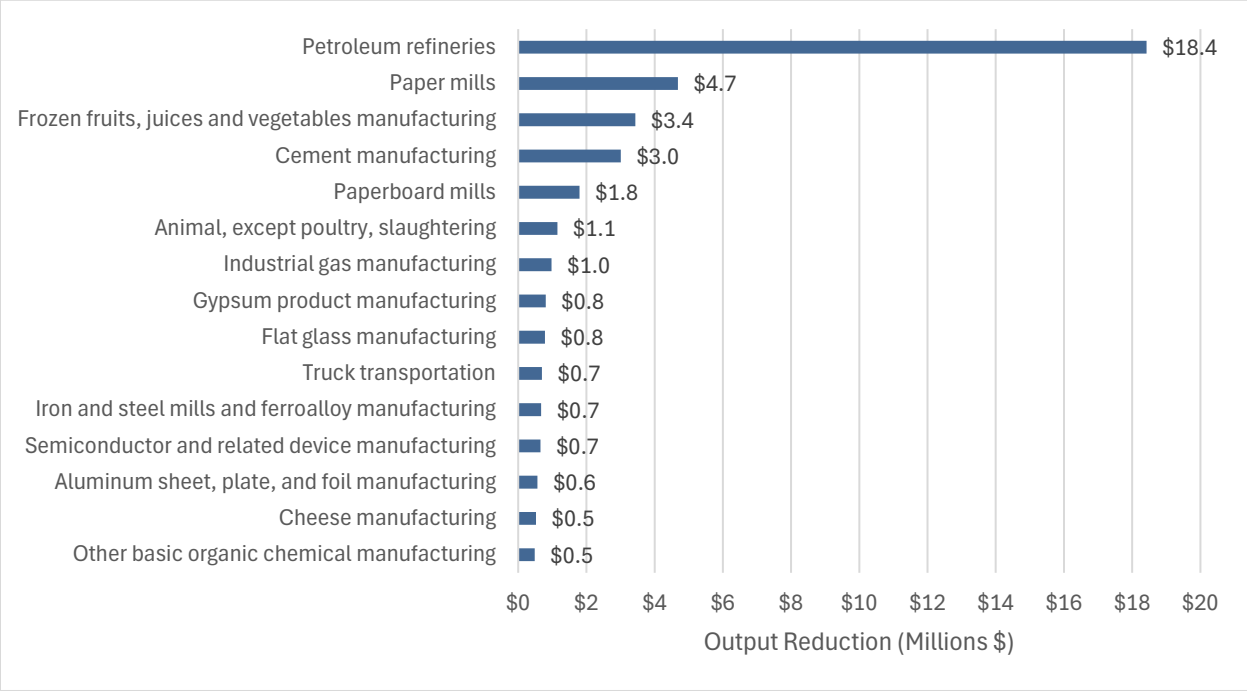

Figure 28. Statewide Indirect Output Effects, Top 15 Industries: Sensitivity Analysis

[22] The model accounts for the fact that fuels used in aviation and agriculture are exempt from the CCA compliance costs. If aviation fuels were not exempt, air transportation would experience the largest decline in output from cost pass through, estimated at $5.9 million.

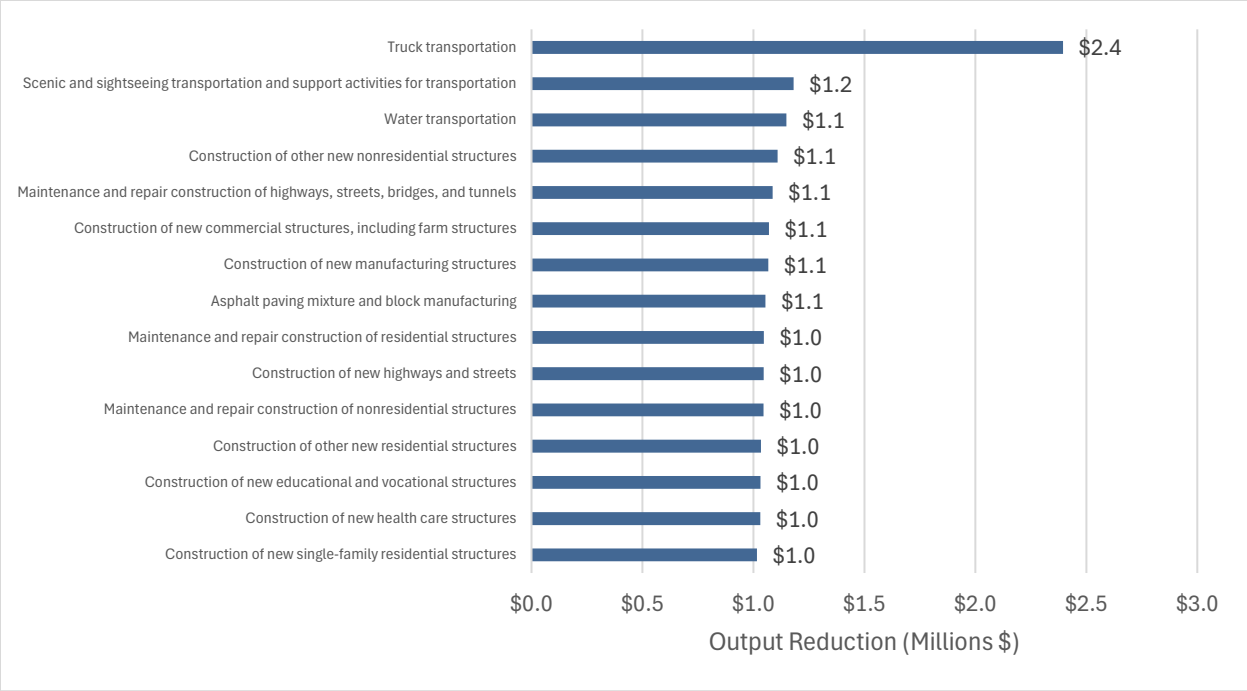

Figure 29. Statewide Output Effects, Top 15 Industries, 50 Percent Pass Through: Sensitivity Analysis

Tax revenues from 2027 to 2034 would decrease by about $24 million across the state of Washington (approximately $3 million annually) under the 50 percent pass through scenario. This is more than the $17 million reduction in tax revenue under the scenario where the EITEs fully absorb the compliance costs. However, most of the additional loss in tax revenue would be for taxes other than county and state taxes. Tax revenues would decrease by $752 thousand at the county level and $6.1 million at the state level under the 50 percent pass through scenario, compared to $752 thousand at the county level and $5 million at the state level under the scenario where the EITEs fully absorb the compliance costs. State and county tax revenue lost from 2027 to 2034 due to costs passed to consumers would total $187 thousand. Figure 30 and Figure 31 describe the cumulative expected tax effects between 2027 and 2034 under the 50 percent pass through scenario.

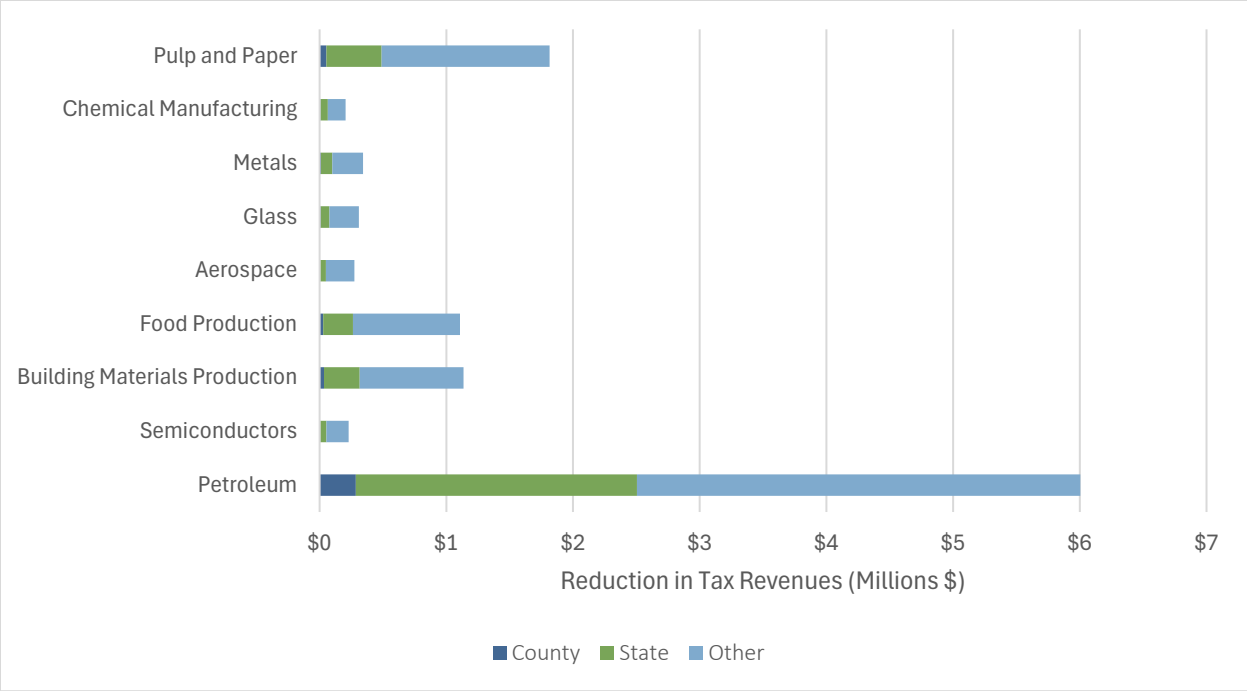

Figure 30. Statewide Cumulative Tax Effects, 50 Percent Absorbed: Sensitivity Analysis

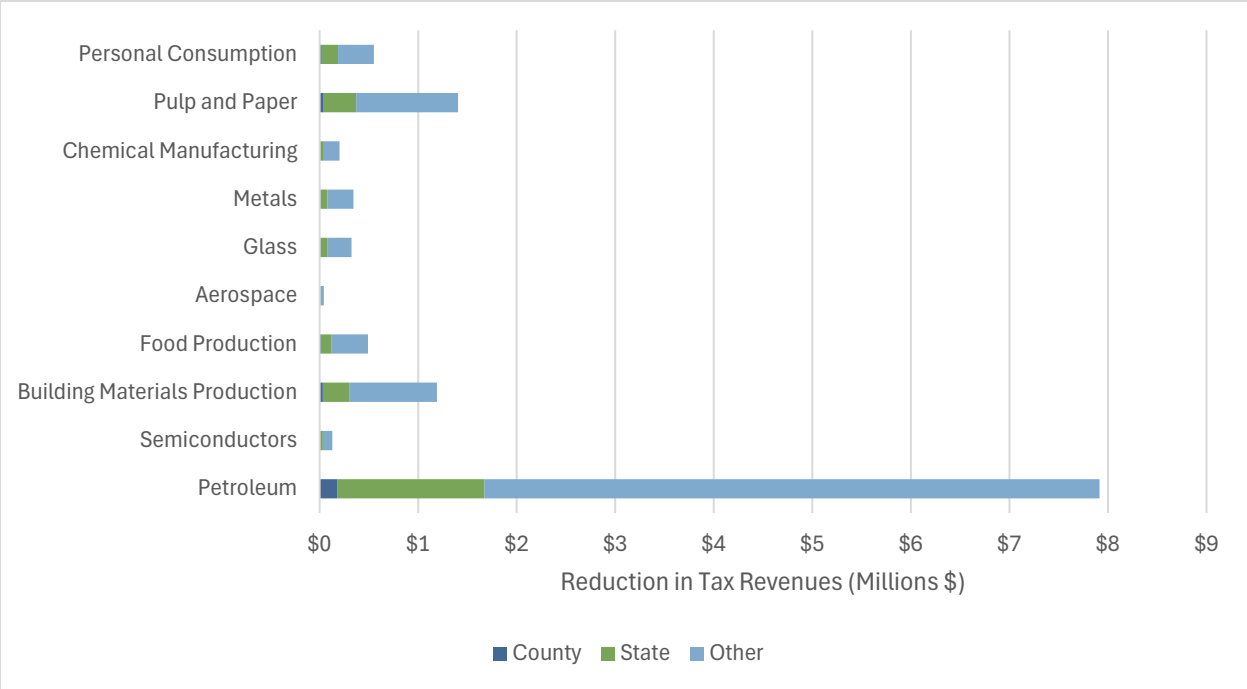

Figure 31. Statewide Cumulative Tax Effects, 50 Percent Pass Through: Sensitivity Analysis

Demographics and Overburdened Communities

Below we present demographic information for EITE host communities and explore proximity of EITEs to overburdened communities, as identified by the Department of Ecology.

Host communities compared to state

Table 17 presents select demographics of the host communities of EITE facilities. Host communities are defined as the census block groups that are within a 3-mile radius of the EITE.[23] Characteristics of those block groups surrounding each EITE are compared to the state average. Percentages that are above the state average are highlighted in blue. Demographic data is from the 2022 U.S. Census American Community Survey[xxxix] for characteristics used in the Overburdened Community Highly Impacted by Air Pollution Report.[xl]

Table 17. Demographics of host EITE communities.

EITE	Total Pop.	POC %	Below Federal Poverty %	Under 5 %	Over 64 Years Old %	No Health Insurance %
Statewide	7,705,281	34.8%	10.3%	5.7%	17.1%	6.3%
Air Liquide Hydrogen Plant - Anacortes	10,081	16.9%	7.1%	3.9%	31.0%	4.4%
Analog Devices, Inc. - Camas	65,548	31.4%	4.2%	4.7%	16.5%	5.0%
Ash Grove Cement Company - Seattle	197,788	48.1%	8.9%	4.5%	14.0%	4.7%
Basic American Foods - Moses Lake	11,625	33.9%	5.7%	7.8%	14.5%	4.7%
Boeing Commercial Airplanes - Everett	110,357	48.3%	6.2%	6.0%	13.6%	8.9%
Boeing Company - Auburn Site - Auburn	96,168	47.8%	4.4%	5.9%	13.1%	7.9%
Cardinal FG Company - Winlock	11,978	12.9%	7.0%	3.7%	22.1%	4.6%
CertainTeed Gypsum - Seattle	188,047	51.1%	7.1%	5.6%	13.8%	5.8%
Darigold - Sunnyside	29,177	83.5%	4.4%	7.9%	11.7%	18.2%
Emerald Kalama Chemical, LLC / LANXESS Corporation	9,908	12.8%	8.0%	4.4%	20.5%	5.5%
Georgia-Pacific Consumer Operations LLC - Camas	98,861	48.3%	7.9%	6.2%	12.9%	7.1%
Georgia-Pacific Gypsum LLC - Tacoma	44,054	24.8%	5.3%	5.0%	15.2%	3.5%
Goodrich Corporation / Collins Aerospace	15,019	21.6%	5.5%	7.6%	14.0%	3.3%
HollyFrontier Puget Sound Refinery LLC	11,735	15.7%	7.0%	4.0%	29.8%	4.0%
J.R. Simplot Company - Moses Lake	8,508	25.4%	4.7%	6.9%	15.5%	6.4%
J.R. Simplot Company - Othello	16,087	79.0%	5.6%	10.0%	9.4%	17.7%
Kaiser Aluminum Washington, LLC (Trentwood Works)	77,575	17.9%	8.9%	6.5%	17.7%	6.1%
Lamb Weston - Pasco	38,951	55.9%	5.3%	7.7%	10.4%	9.5%
Lamb Weston - Quincy	13,573	69.9%	4.6%	7.9%	11.4%	22.8%
Lamb Weston - Richland	53,382	28.4%	5.7%	6.4%	14.8%	4.9%
Marathon Anacortes Refinery	16,039	15.8%	7.8%	4.1%	29.2%	4.1%

[23] A 3-mile radius was used to be consistent with the methodology used by the Department of Ecology for their 2023 report on overburdened communities highly impacted by air pollution.

EITE	Total Pop.	POC %	Below Federal Poverty %	Under 5 %	Over 64 Years Old %	No Health Insurance %
Matheson - Anacortes	10,612	16.3%	7.0%	3.9%	30.9%	4.3%
McCain Foods	16,087	79.0%	5.6%	10.0%	9.4%	17.7%
Nippon Dynawave	45,687	21.9%	9.3%	6.6%	19.3%	6.1%
North Pacific Paper Company, LLC	46,010	21.9%	9.4%	6.5%	19.2%	6.1%
Nucor Steel Seattle, Inc.	132,508	42.7%	8.1%	4.5%	14.7%	4.4%
Nutrien Kennewick Fertilizer Operations	12,304	39.4%	4.1%	5.1%	15.2%	13.3%
Owens-Brockway Glass Container Inc Plant	8,112	14.8%	8.2%	5.3%	20.4%	6.7%
Packaging Corporation of America	5,961	44.7%	4.5%	7.7%	14.9%	10.2%
Phillips 66 Ferndale Refinery	12,580	32.6%	7.7%	4.0%	23.8%	7.1%
Port Townsend Paper Corporation	18,501	12.4%	10.0%	2.1%	39.6%	5.4%
Solvay Chemicals, Inc.	46,844	22.4%	9.5%	6.4%	19.1%	6.0%
Steelscape - Kalama	8,112	14.8%	8.2%	5.3%	20.4%	6.7%
Tyson Fresh Meats, Inc. - Wallula	5,818	37.5%	4.2%	6.0%	15.9%	10.9%
U.S. Oil & Refining Co. - Tacoma	107,603	51.0%	9.1%	6.5%	12.2%	7.5%
WaferTech LLC - Camas	83,228	32.5%	4.3%	5.0%	15.8%	5.6%
Washington Potato Company	3,758	58.8%	6.7%	5.2%	18.2%	11.8%
WestRock LLC	31,053	21.0%	12.6%	5.3%	18.4%	7.4%
BP Cherry Point Refinery - Blaine	9,801	14.8%	5.9%	7.8%	20.4%	3.3%

Overburdened Communities

Overburdened Communities (OBC's) in Washington State are census tracts where vulnerable populations face cumulative environmental and health impacts.[xli] The areas integrate 2010 census tracts ranked 9 or 10 by the Washington Environmental Health Disparities Map, tracts identified as "disadvantaged" by the federal Climate and Economic Justice Screening Tool, and tracts overlapping with Tribal Reservations.

Ecology uses OBC data and air quality data to identify OBCs Highly Impacted by Air Pollution.[xlii] These are census tracts where people who are vulnerable to health, social, and environmental inequities are also highly impacted by criteria air pollution. In addition to OBCs, this analysis looked at the proximity of EITEs to Tribal Lands, which include Reservations, disputed lands, Off-Reservation Tribal Land, and rescinded Reservation features.[xliii]

There are 20 EITEs located within overburdened communities in Washington State, and an additional 15 EITE facilities located nearby (within three miles) of overburdened communities (see Figure 32). Of those 35 facilities, 10 are located in six overburdened communities highly impacted by air pollution and four more are within three miles of overburdened communities highly impacted by air pollution. See Table 18 for additional details and Figure 33 for a map of EITE facilities and the overburdened communities highly impacted by air pollution.

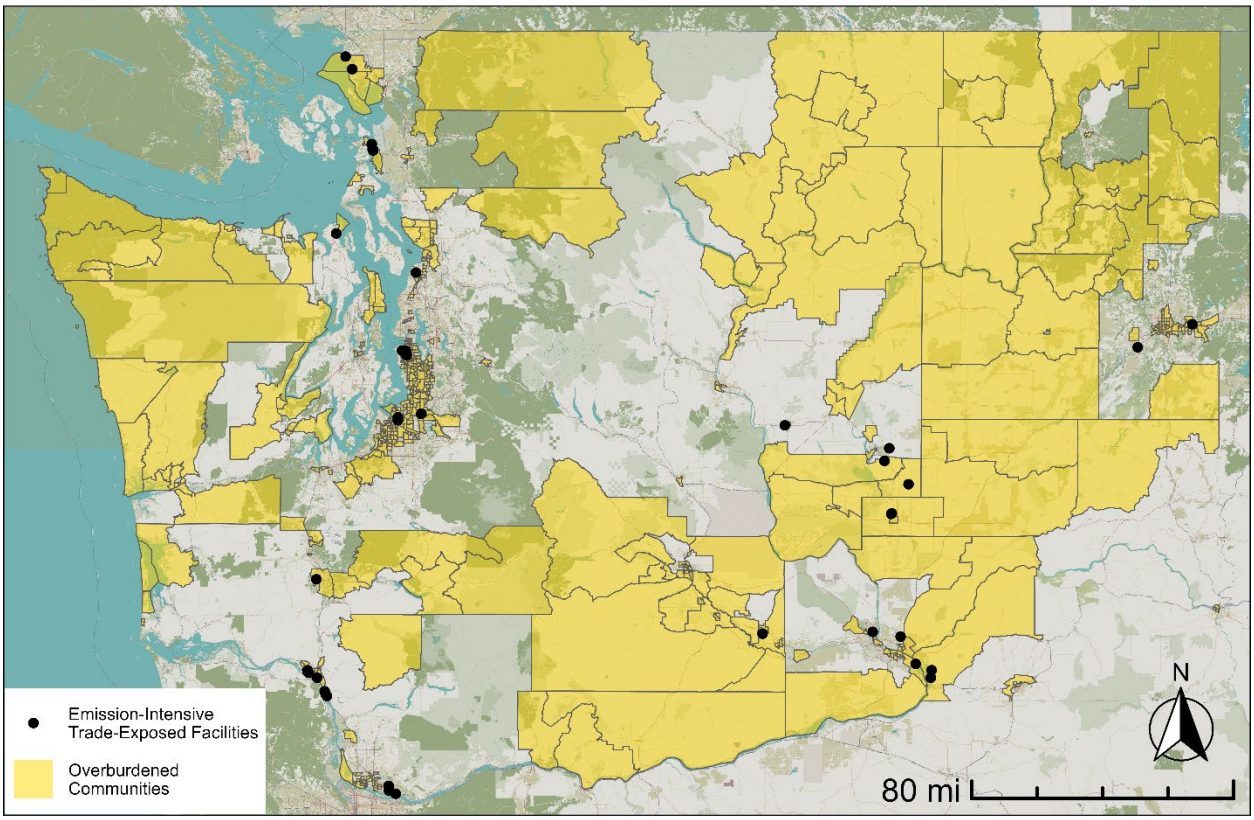

Figure 32. Map of overburdened communities and EITE facilities.

Table 18. EITEs in Overburdened Communities

Overburdened Community Highly Impacted by Air Pollution	EITE Facilities
South Seattle	Ash Grove Cement Co. CertainTeed Gypsum Nucor Steel Seattle
Tri-Cities to Wallula	Tyson Fresh Meats Packaging Corp. of America Nutrien US *Lamb-Weston Pasco*[2424] *Lamb-Weston Richland*[24]
Everett	Boeing Commercial Airplanes
Lower Yakima Valley	Darigold-Sunnyside
South King County	Boeing Company-Auburn *U.S. Oil & Refining Co*[2424]

[24] EITE facility is located within 3 miles of overburdened community.

	Georgia-Pacific Gypsum[2424]
Spokane and Spokane Valley	Kaiser Aluminum
South and East Tacoma	*U.S. Oil & Refining Co*[2424] *Georgia-Pacific Gypsum*[2424]

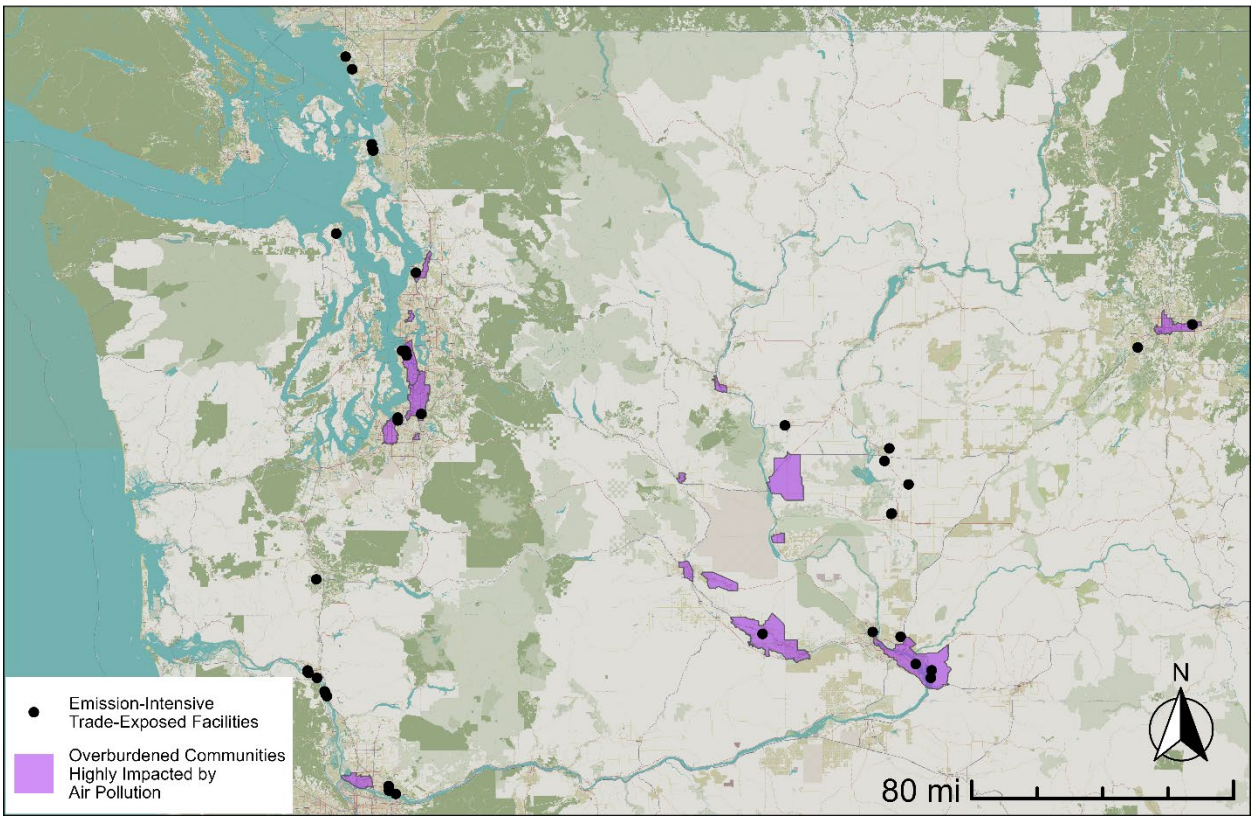

Figure 33. Map of EITEs and OBCs highly impacted by air pollution.

There are six Tribal Reservations that either have EITEs within their boundaries or are located within 10 miles of one or more EITEs (shown in Table 19), many of which are refineries. Figure 34 presents the EITE locations and Tribal Reservations in Washington State.

Table 19. EITEs Within or Nearby Tribal Reservations

Tribal Reservation	EITE Facilities
Puyallup Reservation	Georgia-Pacific Gypsum U.S. Oil & Refining Co. *Boeing Company-Auburn*[2525]
Swinomish Reservation	*HF Sinclair Puget Sound Refinery*[25] *Marathon Anacortes Refinery*[2525] *Air Liquide Hydrogen Plant*[2525] *Matheson-Anacortes*[2525]
Lummi Reservation	*BP Cherry Point Refinery*[2525] *Phillips 66 Ferndale Refinery*[2525]
Yakima Reservation	*Dairygold-Sunnyside*[2525]
Muckleshoot Reservation	*Boeing Company-Auburn*[2525] *U.S. Oil & Refining Co*[2525] *Georgia-Pacific Gypsum*[2525]
Tulalip Reservation	*Boeing Commercial Airplanes*[2525]

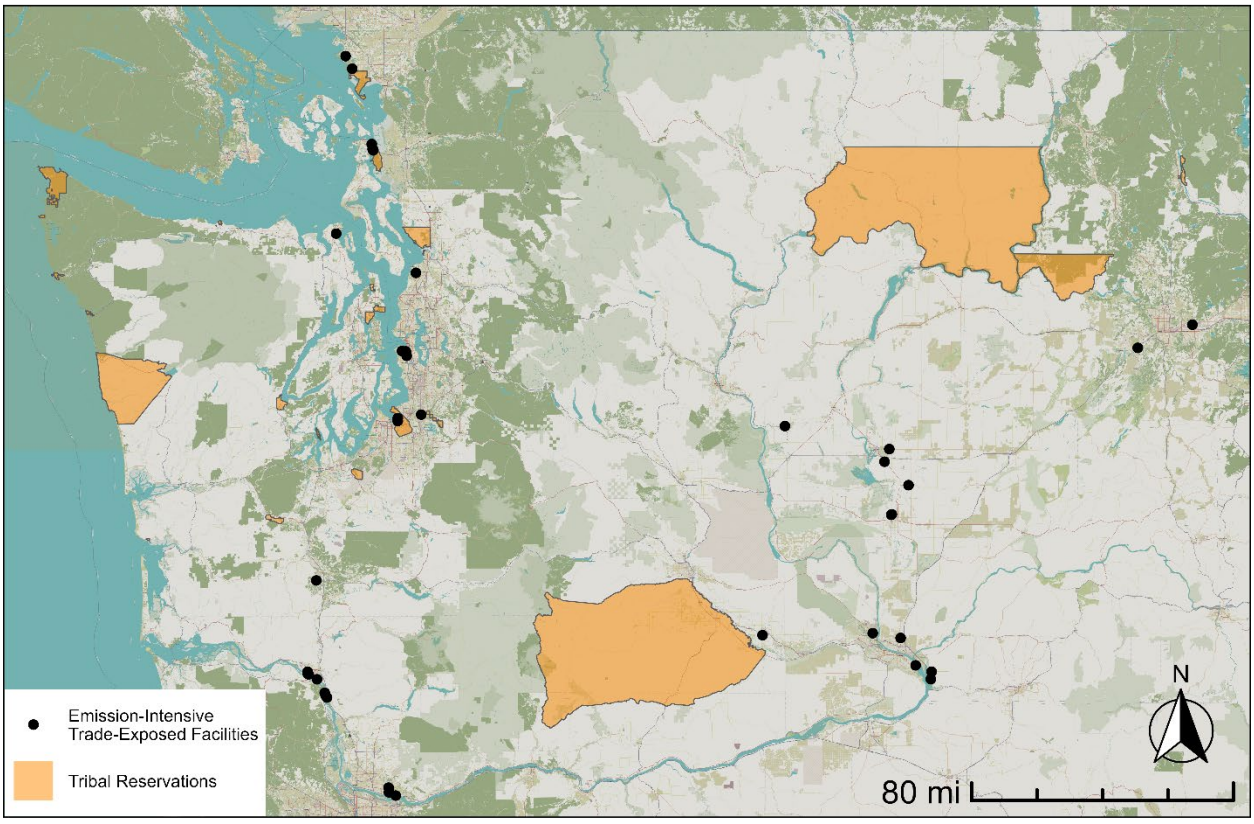

Figure 34. Map of EITE locations and Tribal Reservations

[25] EITE facility is located within 10 miles of Tribal Reservation.

Emissions, Health, Economic Impacts and Air Quality

Below we present an analysis that combines demographic data on race and poverty of EITE host communities with indicators of emissions, air quality, health impacts and economic impacts. Table 20 shows the names of the facilities where host communities had people of color (POC) or poverty rates above the state average (34.5 percent for POC and 10.3 percent for poverty rate) and the following indicators:

- **High EITE Emissions:** EITE emissions in top 25 percent across all EITEs
- **High Health Impacts:**
    - Estimated asthma incidence from baseline CAP emissions in top 25 percent across all EITEs
    - Valuation of health impacts from baseline CAP emissions in top 25 percent across all EITEs
- **High Economic Impacts:** Economic impacts for current economic contribution in top 25 percent across all EITEs

Table 20. EITEs with High Emissions, High Health Impacts, and High Economic Impacts

Criteria	POC Percentage of census block groups surrounding EITE over State Average	Percent Poverty of census block groups surrounding EITE over State Average
High EITE Emissions		
CO	Ash Grove Cement Company Boeing Commercial Airplane Auburn Nucor Steel Seattle Inc Packaging Corporation of America	WestRock LLC - Longview
NOX	Ash Grove Cement Company Boeing Commercial Airplane Auburn Nucor Steel Seattle Inc	WestRock LLC - Longview
SO2	Packaging Corporation of America - Wallula	WestRock LLC - Longview
High Health Impacts		
Asthma Incidence (top 25%)	Ash Grove Cement Company Boeing Company Nucor Steel Seattle, Inc	WestRock LLC - Longview
Valuation of Health Impacts (top 25%)	Ash Grove Cement Company - Seattle	N/A
High Economic Impacts		
Total Direct, Indirect and Induced Output Impacts	Boeing Commercial Airplanes – Everett Tyson Fresh Meats, Inc. – Wallula CertainTeed Gypsum - Seattle	WestRock LLC - Longview

Note: N/A indicates no facilities met criteria.

For air quality, Table 21 shows the names counties that host EITE facilities where host communities had people of color or poverty rates above the state average and the following indicators:

- **Poor Air Quality:** Air quality monitoring data from monitoring sites within the county indicate results above NAAQS for CAPs.

Table 21. EITE Host Counties with Air Quality over NAAQS

YCriteria	POC Percentage of census block groups surrounding EITE over State Average	Percent Poverty of census block groups surrounding EITE over State Average
Poor Air Quality		
CO	N/A	N/A
NOX	N/A	N/A
SO2	N/A	N/A
O3	Benton Clark King	N/A

Note: N/A indicates no facilities met criteria.

Case Studies

We have compiled three case studies with more detailed assessments of the relative contribution of EITEs to air quality in host communities, information on federal regulatory actions that may impact emissions, and the demographic characteristics of those communities. These case studies were selected because they host a large number of EITEs and have high levels of GHG emissions from EITEs.

Cowlitz County

Cowlitz County has the highest number of active EITEs facilities in Washington. The county has seven EITE facilities across four industries. Additionally, the county contains one power plant, which is not an EITE but is a covered entity under the Cap-and-Invest Program.[26] See Table 22 for the number of facilities by industry.

Table 22. Cowlitz County EITE facilities by industry

Industry	Cowlitz County Facilities
Chemical Manufacturing	2
Glass Manufacturing	1
Steel and Aluminum	1
Pulp and Paper	3

[26] This excludes greenhouse gas emissions from covered entities that are not deemed 'point sources' of emissions, such as natural gas and other fuel suppliers.

GHG Emissions

Table 23 summarizes Cowlitz County reported greenhouse gas emissions in 2023 by facility. This excludes emissions from covered entities that are not considered 'point sources', such as natural gas and transportation fuel suppliers. In 2023 EITEs emitted 48 percent of Cowlitz County's covered greenhouse gas emissions and 100 percent of the County's biogenic emissions. Biogenic emissions are not covered under the Cap-and-Invest Program, which suggests that CAP and HAP emissions associated with biogenic GHG emissions will not be affected by the program. Overall, EITEs are responsible for about 79 percent of the County's reported emissions. The three pulp and paper facilities produce over half of the County's total greenhouse gas emissions.

Table 23. 2023 Greenhouse gas emissions for Cowlitz County by facility (MTCO2e)

Industry	Covered Facility	Covered Emissions	Biogenic Emissions	Total Emissions
Pulp and Paper	Nippon Dynawave	376,528	1,197,530	1,574,058
	WestRock	182,345	1,129,402	1,311,747
	North Pacific Paper	36,395	-	36,395
Chemical Manufacturing	Solvay Chemicals, Inc.	50,068	-	50,068
	LANXESS Corporation	60,120	-	60,120
Glass Manufacturing	Owens-Brockway Glass Container, Inc.	21,704	-	21,704
Steel and Aluminum	Steelscape	18,633	-	18,633
Power Plants[27]	*Mint Farm Generating Station*	*798,751*	-	*798,751*
Total	--	1,544,544	2,326,932	3,871,476

CAP Emissions

Figure 35 summarizes the EITE proportion of CAP emissions in Cowlitz County from 2022. EITEs produced over 80 percent of the County's sulfur dioxide emissions and over forty percent of the County's nitrous oxide emissions. EITEs produced less than twenty percent of all other CAPs.

[27] The Mint Farm Generating Station is not an EITE but is considered a covered source under the Cap and Invest Program.

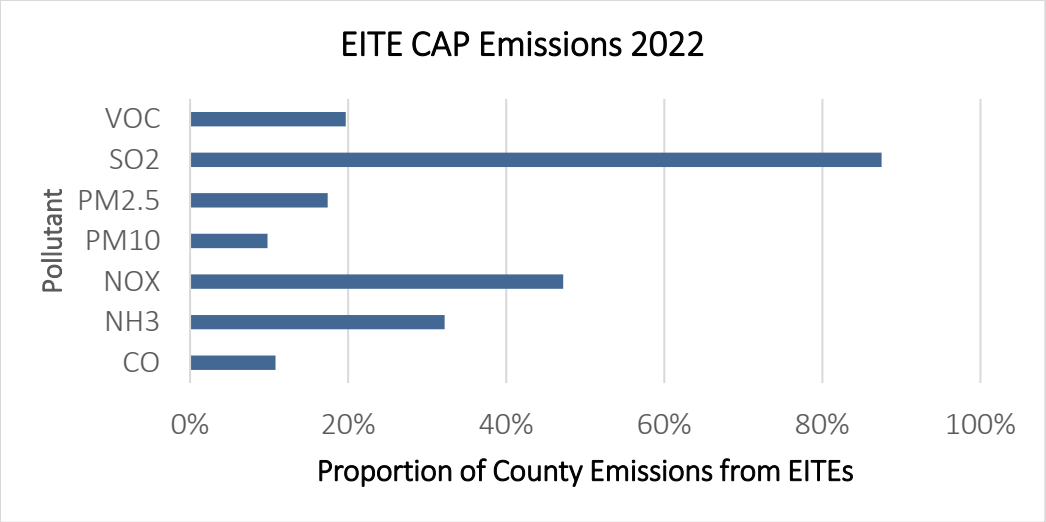

Figure 35. EITE proportion of Cowlitz County CAP emissions 2022

Table 24 provides proportion of County CAP emissions from 2022 by covered facility. Pulp and Paper facilities are the largest EITE emitters of CAPs in Cowlitz County. In 2022, the Nippon Dynawave facility alone was responsible for over half of the county's sulfur dioxide and almost one third of the county's nitrous oxide emissions. Collectively, the pulp and paper facilities emitted 85 percent of the county sulfur dioxide, over 45 percent of the county's nitrous oxides, and nearly one third of the county's ammonia. In contrast, EITEs in the chemical, glass and steel and aluminum industries emitted a small proportion of each of the county's CAPs.

Table 24. 2022 Cowlitz County CAP emissions by covered facilities in tons. (Proportion of county total)

Industry	Covered Facility	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
Pulp and Paper	Nippon Dynawave	1498.66 (7.2%)	48.7 (13.3%)	2069.05 (31.0%)	116.66 (3.6%)	106.81 (6.4%)	432.6 (58.0%)	150.51 (3.3%)
	North Pacific Paper	273.78 (1.3%)	0 (0.0%)	4.62 (0.1%)	8.25 (0.3%)	8.25 (0.5%)	0.22 (< 0.1%)	318.85 (7.0%)
	WestRock	443.41 (2.1%)	68.56 (18.8%)	981.73 (14.7%)	162.94 (5.0%)	146.25 (8.8%)	201.12 (27.0%)	207.71 (4.6%)
Chemical Manufacturing	Solvay Chemicals	--	--	--	--	--	--	--
	LANXESS Corporation	38.64 (0.2%)	0.41 (0.1%)	70.03 (1.1%)	12.29 (0.4%)	12.29 (0.7%)	1.99 (0.3%)	201.66 (4.4%)

Industry	Covered Facility	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
Glass Manufacturing	Owens-Brockway Glass Container	2.26 (< 0.1%)	--	21.29 (0.3%)	8.48 (0.3%)	8.44 (0.5%)	16.29 (2.2%)	14.18 (0.3%)
Steel and Aluminum	Steelscape	--	--	--	--	--	--	--
Power Plants[28]	*Mint Farm Generating Station*	0.24 (< 0.1%)	7.51 (2.1%)	42.52 (0.6%)	21.45 (0.7%)	21.45 (1.3%)	3.25 (0.4%)	3.93 (0.1%)
Covered Sources Total	All Covered Facilities	2257 (10.8%)	125.2 (34.3%)	3189.2 (47.8%)	330.1 (10.2%)	303.5 (18.2%)	655.5 (87.9%)	896.8 (19.8%)
County Total		20,846.4	365.0	6,668.6	3,236.7	1,669.7	745.7	4,533.4

HAP Emissions

Table 25 presents the sum of 2022 HAP emissions by covered facility.

Table 25. 2022 Cowlitz County HAP emissions by covered facilty

Industry	Covered Facility	Total HAPs (tons)	% of County Total
Pulp and Paper	Nippon Dynawave	43.78	8.28%
	North Pacific Paper	--	--
	WestRock	0.01	0.00%
Chemical Manufacturing	Solvay Chemicals	--	--
	LANXESS Corporation	0.05	0.01%
Glass Manufacturing	Owens-Brockway Glass Container	<0.0005	0.00%
Steel and Aluminum	Steelscape	--	--
Power Plants[29]	*Mint Farm Generating Station*	5.48	1.04%
Total		49.32	9.32%

Air Quality

There are two air quality monitoring sites for HAPs in Cowlitz County. As described in more detail above, analysis of air quality monitoring data did not find cancer or non cancer risk greater than 1 in a million, or annual average ambient monitoring data equal or greater than acceptable source impact levels.

[28] Facility is not classified as EITE but is a covered source under the CCA.

[29] Facility is not classified as EITE but is a covered source under the CCA.

Federal Regulatory Actions

In Cowlitz County, one EITE and one other covered facility are subject to changes in federal air quality regulations that may affect future emissions. WestRock Longview, LLC is subject to 40 CFR Part 63, Subpart DDDDD, which was amended in 2022 with several numeric emission limits for new and existing boilers and process heaters, including compliance dates for these new emissions limits, which are expected to affect emissions of HCl, PM, Non-Hg metals and Hg[xliv,30]. The Mint Farm Generating Station is subject to 40CFR 60 Subpart TTTT, which was amended in 2024, and is expected to reduce emission of CO2, NOX, SO2, PM2.5 and Mercury[xlv]. The Mint Farm facility is also subject to proposed changes to 40CFR 60 Subpart GG and 40 CFR 60 Subpart KKK, which both strengthen limits on NOX for most new, modified, and reconstructed fossil fuel-fired stationary combustion turbines[xlvi].

Proximity to Overburdened Communities

Cowlitz County is home to just under 1.5 percent of the state's population. The county's poverty rate is higher than the state average and has a slightly higher percentage of population without health insurance. See Table 26 for additional demographic information.

Table 26. Cowlitz County demographics compared to Washington State

Demographics	Cowlitz County[xlvii]	Washington State[xlviii]
Total population	113,982	7,705,281
People of color	18.0%	33.4%
Poverty rate	13.4%	10.3%
Under 5 years of age	5.8%	5.7%
Over 64 years of age	19.7%	17.1%
Population without health insurance	7.0%	6.3%

Demographic data for Cowlitz County can be displayed in relation to EITE locations to illustrate any patterns that might be considered in relation to the impacts of these facilities on host communities. Figure 36 shows the percentage of people under age 5 for all block groups in Cowlitz County and the locations of EITEs. Figure 37 shows the percentage of people over age 64, Figure 38 shows the percentage of people of color, Figure 39 shows the percentage of people below the poverty line, and Figure 40 shows the percentage of people without health insurance.

[30] The 2024 final rulemaking is being reconsidered. Source: U.S. Environmental Protection Agency, 2025, *Greenhouse Gas Standards and Guidelines for Fossil Fuel-Fired Power Plants*, https://www.epa.gov/stationary-sources-air-pollution/greenhouse-gas-standards-and-guidelines-fossil-fuel-fired-power

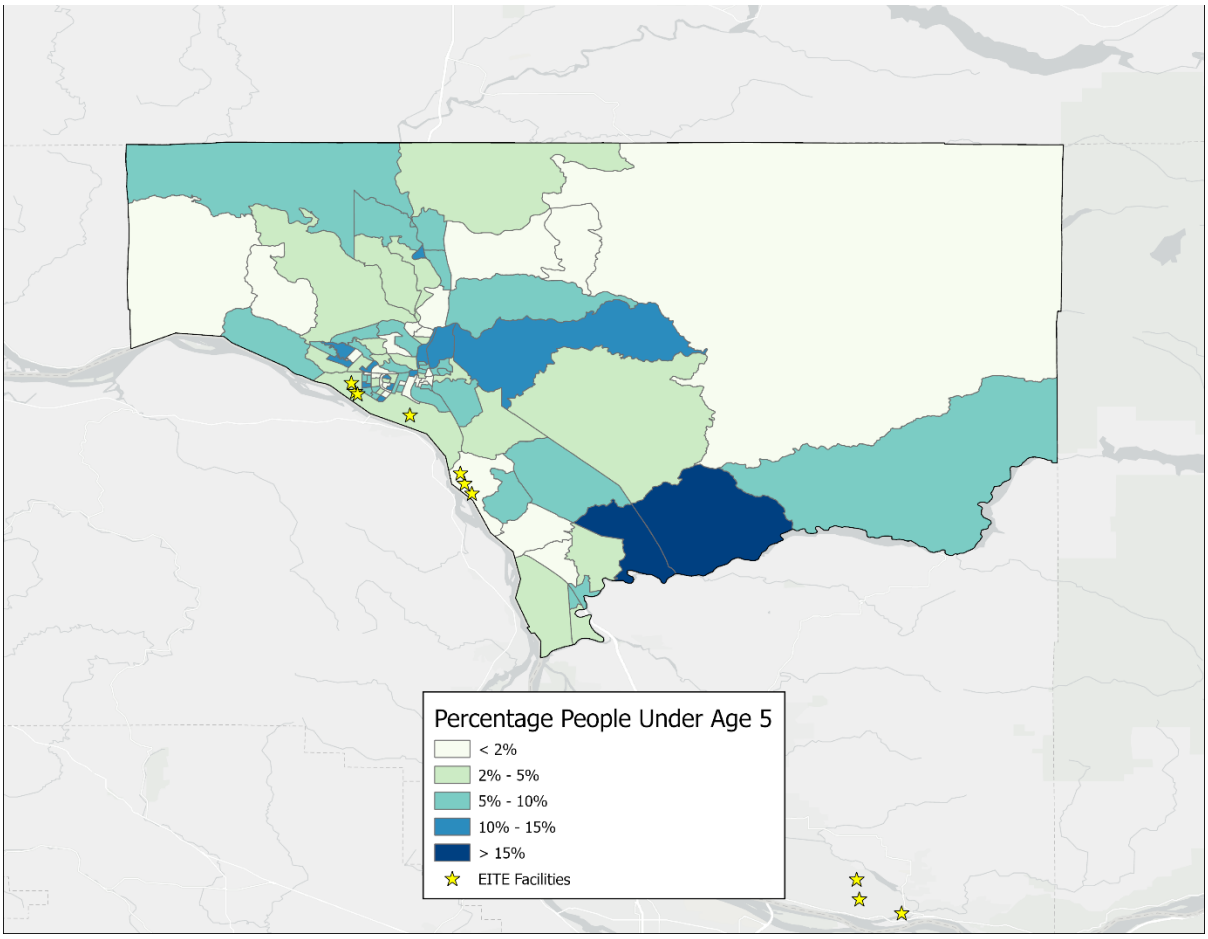

Figure 36. Percentage of people under age 5 by Census Block Group and EITE locations in Cowlitz County

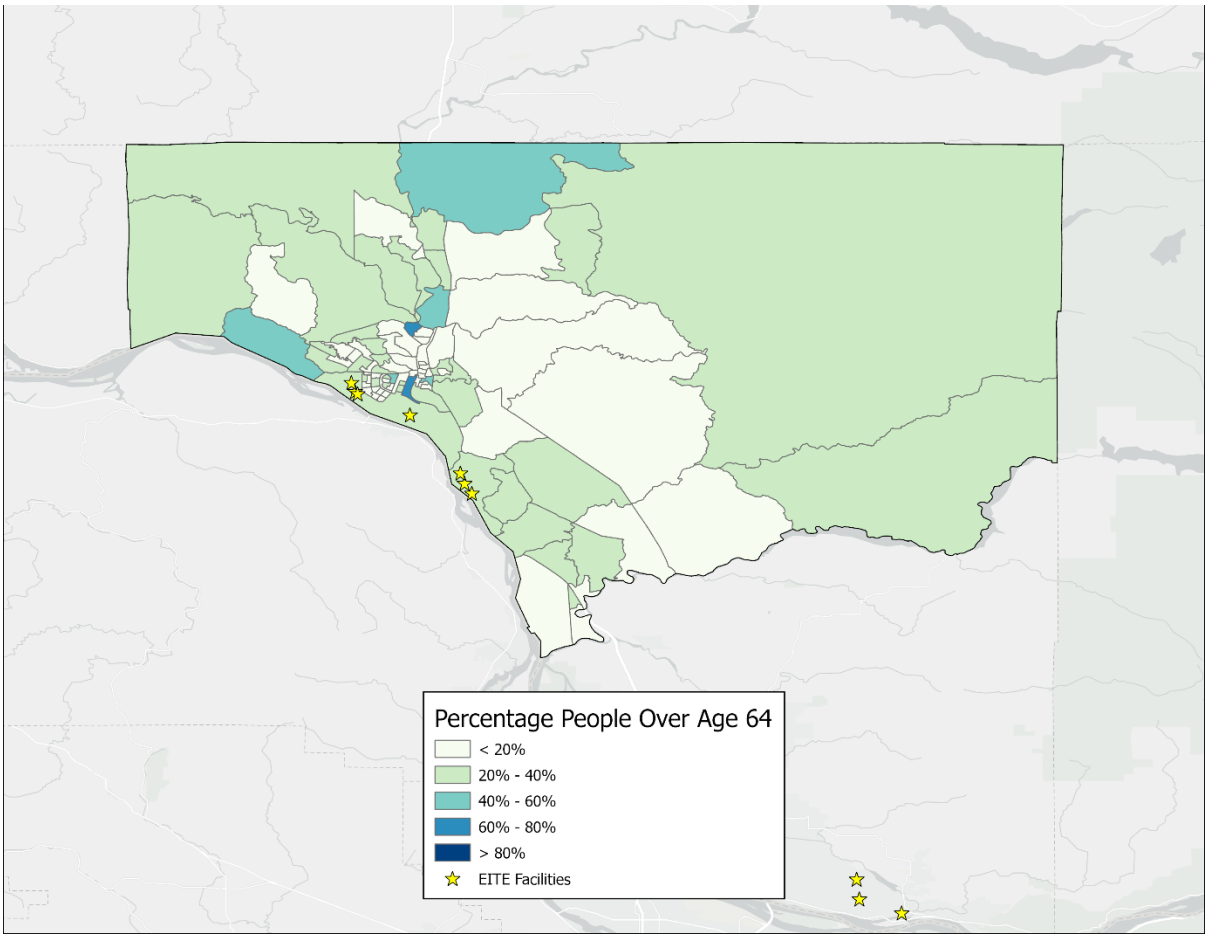

Figure 37. Percentage of People Over Age 64 by Census Block Group and EITE Locations in Cowlitz County

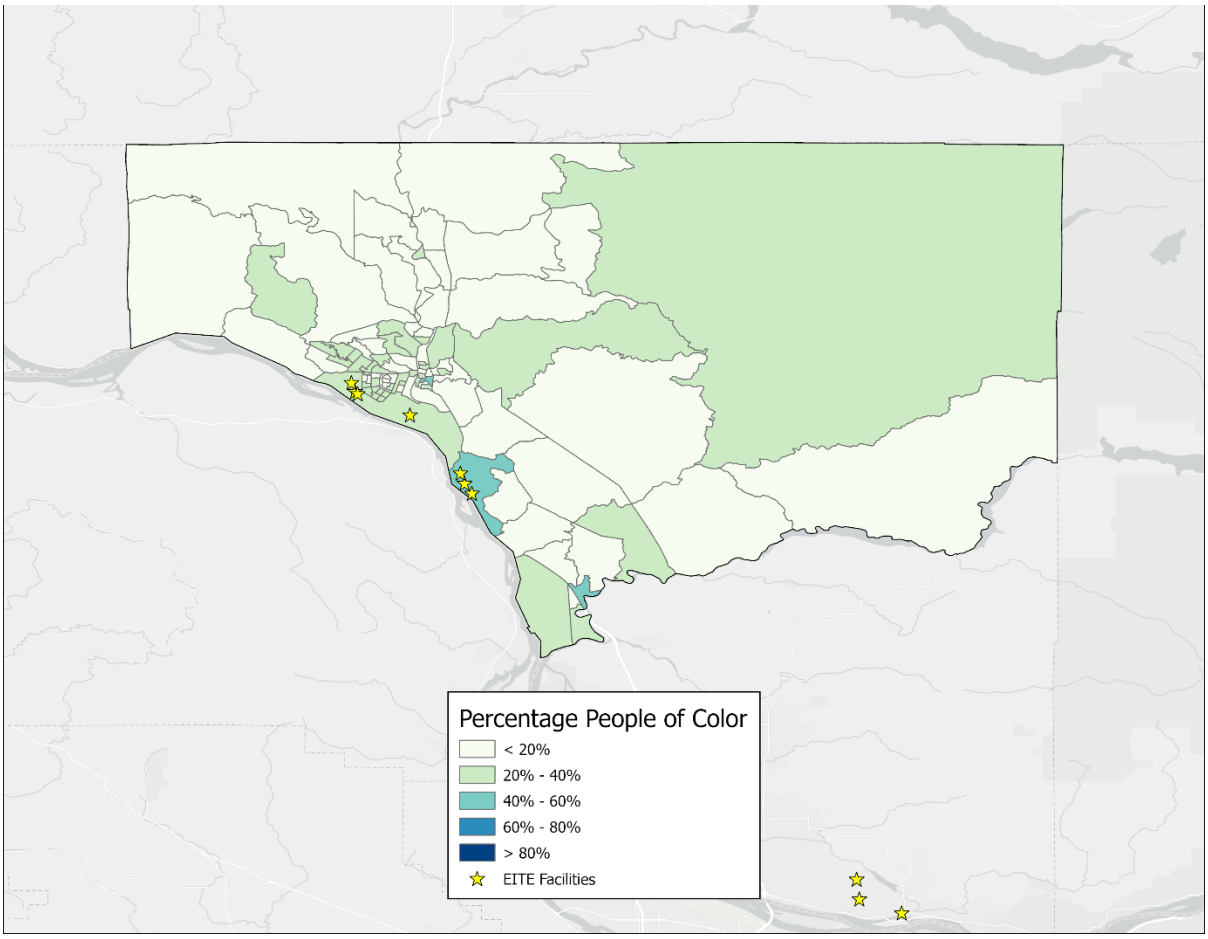

Figure 38. Percentage of People of Color by Census Block Group and EITE Locations in Cowlitz County

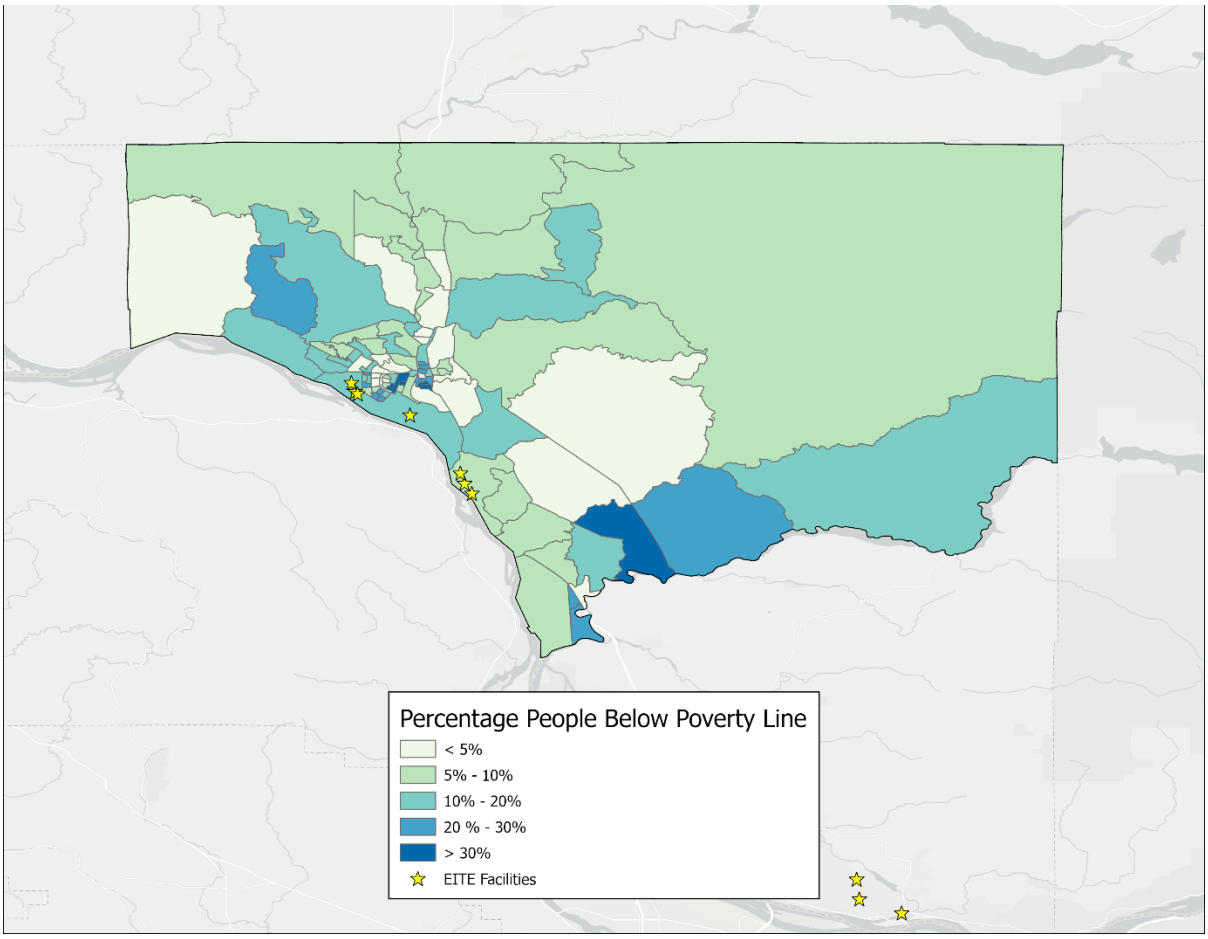

Figure 39. Percentage of People Below the Poverty Line by Census Block Group and EITE Locations in Cowlitz County

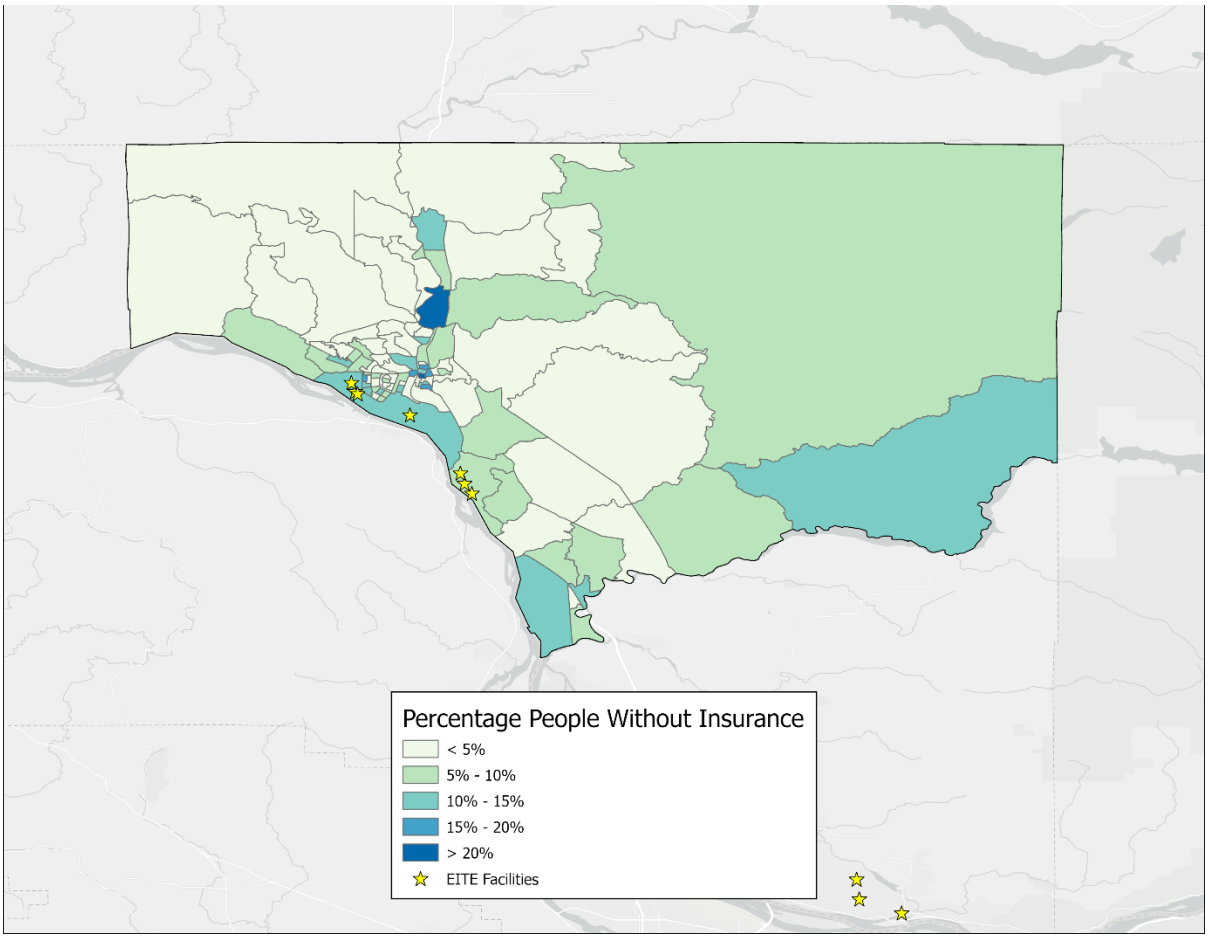

Figure 40. Percentage of People Without Health Insurance by Census Block Group and EITE Locations in Cowlitz County

As shown in Figure 41, there are eleven census tracts within the county designated as OBCs. Four of the seven EITEs are located in OBCs. There are no Tribal Lands in Cowlitz County. There are no overburdened communities highly impacted by air pollution in Cowlitz County.

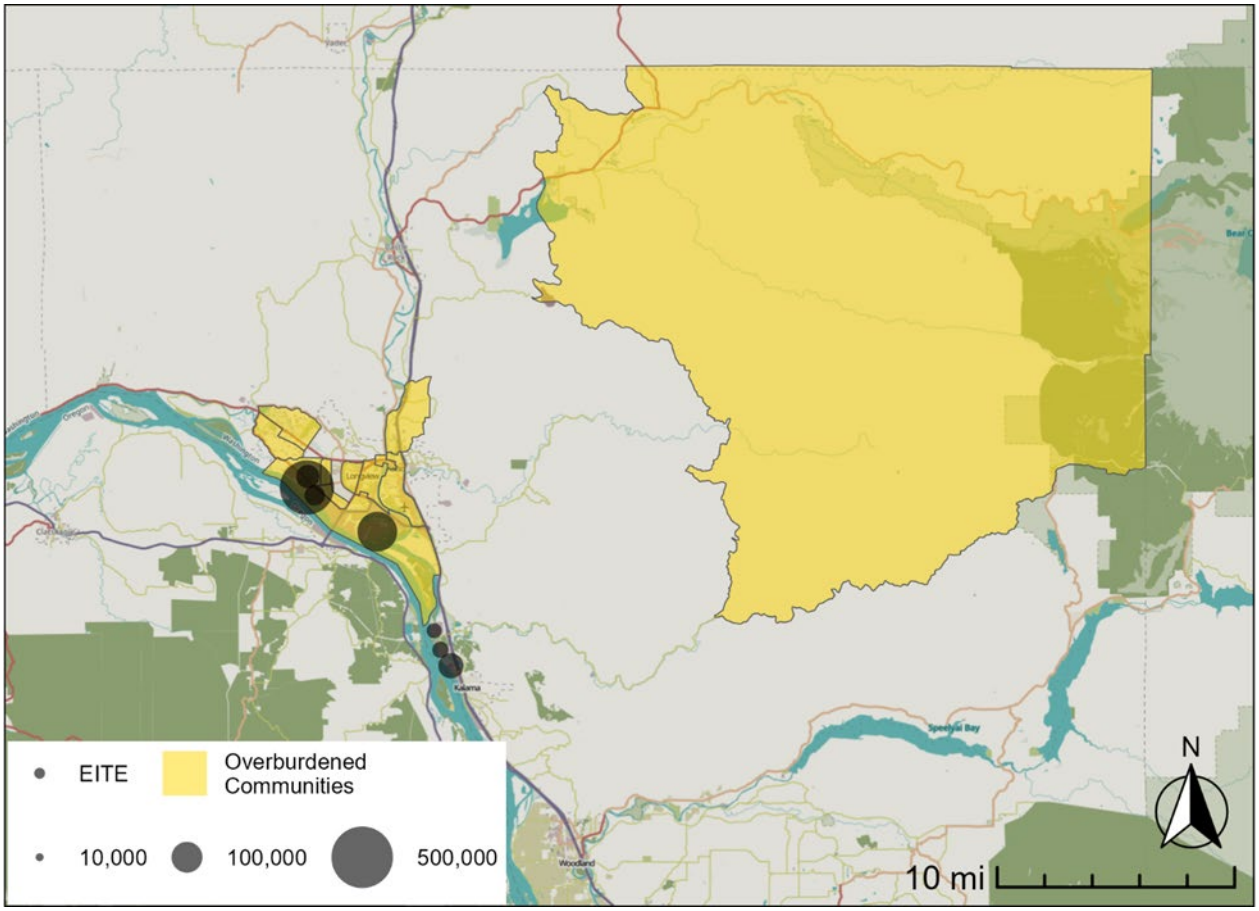

Figure 41. Map of Cowlitz County EITEs and OBC's

King County

King County, along with Skagit and Grant Counties, contains four EITEs. Table 27 provides the number of EITE facilities by industry. Three of the four EITEs are located within Seattle. In addition to EITEs, King County is host to three other covered sources.

Table 27. King County EITEs by industry

Industry	EITE
Aerospace	1
Building Materials Production	2
Steel and Aluminum	1
Total	**4**

GHG Emissions

Table 28 summarizes King County reported greenhouse gas emissions in 2023 by covered facility. In 2023 EITEs emitted 46 percent of King County's reported greenhouse gas emissions excluding non-point sources. Ash Grove Cement Company produced the majority of EITE greenhouse gas emissions. EITEs

and other covered sources under the CAA combined produced almost two thirds of the County's reported emissions.

Table 28. 2023 Greenhouse gas emissions for King County

Industry	Covered Facility	Covered Emissions (MT CO2e)	% of Reported County Emissions
Aerospace	Boeing Company - Auburn Site	33,130	2.8%
Building Materials Production	CertainTeed Gypsum	55,645	4.8%
	Ash Grove Cement Company	367,651	31.4%
Steel and Aluminum	Nucor Steel Seattle, Inc.	82,396	7.0%
Power Plant	*University of Washington Seattle Campus*[31]	*80,376*	*6.9%*
Natural Gas	*Puget Sound Energy LDC Facility - Bellevue*[3131]	*67,479*	*5.8%*
Power Plant	*CenTrio Energy Seattle LLC*[313131]	*67,317*	*5.7%*

CAP Emissions

EITEs and other covered sources in King County do not produce a large proportion of the county's CAP emissions. As shown by Figure 42, EITEs produced less than four percent of County emissions in 2022 for each of the CAPs.

[31] Facility is not classified as EITE but is a covered source under the CCA.

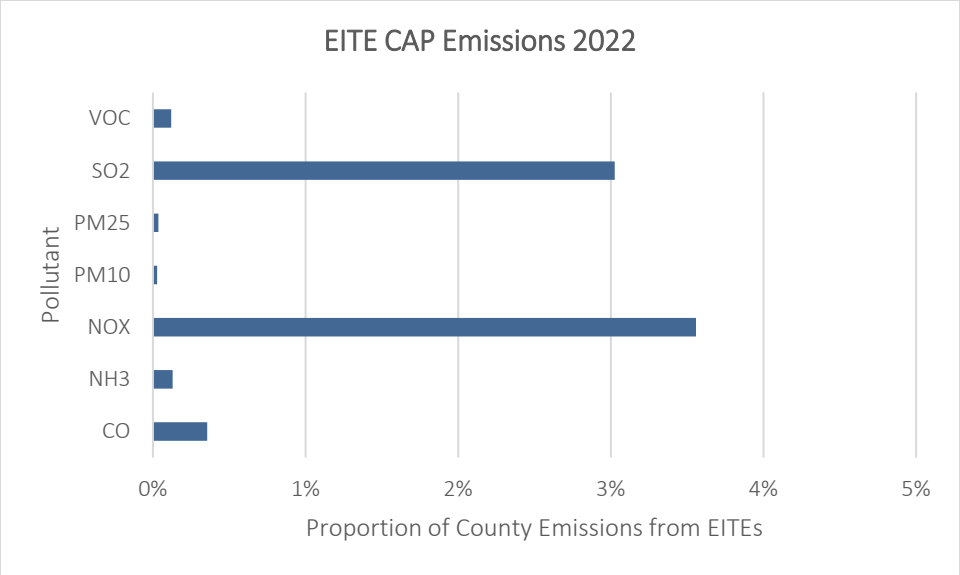

Figure 42. Proportion of EITE CAP emissions for King County

Table 29 shows the facility percentage of King County CAP emissions from each source.

Table 29. 2022 King County CAP Emissions by covered facilities in tons. (Proportion of county total)

Industry	Covered Facility	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
Aerospace	Boeing Company - Auburn Site	26.87 (< 0.1%)	0.00 (0.0%)	74.91 (0.3%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	73.79 (0.1%)
Building Materials Production	CertainTeed Gypsum	--	--	--	--	--	--	--
	Ash Grove Cement Company	738.14 (0.3%)	3.88 (0.1%)	805.66 (2.7%)	13.62 (< 0.1%)	8.43 (< 0.1 %)	46.19 (3.0%)	4.07 (< 0.1%)
Steel and Aluminum	Nucor Steel Seattle, Inc.	271.50 (0.1%)	--	173.56 (0.6%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	*0.00 (0.0%)*
Government	*University of Washington Seattle Campus*[32]	32.94 *(< 0.1%)*	0.00 *(0.0%)*	83.02 *(0.3%)*	0.00 *(0.0%)*	0.00 *(0.0%)*	0.00 *(0.0%)*	*0.00 (0.0%)*
Natural Gas	*Puget Sound Energy LDC Facility - Bellevue* *Error! Bookmark not defined.Error! Bookmark*	*--Error! Bookmark not defined.*	--	--	--	--	--	--

[32] Facility is not classified as a EITE but is a covered source under the CCA.

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Power Plant	*CenTrio Energy Seattle LLC Error! Bookmark not defined.Error! Bookmark not defined.Error! Bookmark not defined.Error! Bookmark not defined.Error! Bookmark not defined.Error! Bookmark not defined.*	*54.80 (< 0.1%)*	*0.00 (0.0%)*	*182.46 (0.6%)*	*0.00 (0.0%)*	*0.00 (0.0%)*	*0.00 (0.0%)*	*0.00 (0.0%)*
Covered Sources Total	All Covered Facilities	**1124.25 (0.4%)**	**3.88 (0.1%)**	**1319.61 (4.5%)**	**13.62 (< 0.1%)**	**8.43 (< 0.1%)**	**46.19 (3.0%)**	**77.86 (0.1%)**
County Total		**291145.0**	**3,007.7**	**29,628.0**	**49,467.5**	**23,304.6**	**1,526.9**	**64,938.1**

HAP Emissions

Table 30 presents the total HAP emissions in 2022 by covered facility within King County.

Table 30. 2022 King County HAP emissions by covered facility

Industry	Covered Facility	HAPs (tons)	% of County Total
Aerospace	Boeing Company - Auburn Site	0.7954	0.02%
Building Materials Production	CertainTeed Gypsum	--	--
	Ash Grove Cement Company	--	--
Steel and Aluminum	Nucor Steel Seattle, Inc.	--	--
Government	*University of Washington Seattle Campus*[33]	--	--
Natural Gas	*Puget Sound Energy LDC Facility - Bellevue*[3333]	--	--
Power Plant	*CenTrio Energy Seattle LLC*[3333] *Error! Bookmark not defined.*	--	--
Total	**All Covered Facilities**	**0.7954**	**0.02%**

Air Quality

There are several air quality monitoring sites in King County: 21 for HAPs, 8 for CO, and 4 each for NO2 and O3. As presented in detail above in the Air Quality Monitoring section of this report, monitoring data show 84 NAAQS exceedances for ozone in 2020-2023, as well as cancer risk greater than one in a million for cadmium, naphthalene and arsenic PM10Lc in 2023, and non-cancer risk greater than one in a million for acrolein in 2023.

[33] Facility is not classified as a EITE but is a covered source under the CCA.

Federal Regulatory Actions

In King County, one EITE is subject to changes in federal air quality regulations that may affect future emissions. Boeing Commercial Airplane Group Auburn is subject to 40 CFR 63 Subpart DDDDD, which was amended in 2022 with numeric emission limits for new and existing boilers and process heaters and sets compliance dates for these new emission limits[xlix].

Demographics and Proximity to Overburdened Communities

King County is Washington's most populous county. It is home to nearly thirty percent of the state's population. Compared to Washington State, King County has a slightly lower proportion of poverty, lower than average elderly population and lower rate of population without health insurance. See Table 31 for select demographics.

Table 31. King County demographics compared to Washington State

Demographics	King County[l]	Washington State[li]
Total population	2,269,675	7,705,281
People of color	43.9%	33.4%
Poverty rate	8.8%	10.3%
Under 5 years of age	5.3%	5.7%
Over 64 years of age	14.5%	17.1%
Population without health insurance	4.9%	6.3%

Demographic data for King County can be displayed in relation to EITE locations to illustrate any patterns that might be considered in the allocation of no-cost allowances. Figure 43 shows the percentage of people under age 5 for all block groups in King County and the locations of EITEs. Figure 44 shows the percentage of people over age 64, Figure 45 shows the percentage of people of color, Figure 46 shows the percentage of people below the poverty line, and Figure 47 shows the percentage of people without health insurance.

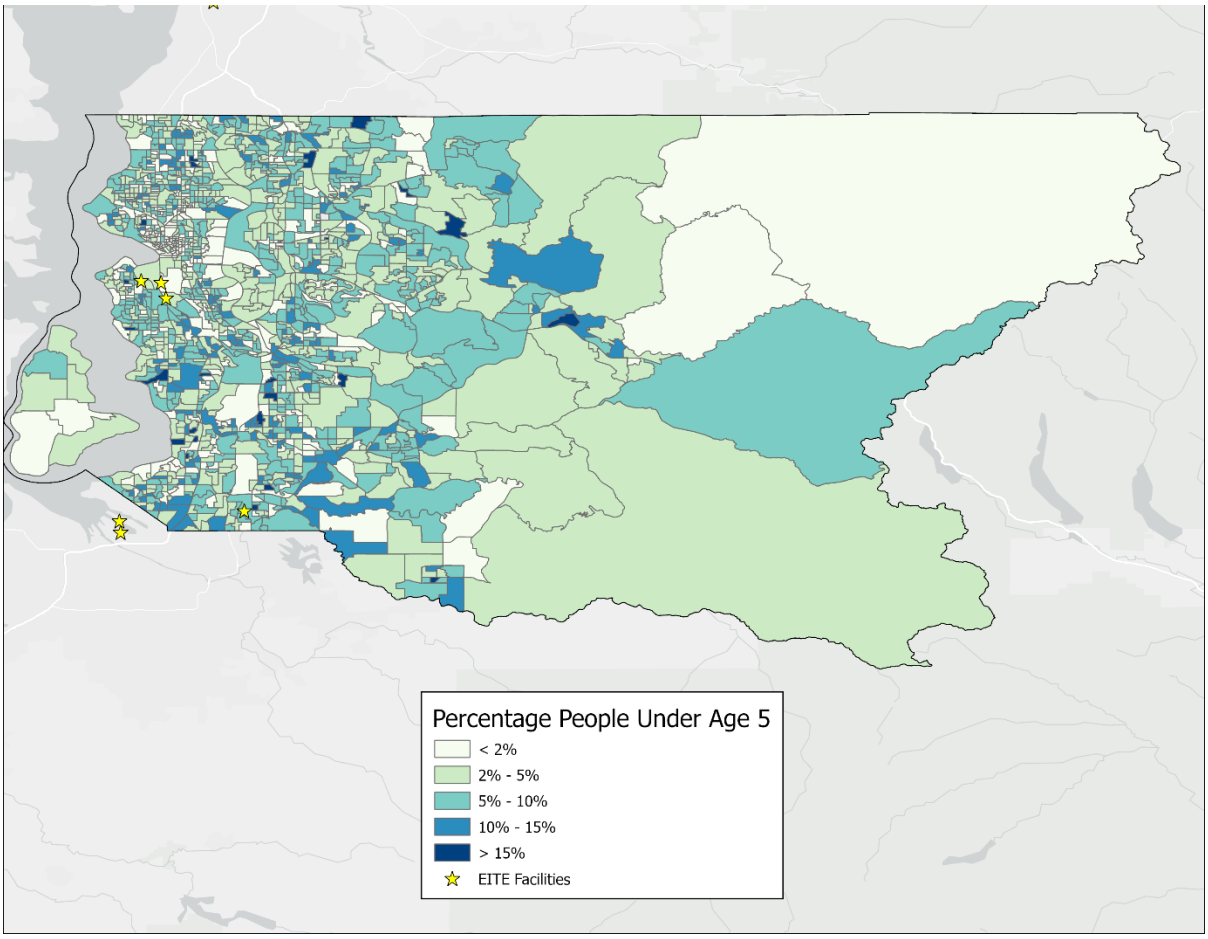

Figure 43. Percentage of People Under Age 5 by Census Block Group and EITE Locations in King County

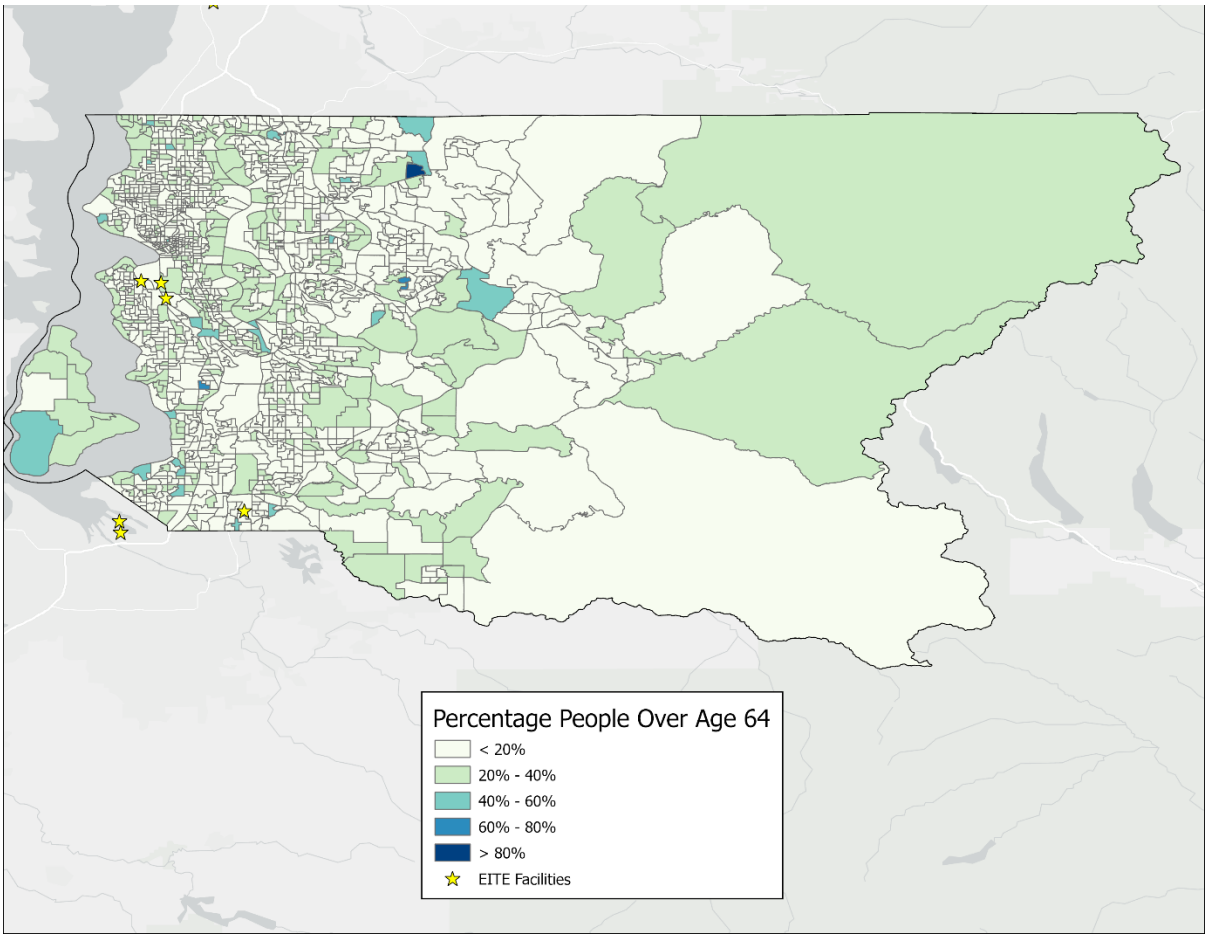

Figure 44. Percentage of People Over Age 64 by Census Block Group and EITE Locations in King County

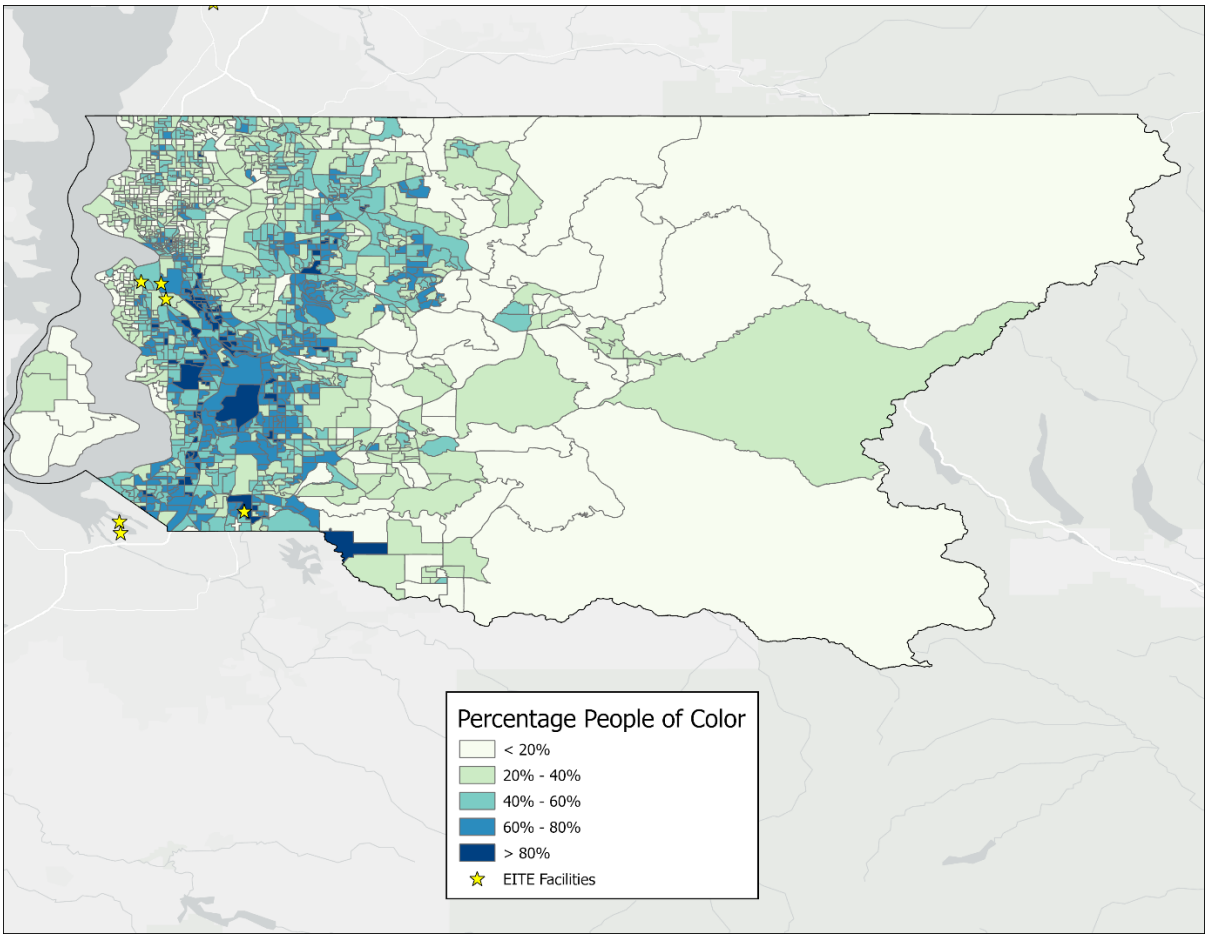

Figure 45. Percentage of People of Color by Census Block Group and EITE Locations in King County

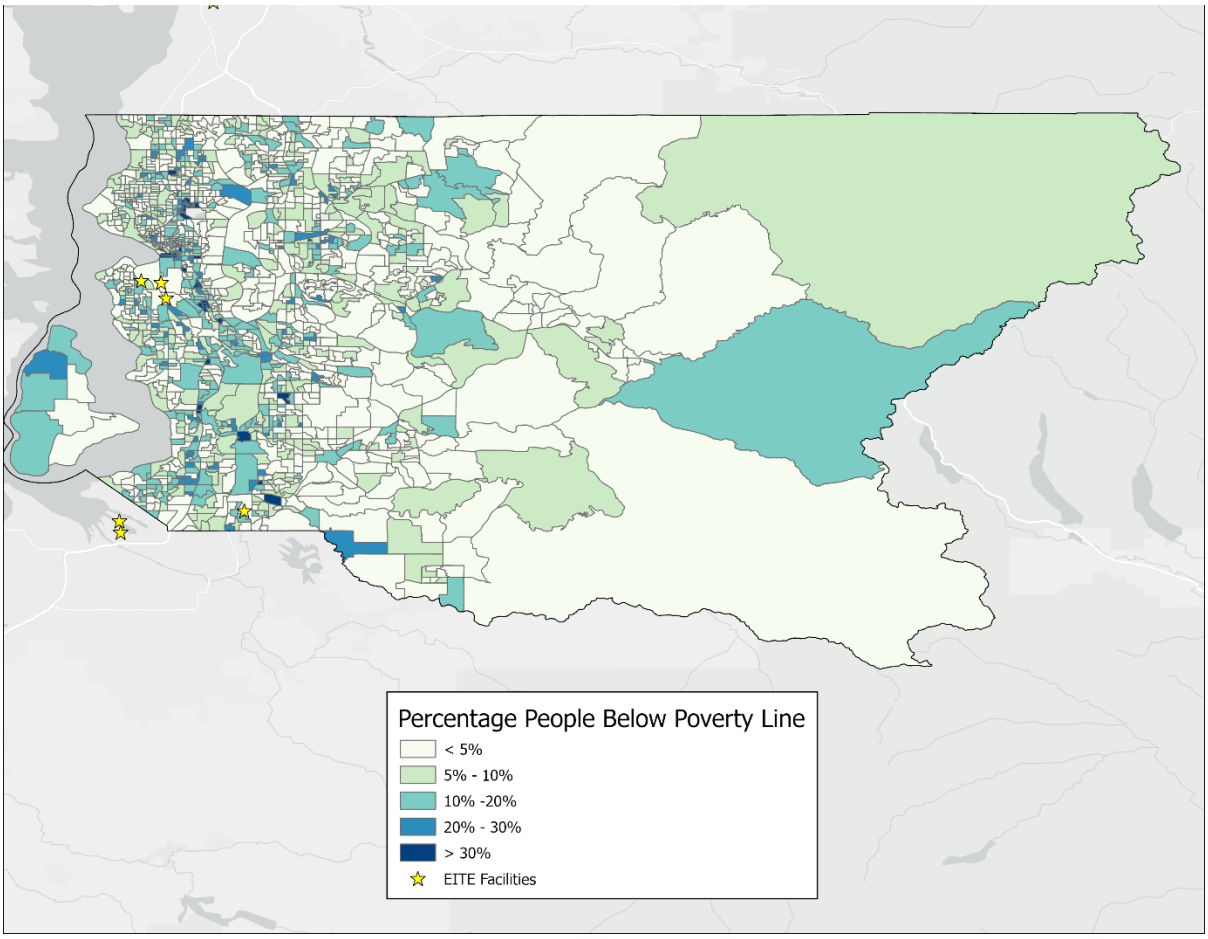

Figure 46. Percentage of People Below the Poverty Line by Census Block Group and EITE Locations in King County

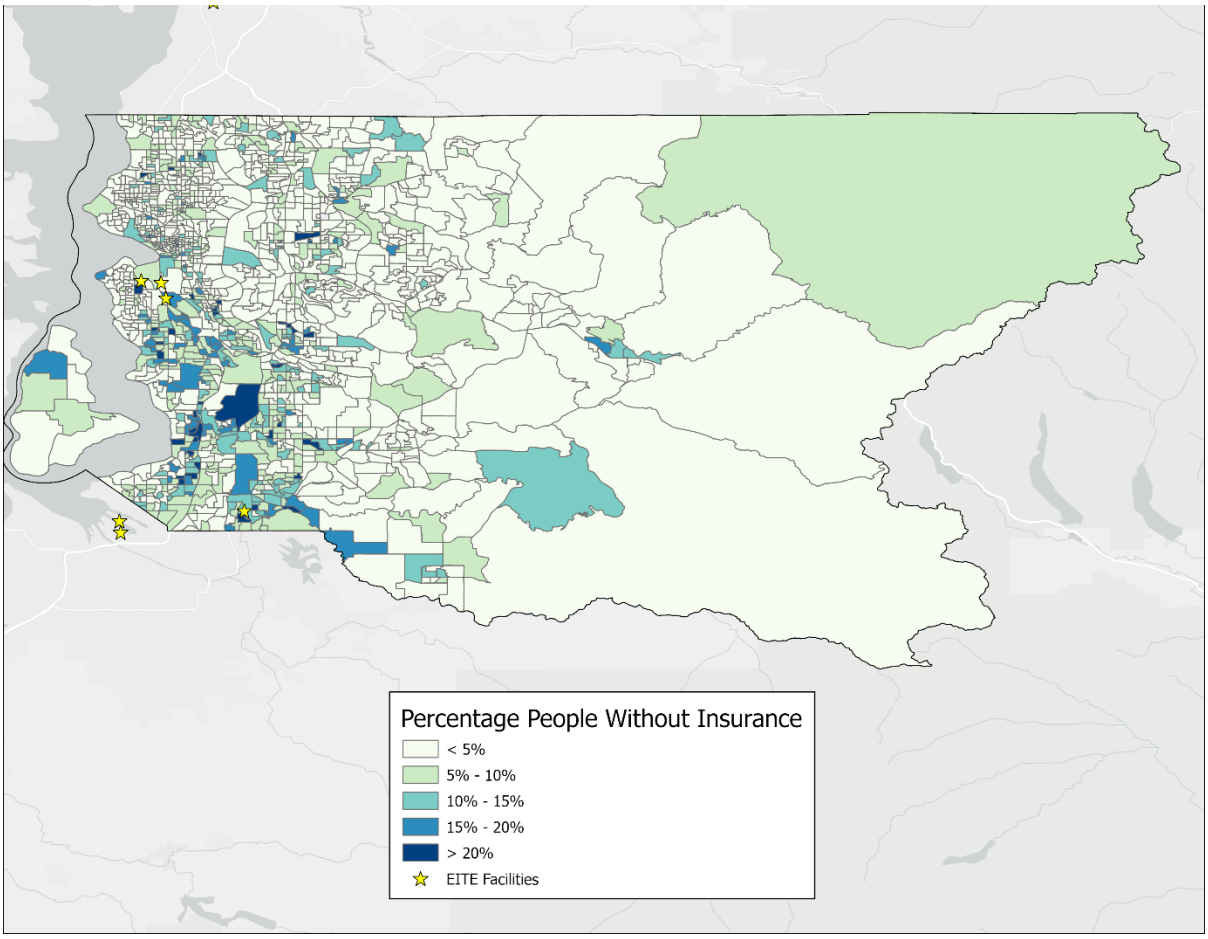

Figure 47. Percentage of People Without Health Insurance by Census Block Group and EITE Locations in King County

Figure 48 presents a map of the overburdened communities within King County, overlaid with EITE and other covered sources facility data. The majority of King County's EITEs are located within South Seattle.

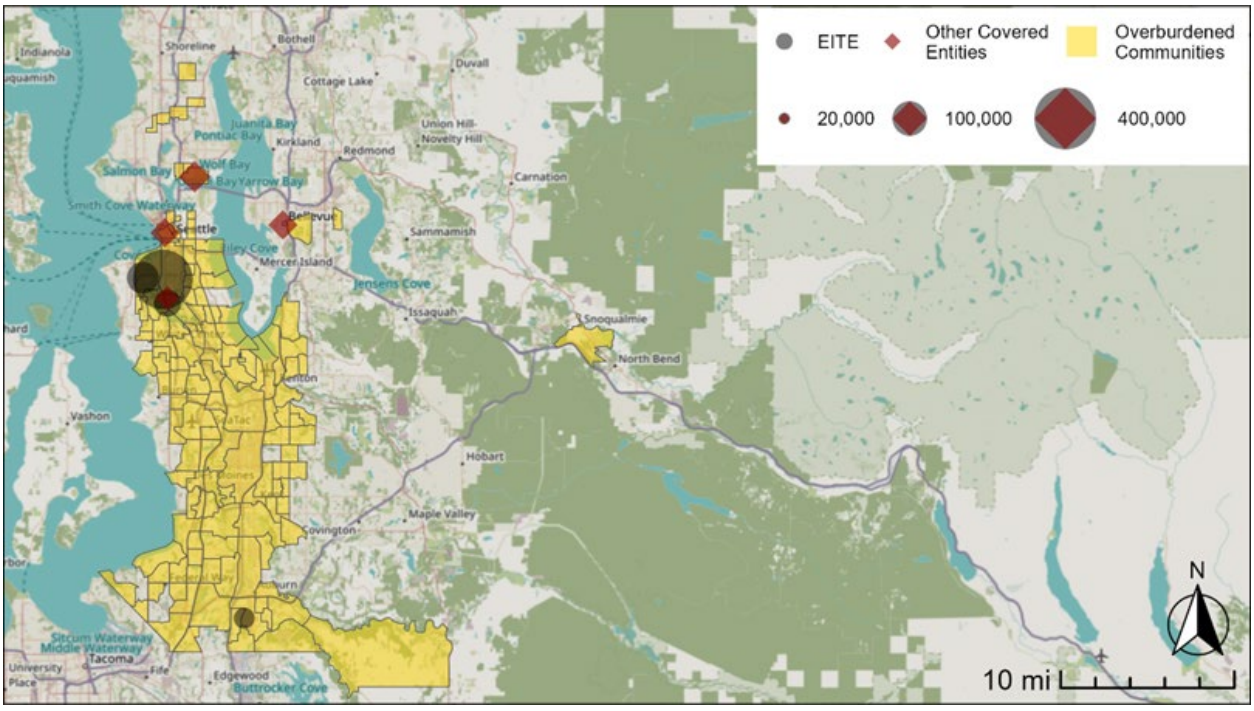

Figure 48. Map of King County OBCs and Covered Sources

Figure 49 shows that all four of the King County EITEs are located within overburdened communities that are also identified by Ecology as highly impacted by air pollution.[34] One of the EITEs is also located within a few miles of a Tribal Reservation.

[34] For more information on overburdened communities highly impacted by air pollution, see Washington State Department of Ecology, n.d., *Improving air quality in overburdened communities*, https://ecology.wa.gov/air-climate/climate-commitment-act/overburdened-communities

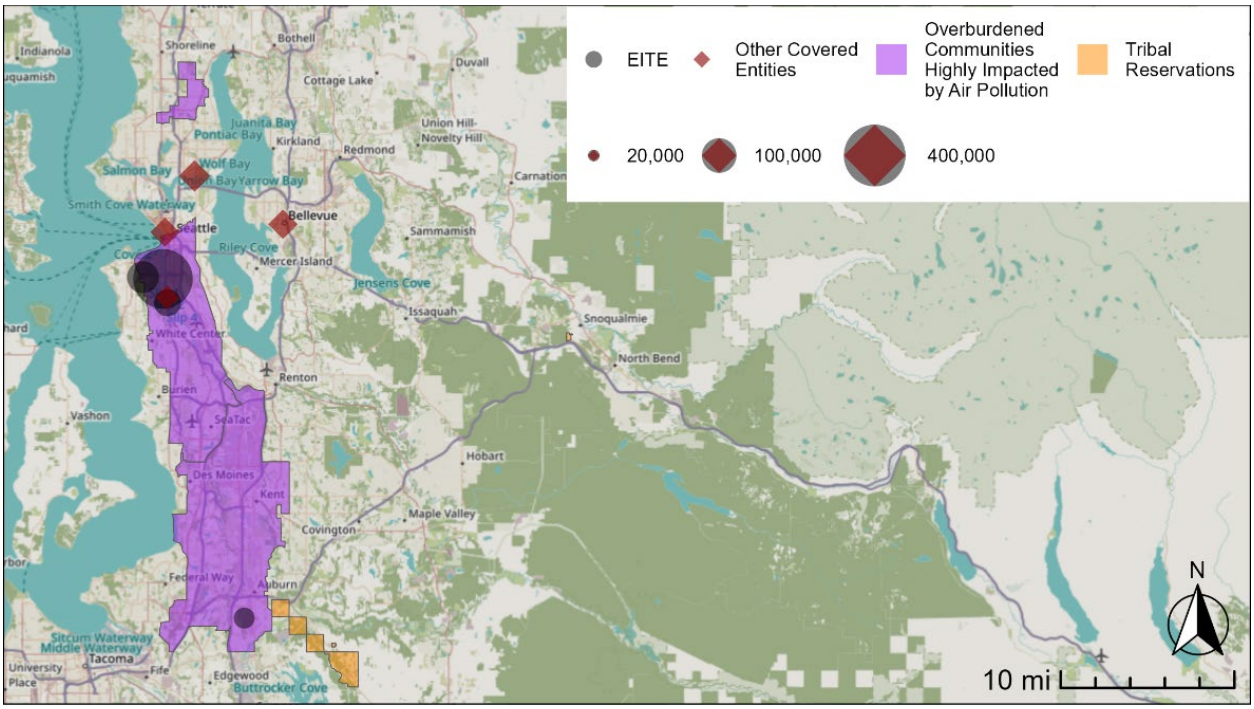

Figure 49. Map of King County of OBCs Highly Impacted by Air Pollution, Tribal Reservations, and Covered Sources

Skagit County

Skagit County contains four EITE facilities across two industries and two other-covered sources under the CCA (see Table 32). Skagit, along with King and Grant counties, has the second highest number of EITEs per county in the state.

Table 32. Skagit County EITE facilities by industry

Industry	EITE Facilities
Industrial Gas Manufacturing	2
Petroleum Refineries	2

GHG Emissions

Table 33 presents the 2023 covered ghg emissions by facility for Skagit County. Over all, EITEs produced 81.9 percent of the county's reported GHG emissions, excluding non-point sources. The two petroleum refineries were the highest ghg emitters, producing a combined 78.7 percent of reported emissions.

Table 33. 2023 Skagit County GHG emissions by covered source

Industry	Covered Facility	Covered Emissions (MT CO2e)	% of Reported County Emissions
Industrial Gas Manufacturing	Air Liquide Hydrogen Plant	72,277	1.8%

	Matheson - Anacortes	53,407	1.4%
Petroleum Refineries	HF Sinclair Puget Sound Refinery LLC	1,900,827	48.2%
	Marathon Anacortes Refinery	1,202,228	30.5%
Natural Gas Transmission/Compression	*Northwest Pipeline C/S*[35]	*74,378*	*1.9%*
Natural Gas Turbine Plants	*Puget Sound Energy - Fredonia Generating Station*[3535]	*641,250*	*16.3%*

CAP Emissions

Figure 50 shows that Skagit County EITEs make up less than ten percent of reported CO, NH3, PM10, PM2.5 and VOC emissions. Of the reported CAPs, EITE facilities contribute the most to the county's NOX (over 40 percent) and SO2 (just over 30 percent) emissions.

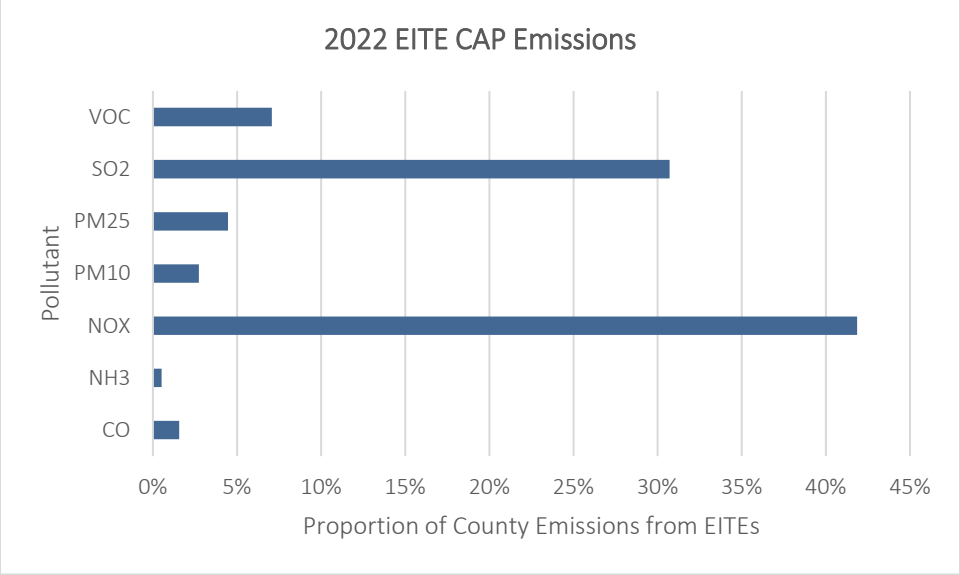

Figure 50. Proportion of EITE CAP emissions for Skagit County

Table 34 presents facility level CAP emissions for each pollutant as a proportion of the county's total CAP emissions from 2022. Both industrial gas manufacturing facilities produce less than one percent of each

[35] Facility not classified as EITE but is a covered source under the CCA.

pollutant. Of the covered sources, the HG Sinclair Puget Sound Refinery produced the largest proportion of SO2, while the Marathon Refinery produced the proportion of NOX.

Table 34. 2022 Skagit County CAP emissions by covered facilities in tons. (Proportion of county total)

Industry	Covered Facility	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
Industrial Gas Manufacturing	Air Liquide Hydrogen Plant	0.30 (< 0.1%)	0.00 (0.0%)	9.70 (0.1%)	1.36 (< 0.1%)	1.36 (< 0.1%)	0.01 (< 0.1%)	1.62 (< 0.1%)
	Matheson - Anacortes	1.39 (< 0.1%)	1.38 (0.1%)	7.52 (0.1%)	1.10 (< 0.1%)	0.98 (< 0.1%)	0.51 (0.1%)	2.35 (< 0.1%)
Petroleum Refineries	HF Sinclair Puget Sound Refinery LLC	603.52 (0.9%)	2.16 (0.2%)	1316.46 (17.2%)	209.75 (1.6%)	209.75 (2.6%)	213.01 (22.2%)	476.99 (2.6%)
	Marathon Anacortes Refinery	463.77 (0.7%)	2.68 (0.2%)	1873.17 (24.5%)	149.35 (1.1%)	146.58 (1.8%)	80.75 (8.4%)	803.51 (4.4%)
Natural Gas Transmission/ Compression	*Northwest Pipeline C/S*[36]	183.61 (0.3%)	0.00 (0.0%)	188.91 (2.5%)	4.19 (< 0.1%)	4.19 (0.1%)	0.69 (0.1%)	9.62 (0.1%)
Natural Gas Turbine Plants	*Puget Sound Energy - Fredonia Generating Station*[Error! Bookmark not defined.Error! Bookmark not defined.]	10.10 (< 0.1%)	1.90 (0.2%)	484.32 (6.3%)	11.20 (0.1%)	11.20 (0.1%)	3.27 (0.3%)	4.80 (< 0.1%)
Covered Sources Total	**All Covered Facilities**	**1,262.69 (1.8%)**	**8.12 (0.7%)**	**3,880.1 (50.6%)**	**376.95 (2.9%)**	**374.06 (4.7%)**	**298.24 (31.1%)**	**1,298.9 (7.1%)**
County Total		**68,457.4**	**1,207.2**	**7,662.1**	**13,244.5**	**8,036.9**	**958.4**	**18,181.5**

HAP Emissions

Table 35 presents total HAP emissions from each covered facility in Skagit County from 2022.

Table 35. 2022 Skagit County HAP emissions by covered facility.

Industry	Covered Facility	HAPs (tons)	% of County Total
Industrial Gas Manufacturing	Air Liquide Hydrogen Plant	--	--
	Matheson - Anacortes	0.36	0.06%
Petroleum Refineries	HF Sinclair Puget Sound Refinery LLC	2.50	0.44%
	Marathon Anacortes Refinery	3.95	0.70%
Natural Gas Transmission/ Compression	*Northwest Pipeline C/S*[37]	6.30	1.12%
Natural Gas Turbine Plants	*Puget Sound Energy - Fredonia Generating Station*[37]	1.89	0.34%
Total		15.00	2.66%

[36] Facility not classified as EITE but is a covered source under the CCA.

[37] Facility not classified as EITE but is a covered source under the CCA.

Air Quality

There are several air quality monitoring sites in Skagit County: 4 for O3 and 2 for NO2. As presented in detail above in the Air Quality Monitoring section of this report, monitoring data show 4 NAAQS exceedances for ozone in 2022.

Federal Regulatory Actions

In Skagit County, three EITEs and two other covered sources are subject to changes in federal air quality regulations that may affect future emissions. Applicable regulations that have been recently amended or have proposed changes are summarized in Table 36.

Table 36. Summary of recent and proposed changes in federal air quality regulations relevant to EITEs and other covered sources in Skagit County.

Federal Regulation	Affected Facilities	Summary of Changes
40 CFR Part 60 K 40 CFR Part 60 Ka 40 CFR Part 60 Kb	HollyFrontier PS Refining Marathon Anacortes Fredonia	Revised 10/15/24: Several NSPS tank revisions in a new subpart, 40 CFR part 60, Kc, applicable to affected sources constructed, modified, or reconstructed after October 4, 2023[lii].
40 CFR Part 60 GG	HollyFrontier PS Refining Mount Vernon Compressor Station Fredonia Generating Station	Proposed 11/22/2024: Strengthen limits on NOx from most new, modified, and reconstructed fossil fuel-fired stationary combustion turbines[liii].
40 CFR Part 60 VV	HollyFrontier PS Refining	Revised 5/16/2024: Connector monitoring in a new subpart, 40 CFR Part 60 Wb, applicable to affected sources constructed, modified, or reconstructed after October 4, 2023[liv].
40 CFR Part 60 XX	HollyFrontier PS Refining	Revised 5/8/2024: Final emission limits in subpart XXa on non-methane TOC, applicable to affected facilities that begin construction, reconstruction, or modification after June 10, 2022[lv].
40 CFR Part 63 DDDDD	HollyFrontier PS Refining Air Liquide Marathon Anacortes Mount Vernon Compressor Station	Revised 10/6/2022: Numeric emission limits for new and existing boilers and process heaters and set compliance dates for these new emissions limits[lvi].
40 CFR Part 63 F 40 CFR Part 63 G 40 CFR Part 63 H	Marathon Anacortes	Revised 5/16/2024: New requirements for the Synthetic Organic Chemical Manufacturing Industry related to heat exchange systems, process vents, storage

		vessels, transfer racks, wastewater, and equipment leaks[lvii,38].
40 CFR Part 63 GGGGG	Marathon Anacortes	Revised 12/22/2022: Removes exemptions from the rule for site remediation activities performed under authority of CERCLA as a remedial action or a non-time-critical removal action, and for site remediation activities performed under RCRA corrective actions conducted at treatment, storage and disposal facilities, compliance date June 24, 2024[lviii].

Proximity to Overburdened Communities

Skagit County is home to 1.7 percent of the state's total population. The county has a slightly lower poverty rate compared to the state average. Skagit has a higher proportion of older people compared to the state average. See Table 37 for select demographics.

Table 37. Skagit County demographics compared to Washington State

Demographics	Skagit County[lix]	Washington State[lx]
Total population	129,523	7,705,281
People of color	25.4%	33.4%
Poverty rate	8.9%	10.3%
Under 5 years of age	5.5%	5.7%
Over 64 years of age	23.7%	17.1%
Population without health insurance	7.0%	6.3%

Demographic data for Skagit County can be displayed in relation to EITE locations to illustrate any patterns that might be considered in the allocation of no-cost allowances. Figure 51 shows the percentage of people under age 5 for all block groups in Skagit County and the locations of EITEs. Figure 52 shows the percentage of people over age 64, Figure 53 shows the percentage of people of color, Figure 54 shows the percentage of people below the poverty line, and Figure 55 shows the percentage of people without health insurance.

[38] The 2024 final rulemaking is being reconsidered. Source: *U.S. Environmental Protection Agency, 2025, Synthetic Organic Chemical Manufacturing Industry: National Emission Standards for Hazardous Air Pollutants (NESHAP) - 40 CFR 63 Subparts F,G,H,I*, https://www.epa.gov/stationary-sources-air-pollution/synthetic-organic-chemical-manufacturing-industry-national

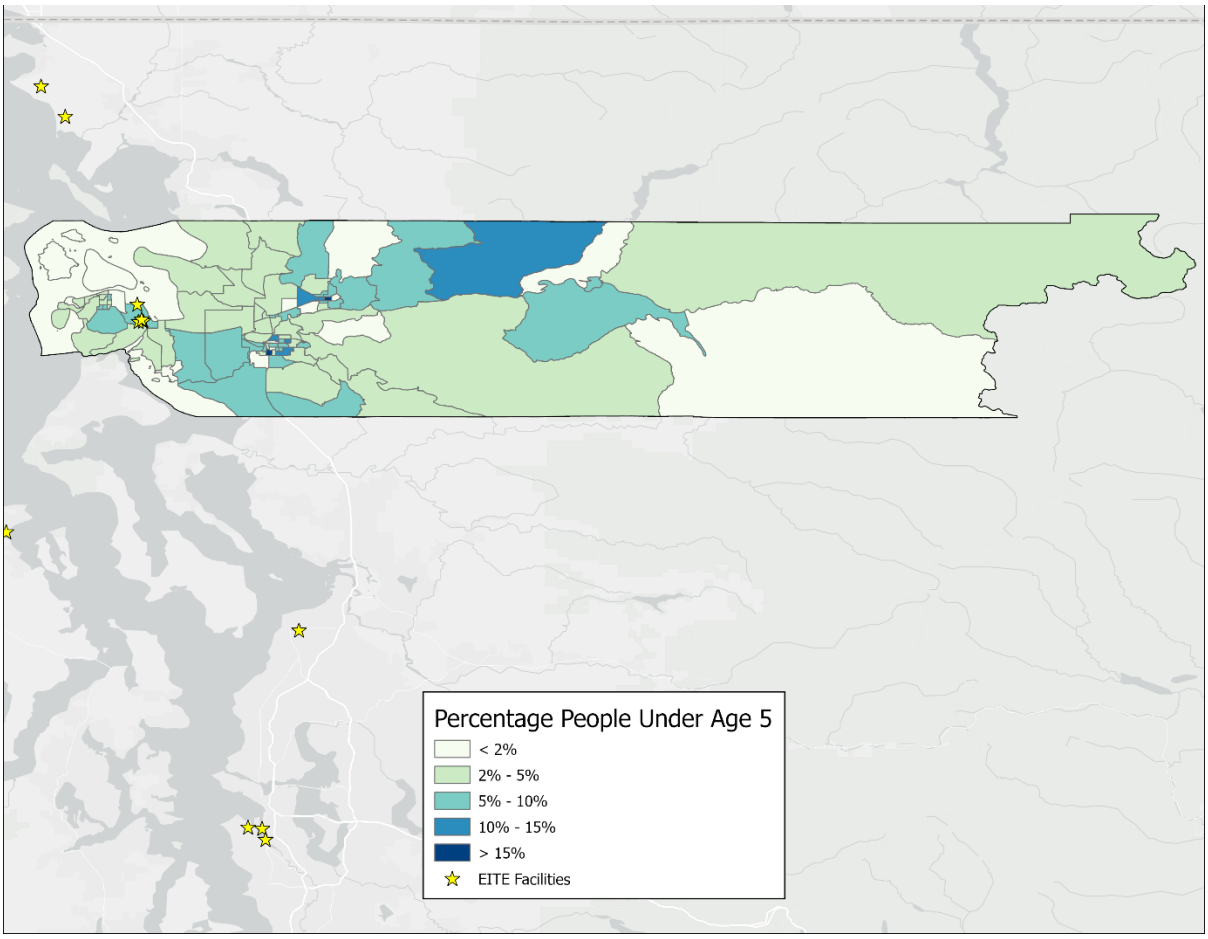

Figure 51. Percentage of People Under Age 5 by Census Block Group and EITE Locations in Skagit County

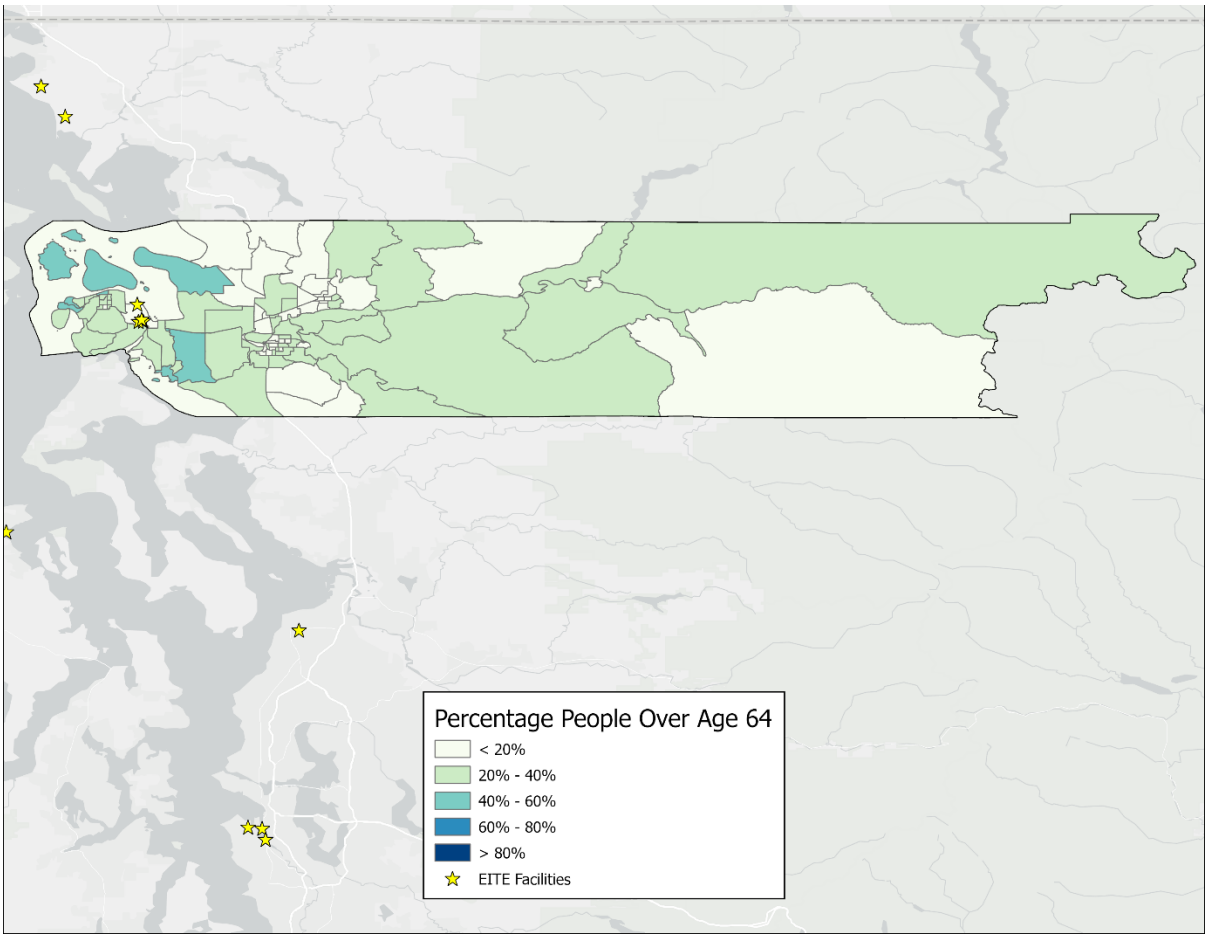

Figure 52. Percentage of People Over Age 64 by Census Block Group and EITE Locations in Skagit County

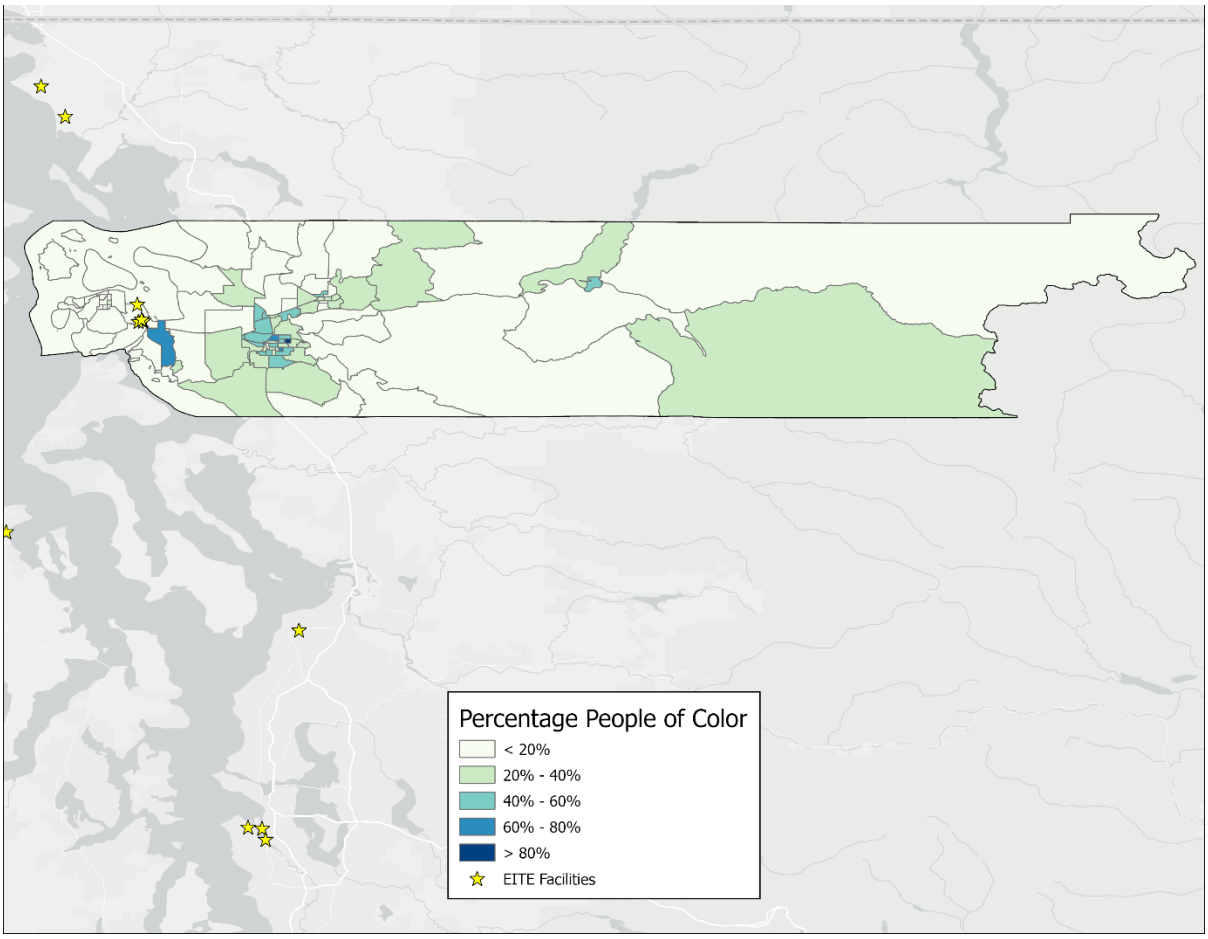

Figure 53. Percentage of People of Color by Census Block Group and EITE Locations in Skagit County

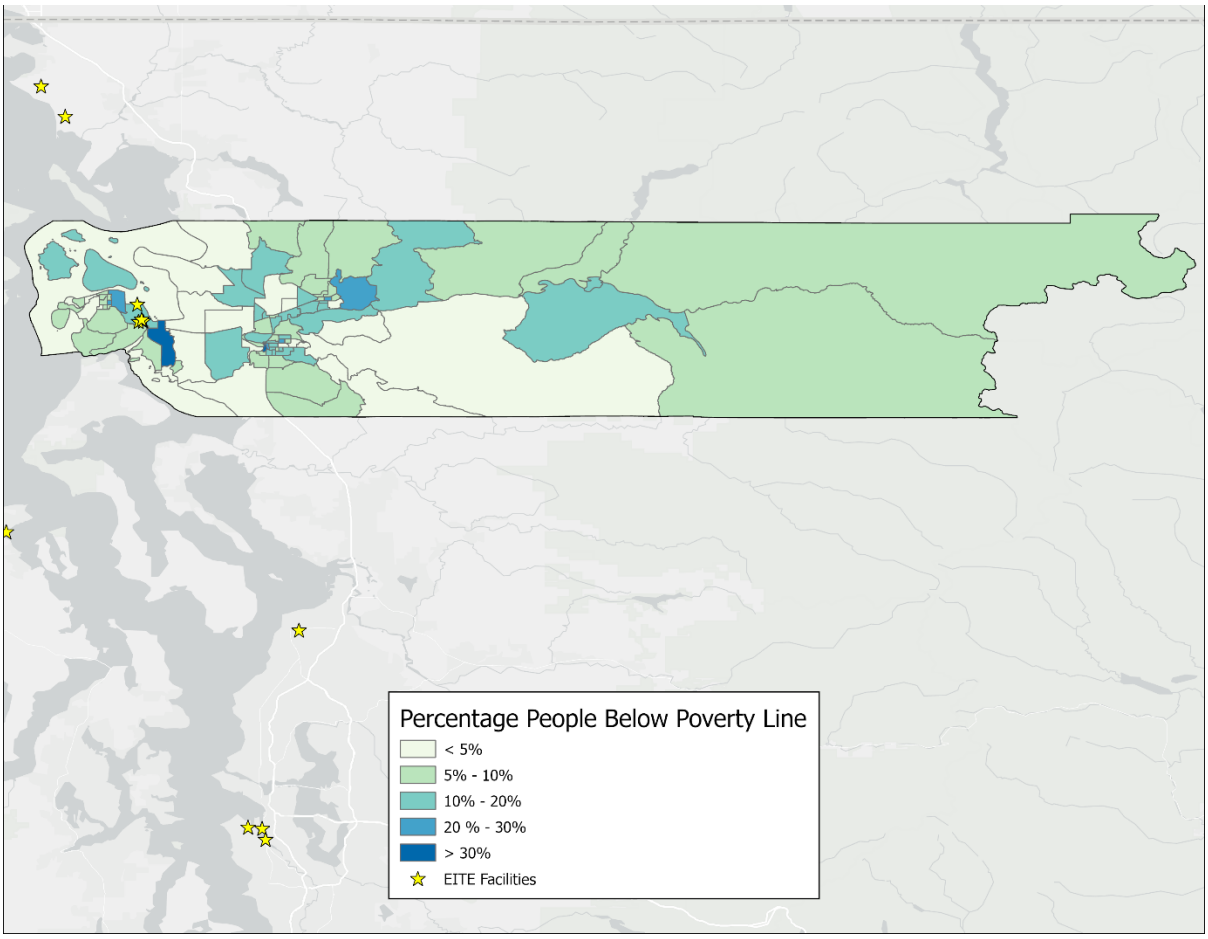

Figure 54. Percentage of People Below the Poverty Line by Census Block Group and EITE Locations in Skagit County

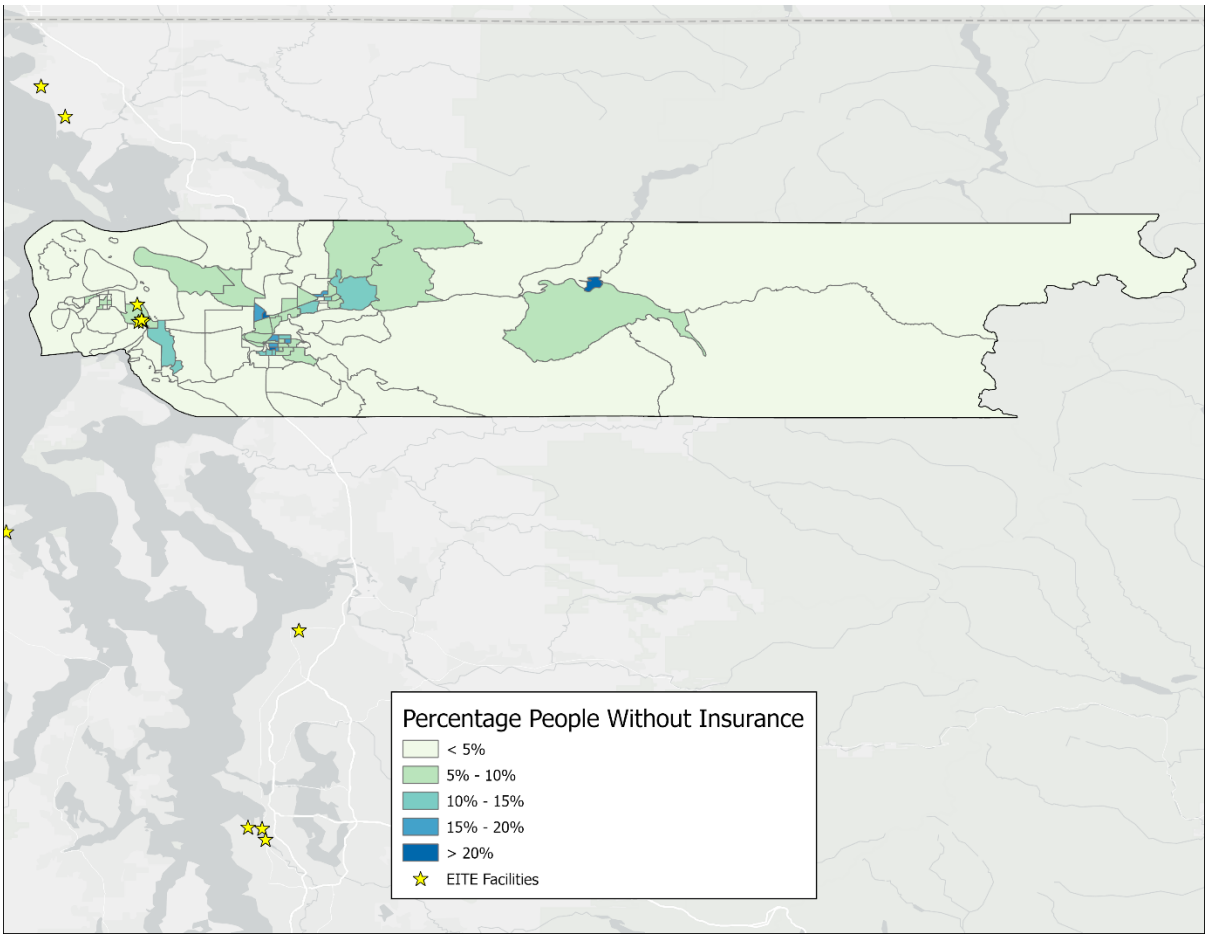

Figure 55. Percentage of People Without Health Insurance by Census Block Group and EITE Locations in Skagit County

Figure 56 and Figure 57 present maps of Skagit County EITEs and other covered sources overlaid with OBCs and Tribal Reservations, respectively. All of the county's EITEs are located near the same two OBCs and the Swinomish Reservation. There were no OBCs identified as highly impacted by air pollution within the county.

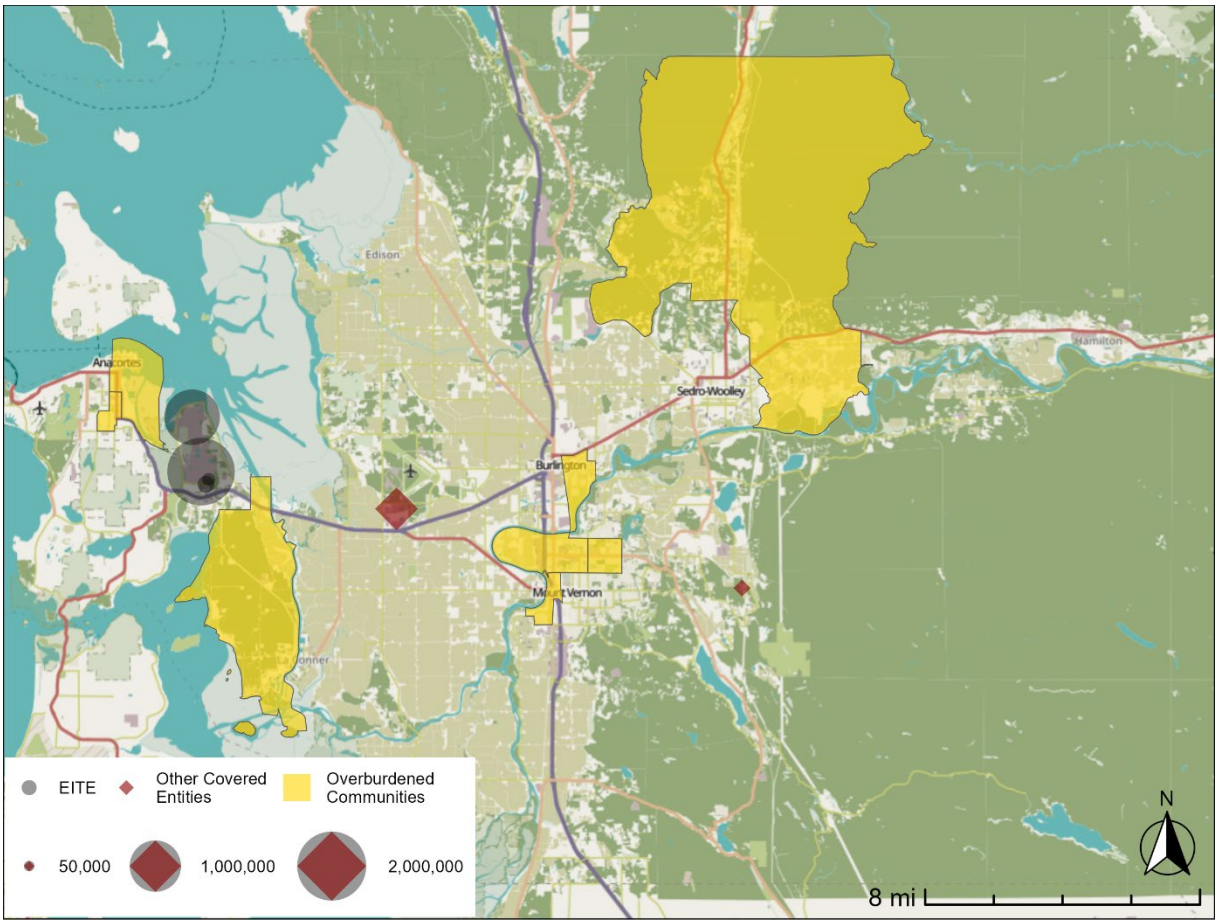

Figure 56. Map of Skagit County EITEs and OBC's

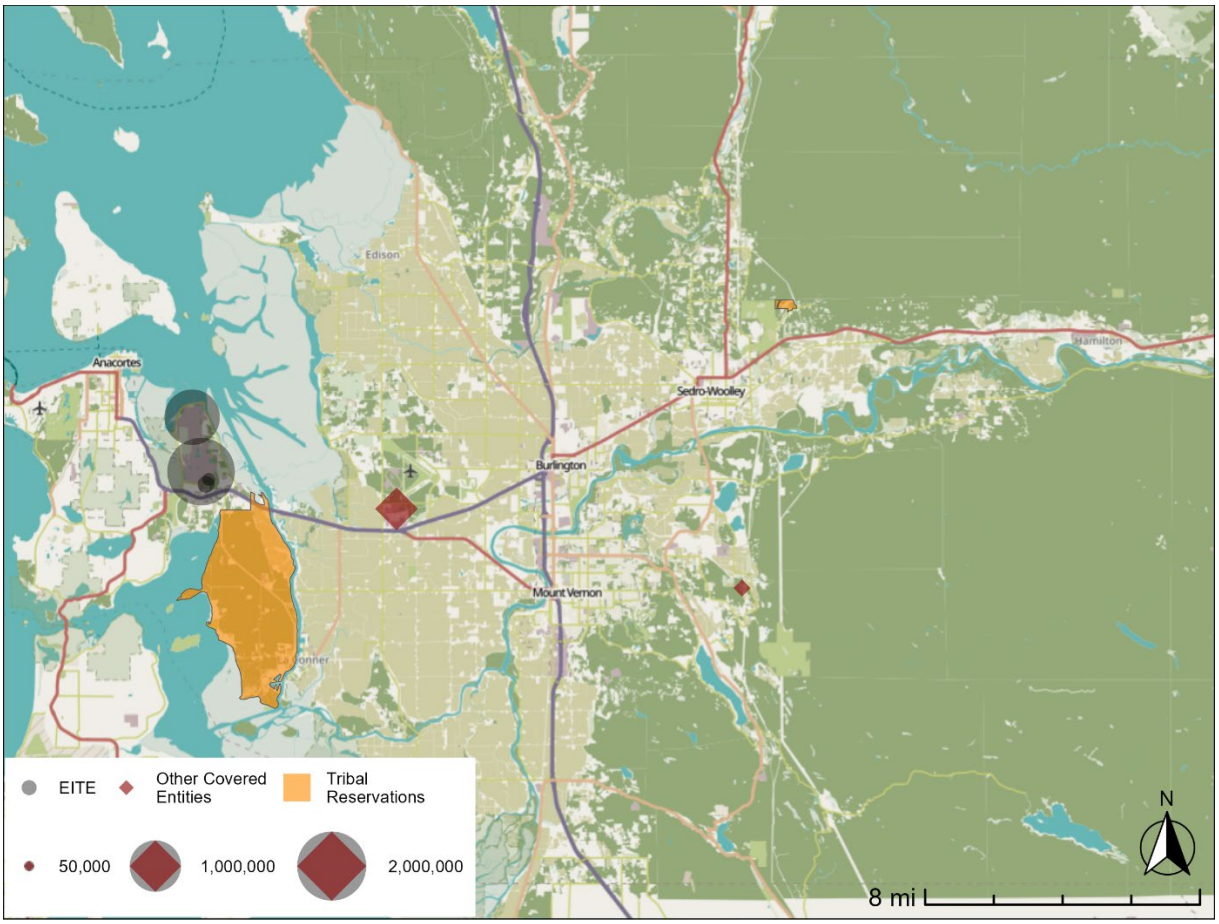

Figure 57. Map of Skagit County EITEs and Tribal Reservations

Industry Profiles

Below, we have compiled information on the market structure and competitive dynamics of EITE industries, including an overview of each industry, domestic competition, international competition and industry outlook. Data for these profiles mostly comes from publicly available datasets published by the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, the U.S. Energy Information Administration, the Internal Revenue Service, the Observatory of Economic Complexity, the World Bank, and the International Carbon Action Partnership. Market structure, projections for industry outlook, and carbon mitigation challenges come from news and research articles, industry associations, and publicly available summaries of market research reports. Data on supply chain impacts does not come from publicly available data; they are derived from IMPLAN modeling.

In some cases, the industries in the datasets are broader than the industries in this profile; we selected the industries from the datasets that were closest to the industries in this profile for those cases. This means that some of the data presented also reflects industries adjacent to the EITE industries rather than just the EITE industries. Another important caveat about the data to note is that domestic export data can include the dollar value of goods that were not produced in state but were exported from the state.

Aerospace

Industry Overview

Aerospace manufacturing involves designing and producing aircraft, spacecraft, and related systems and components for commercial, defense, and space applications. Washington is a national leader in aerospace manufacturing, home to major assembly plants and a dense network of suppliers that produce everything from airframes and engines to avionics and interiors. The state's aerospace sector supports tens of thousands of jobs and plays a critical role in both domestic and international aviation markets.

There are about 115 aerospace product and parts manufacturing facilities located in Washington, three of which are classified as EITEs. One of the facilities is located in King County (The Boeing Company – Auburn), one is located in Snohomish County (The Boeing Company – Everett), and one is located in Spokane County (Goodrich Corporation). Figure 58 shows the locations of the aerospace manufacturing EITEs in Washington.

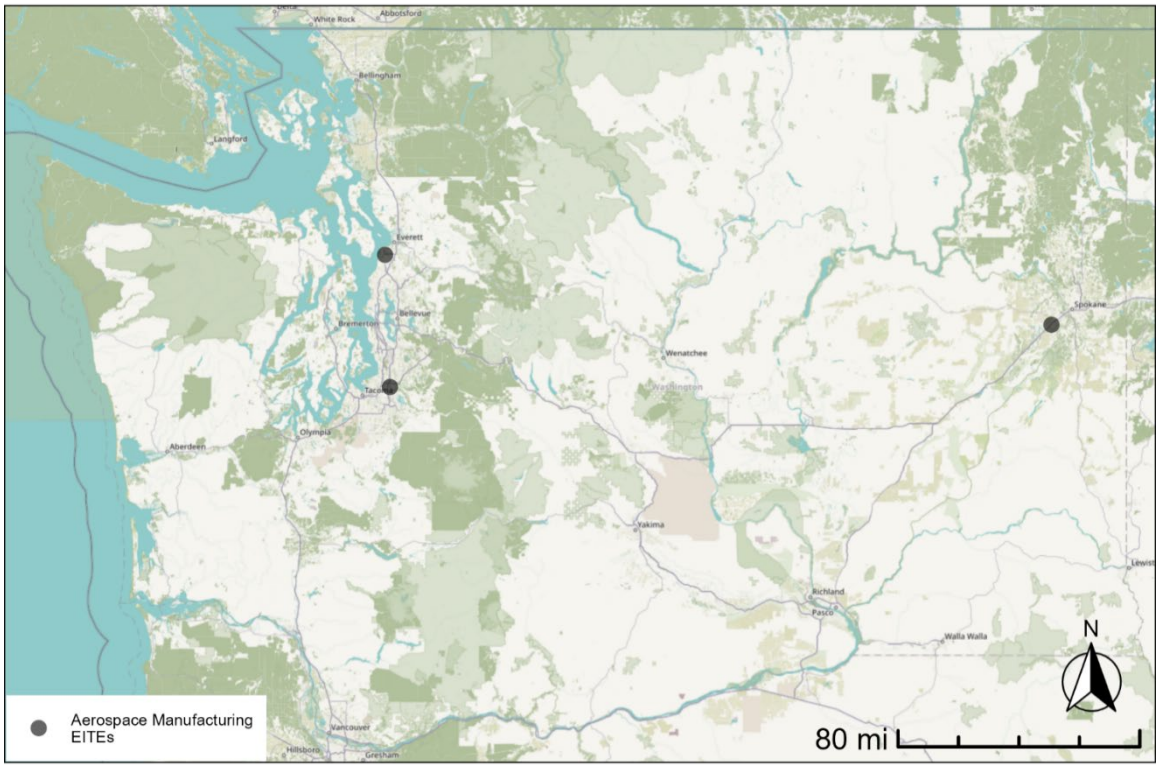

Figure 58. Map of Aerospace Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 59 shows real GDP over the last quarter century for transportation equipment manufacturing[39] in Washington state. Despite a significant spike in activity from 2004 through to 2015, the industry is

[39] The Bureau of Economic Analysis (BEA) does not provide real GDP figures for aerospace manufacturing on its own, instead estimating broader industry GDP figures.

actually at a slightly lower level as of 2023 than in 1997. As a result, the industry now represents less than 4 percent of Washington state GDP overall (see Figure 60).

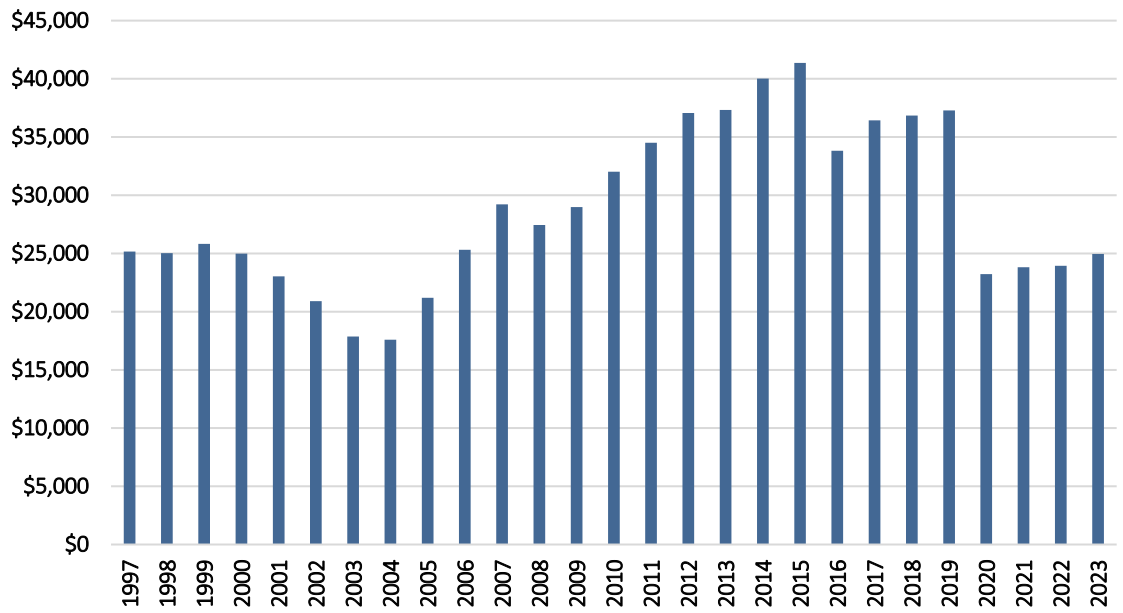

Figure 59. Washington State Other Transportation Equipment Manufacturing Real GDP (Millions 2017 $) (NAICS 3364 through 3369). Source: U.S. Bureau of Economic Analysis

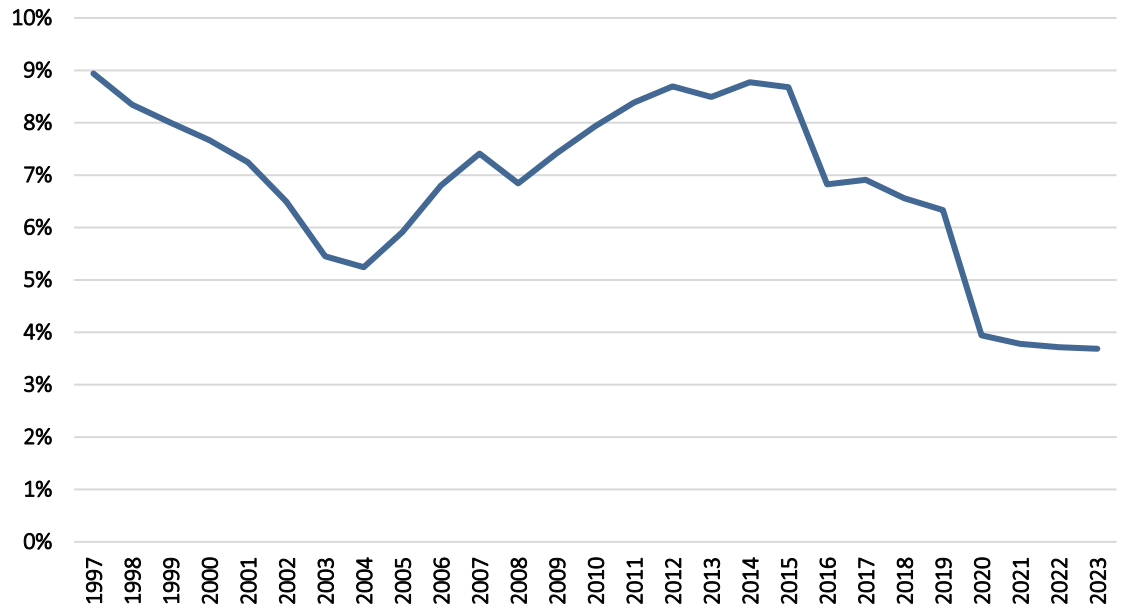

Figure 60. Share of Washington State GDP from Other Transportation Equipment Manufacturing (NAICS 3364 through 3369). Source: U.S. Bureau of Economic Analysis

Employment

Aerospace manufacturing employment has also decreased recently, as shown in Figure 61. It should be noted that employment figures represent employment as of mid-March, so the 2020 estimate does not

reflect what likely happened in the immediate aftermath of the COVID pandemic, instead showing a spike in employment for that year. Changes post-pandemic are clearly shown in the proceeding years. Despite the 9 percent drop-off in employment between 2020 and 2022, Figure 62 shows that Washington state still remained the top aerospace-employing state in the U.S.

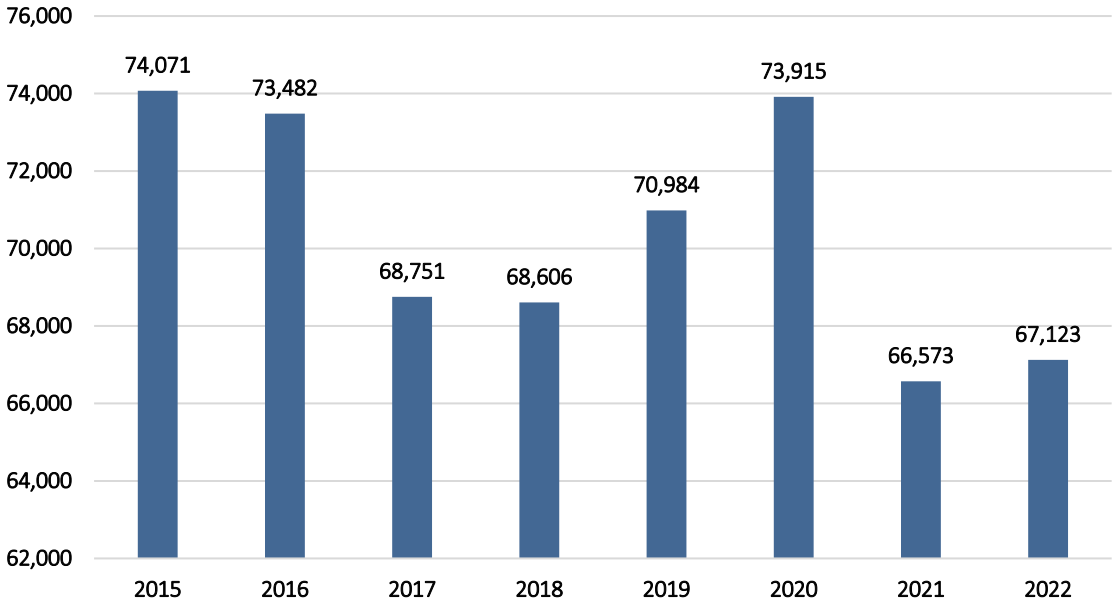

Figure 61. Total Washington State Aerospace Manufacturing Industry Employment (NAICS 3364). Source: U.S. County Business Patterns

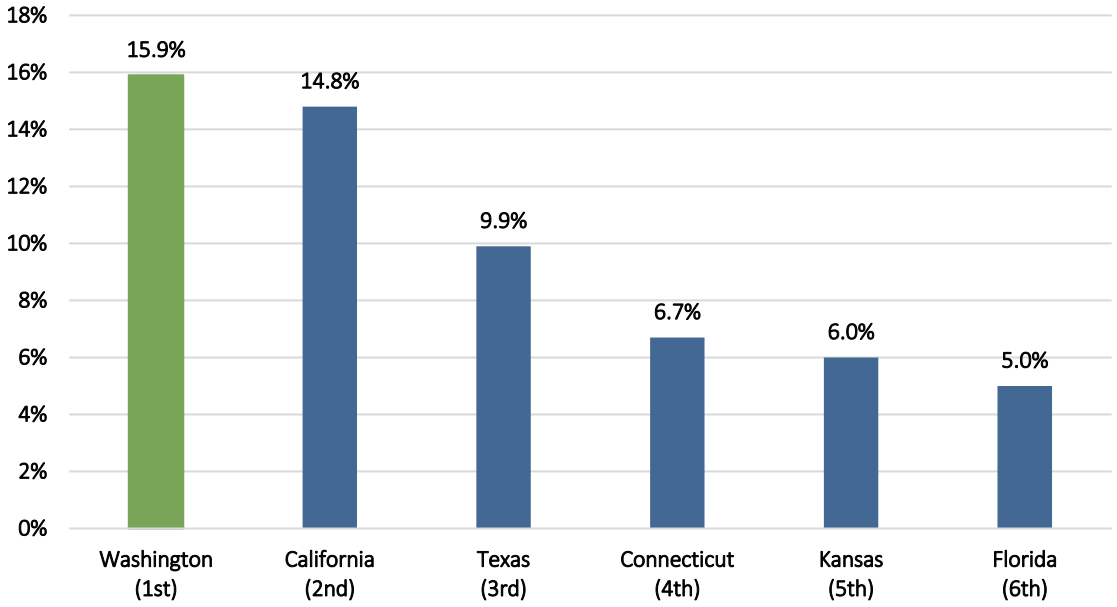

Figure 62. Share of U.S. Aerospace Manufacturing Industry Employment, Top Six States 2022 (NAICS 3364). Source: U.S. County Business Patterns

Revenue

Figure 63 shows that Washington was the top state for aerospace manufacturing revenue generation in 2021, per the Annual Survey of Manufactures. Aerospace manufacturing appears to be a very competitive industry, as Washington, California, and Texas regularly trade spots within the top three in terms of revenue.

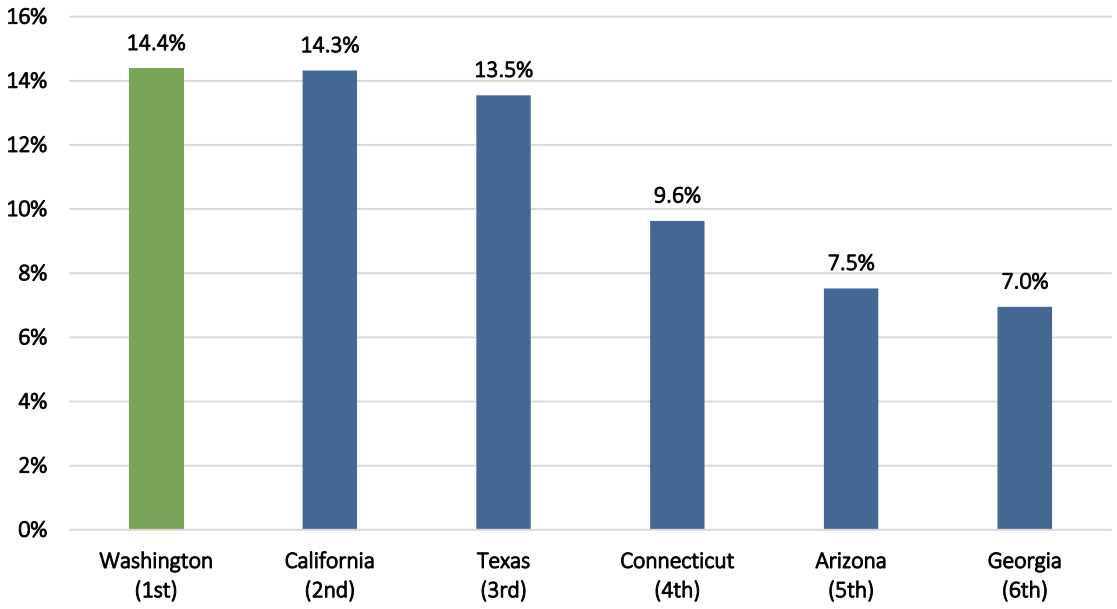

Figure 63. Share of U.S. Aerospace Manufacturing Industry Revenue, Top Six States 2021 (NAICS 3272). Source: Annual Survey of Manufactures

Supply Chains

The aerospace manufacturing industry's supply chain is a highly complex, global network driven by the need for advanced materials that meet rigorous standards for performance, safety, and weight. Key materials include lightweight metals like aluminum and titanium, high-temperature alloys such as Inconel, and advanced composites like carbon fiber-reinforced polymers. These materials are used in critical components ranging from airframes and engines to interior panels and electronic systems. The sourcing of these materials is geographically diverse. For example, aluminum and titanium are heavily sourced from within the U.S. and countries like China and Russia, while carbon fiber and specialty composites are largely produced by firms in Japan and throughout Europe.

The power dynamics of the aerospace supply chain are shaped by Original Equipment Manufacturers (OEMs), namely Boeing and Airbus. These OEMs exert significant control over their tiered supplier networks. However, suppliers of key raw materials—especially those for strategic components like fasteners, high-performance alloys, and semiconductors—hold considerable leverage due to limited availability, high specialization, and geopolitical constraints. Supply risks have increased in recent years due to geopolitical tensions (e.g., reliance on Russian titanium) and industrial disruptions (e.g., fastener shortages due to facility fires). As a result, aerospace firms are increasingly seeking to diversify sourcing,

invest in additive manufacturing, and strengthen resilience through vertical integration and "friend-shoring" strategies.

Table 38 and Table 39 show the five industries that would be most impacted by a $1 million reduction in output from aircraft manufacturing and aircraft parts and auxiliary equipment manufacturing, respectively. These tables also include estimates for the total impact of these $1 million reductions on all industries. Both simulations show that they are very much interconnected with one another, while their other most-impacted industries are actually quite different from one another.

Table 38. Impact of $1 Million Reduction in Output from Aircraft Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Household Appliances and Electrical and Electronic Goods	($19,471)
Other Aircraft Parts and Auxiliary Equipment Manufacturing	($14,678)
Wholesale – Machinery, Equipment, and Supplies	($10,365)
Data Processing, Hosting, and Related Services	($5,698)
Wholesale – Other Durable Goods Merchant Wholesalers	($5,560)
All Industries	**($127,164)**

Table 39. Impact of $1 Million Reduction in Output from Other Aircraft Parts and Auxiliary Equipment Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Custom Computer Programming Services	($34,602)
Aircraft Manufacturing	($21,838)
Computer Systems Design Services	($16,240)
Wholesale – Machinery, Equipment, and Supplies	($15,486)
Management of Companies and Enterprises	($11,789)
All Industries	**($213,651)**

Domestic Competition

Market Structure

The aerospace manufacturing industry is dominated by select companies, particularly Boeing and Airbus[lxi]. These companies source materials from all over the world and deliver products globally. Competition is stiff between the top companies, with one industry stakeholder noting that they compete on factors like fuel efficiency, comfort, and price.

Domestic Carbon Pricing

Of the top states by revenue, Washington, California, and Connecticut have carbon pricing policies in place (Table 40). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction. Connecticut's price of $19.63 per MTCO2e only applies to the electricity sector, so its aerospace manufacturing industry is only impacted indirectly by any pass through of the carbon price in electricity prices.

Table 40. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Aerospace Manufacturing Industry. Sources: Washington State Department of Ecology; California Air Resources Board; Regional Greenhouse Gas Initiative

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
California	$25.87	Yes
Connecticut*	$19.63	N/A
Texas	N/A	N/A
Arizona	N/A	N/A
Georgia	N/A	N/A

* Only applies to the electricity sector

Washington Exports

Figure 64 shows aerospace product exports from Washington state from 2002 to 2024. Similar to GDP in Figure 60, exports of aerospace products from Washington increased substantially up until 2015 (up 123 percent from 2002). Then a significant drop-off occurred reaching a low in 2020 and representing an 84 percent decrease. Since 2020, Washington's aerospace exports have increased, albeit not to pre-pandemic levels.

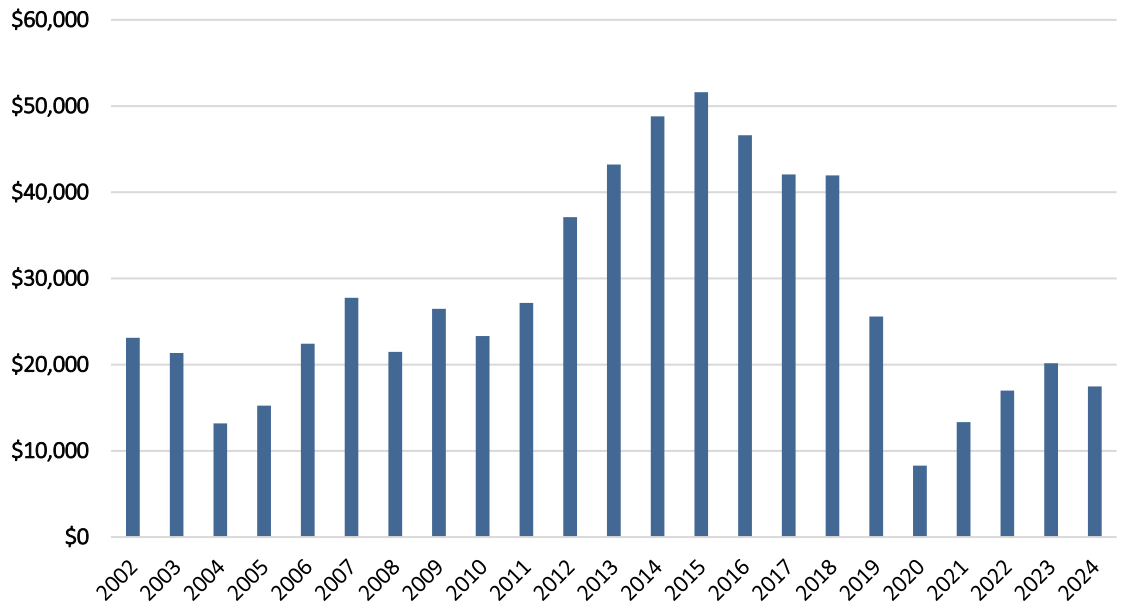

Figure 64. Washington State Aerospace Product and Part Exports (Millions $) (NAICS 3364). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 65 and Figure 66 show data on the value over time and 2024 share of aerospace product exports from the top six exporting states. From 2002 to 2024, export value has increased modestly for most of these top exporting states, with one exception being Washington state itself. In fact, 2024 represents

the first year over the timeframe shown that Washington was not the top exporting state, instead ceding way to Kentucky.

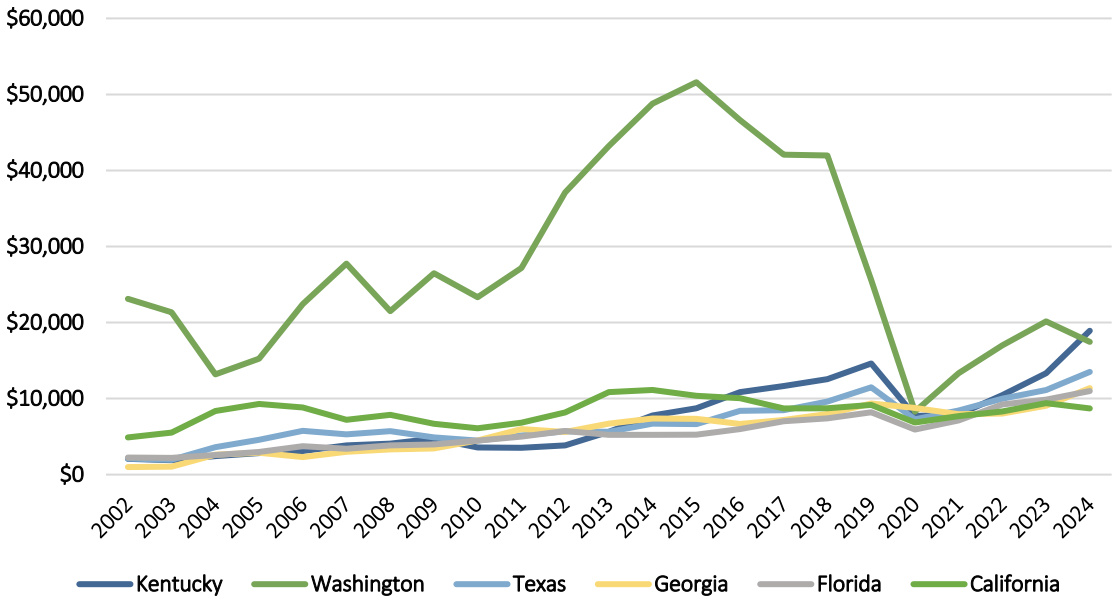

Figure 65. Aerospace Product and Part Exports, Top Six States (Millions $) (NAICS 3364). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

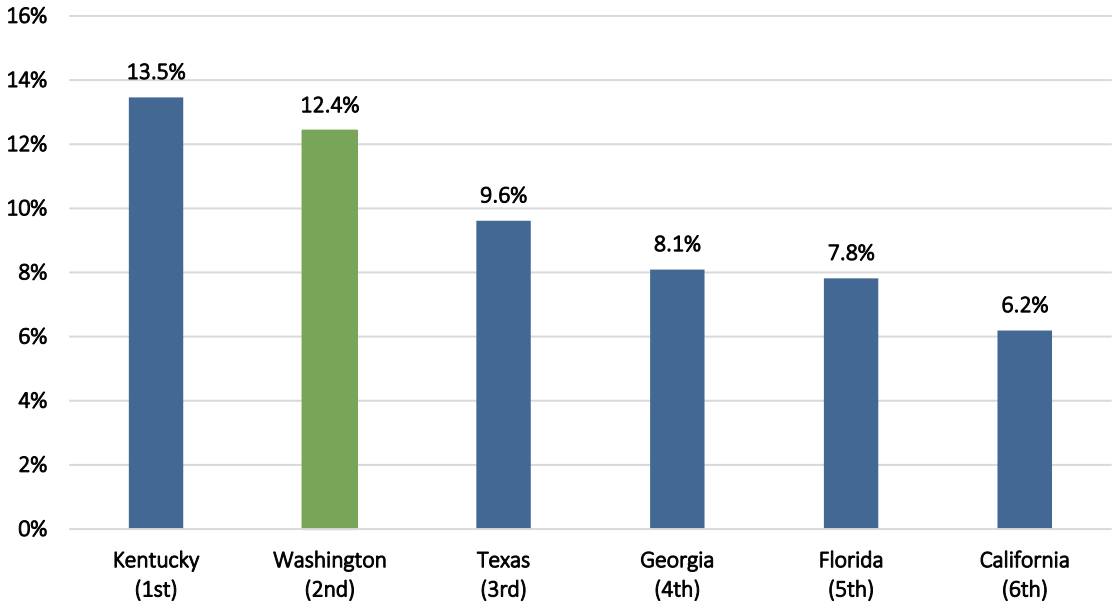

Figure 66. Share of U.S. Aerospace Product and Part Exports, Top Six Exporters 2024 (NAICS 3364). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 67 presents the share of global exports for aerospace products in 2023 for the six largest exporting nations. The U.S. is the clear top exporter of these products, representing 28.4 percent ($65.6 billion) of global exports.

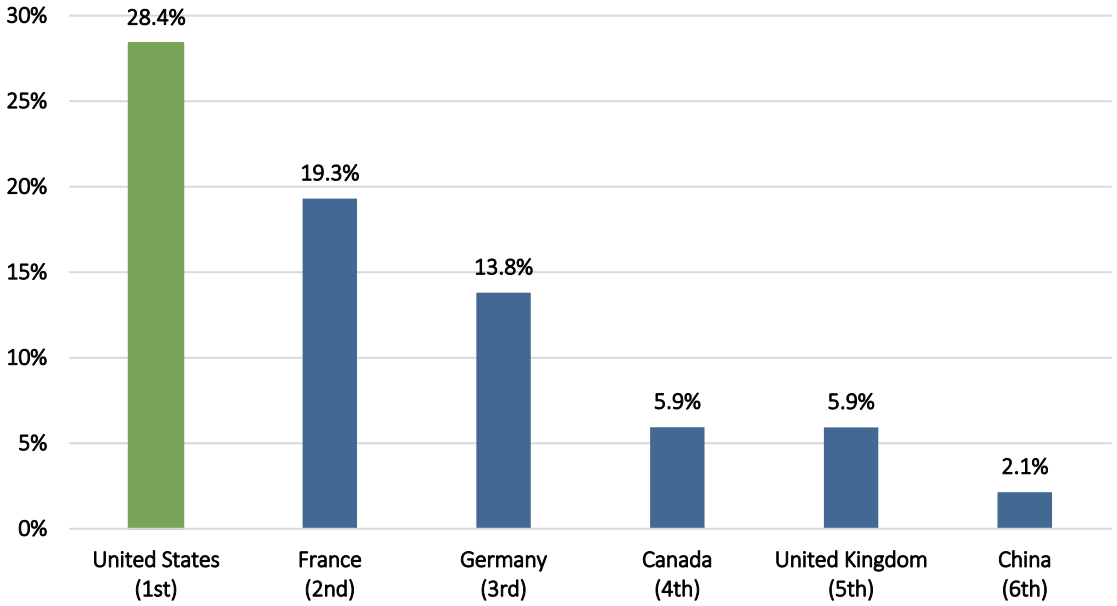

Figure 67. Share of International Aircraft and Spacecraft Exports (HS 88), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Most of the U.S.'s top global competitors in the aerospace market have carbon pricing instituted, as shown in Table 41. The EU has the highest cost for carbon emissions of these top competitors. France and the UK have carbon prices that are roughly similar to the current allowance price in Washington (in USD).

Table 41. International Carbon Pricing for Top Exporters of Aircraft and Spacecraft Products. Sources: World Bank; International Carbon Action Partnership

Country/Region	Price per MTCO2e	EITE Leakage Mitigation Policies
European Union	64.74 EUR ($72.70)	Yes
Canada	95.00 CAD ($68.23)	Yes
Germany	55.00 EUR ($61.76)	Yes
France	44.60 EUR ($50.08)	Yes
United Kingdom	37.18 GBP ($49.18)	Yes
Quebec	$25.87	Yes

China*	95.95 CNY ($13.32)	Yes
South Korea	10,355 SKW ($7.37)	Yes
United States	N/A	N/A

* Only applies to the electricity, cement, steel, and aluminum sectors

Outlook

Projections

Aerospace manufacturing is anticipated to increase in the U.S., with high global demand for established U.S. manufacturers like Boeing[lxii]. The industry is expected to grow at a compound annual growth rate of 1.7 percent globally.

Cost Pass Through

Based on IRS tax returns data, profitability within the aerospace manufacturing industry nationwide stands at 12.3 percent as of 2021. Exposure to global competition makes cost pass through more difficult for the aerospace manufacturing industry to absorb. Long-term contracting throughout the supply chain also hampers the industry's capacity to pass on additional costs.

Key Takeaways

- Washington state is a top performer in the aerospace manufacturing industry, representing the largest employing and revenue-generating state in the U.S.
- With that said, aerospace in Washington is generally trending downwards, with other states catching up in terms of total employment and exported goods.
- The U.S. as a whole is a top performing market for aerospace trade, with over $65 billion of export value from the nation.
- Demand for aerospace technology is expected to increase, with established companies likely to see the vast majority of economic activity around those gains.

Building Materials

Industry Overview

Cement manufacturing involves breaking down and mixing a number of rocks and minerals (e.g., limestone, clay, sand, shale, slate, chalk), firing the mixture in a kiln to produce a substance known as clinker, and then grinding the clinker with materials such as gypsum to create fine cement powder[lxiii]. To make gypsum board, facilities heat gypsum and combine it with water and other materials to form a slurry, combine the slurry with layers of paper to make boards, and then cut and dry the boards[lxiv].

There are about sixteen cement and gypsum product manufacturing facilities located in Washington, three of which are classified as EITEs. Two of the facilities are located in King County (Ash Grove Cement and CertainTeed Gypsum), and one is located in Pierce County (Georgia-Pacific Gypsum). Figure 68 shows the locations of the cement and gypsum manufacturing EITEs in Washington.

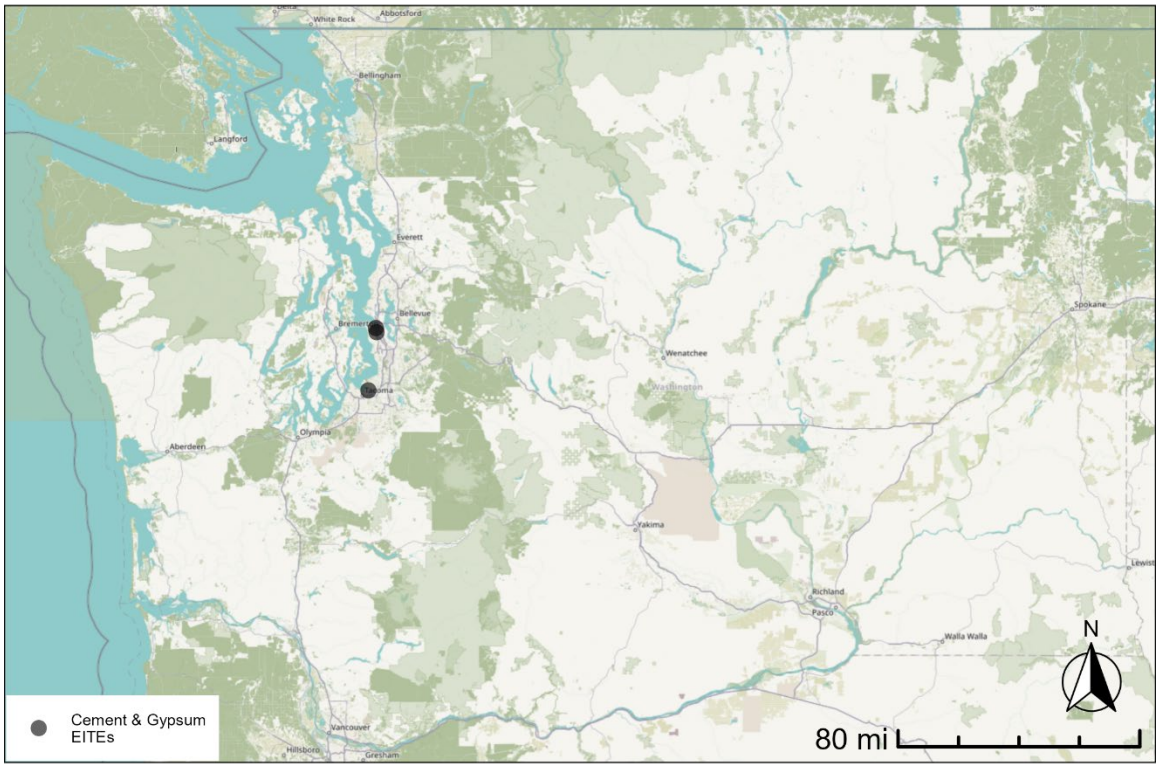

Figure 68. Map of Cement and Gypsum Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 69 shows that economic activity in the nonmetallic mineral manufacturing in Washington has increased overall over the past twenty-five years. Since a peak of $1.4 billion in 2007, though, the industry has been cut by a quarter. Meanwhile, nonmetallic mineral manufacturing has decreased as a percentage of overall Washington state GDP, as shown in Figure 70.

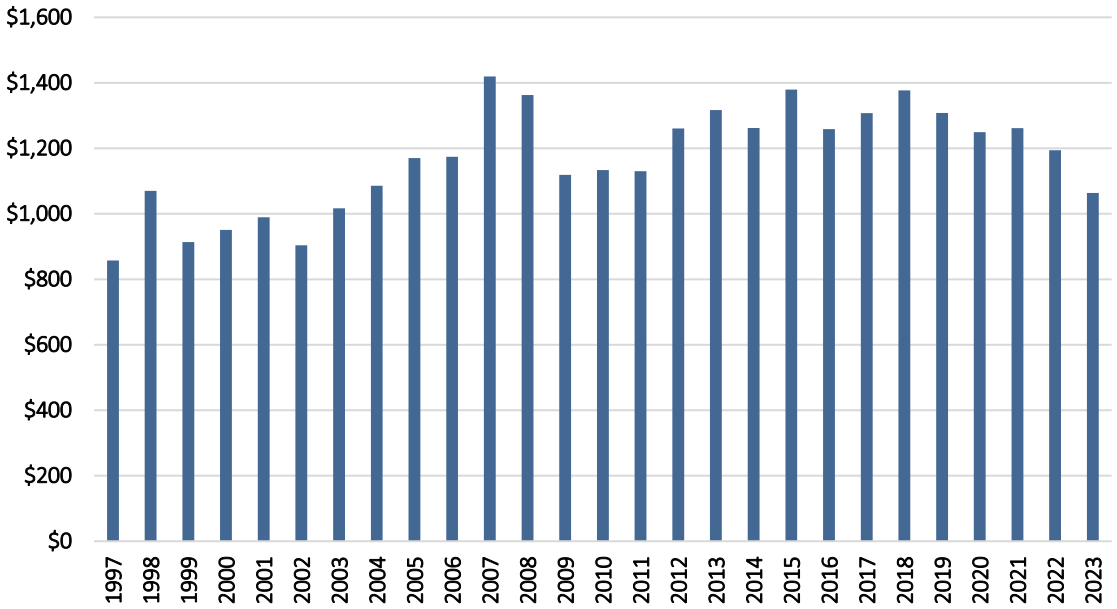

Figure 69. Washington State Nonmetallic Mineral Product Manufacturing Real GDP (Millions 2017 $) (NAICS 327). Source: U.S. Bureau of Economic Analysis

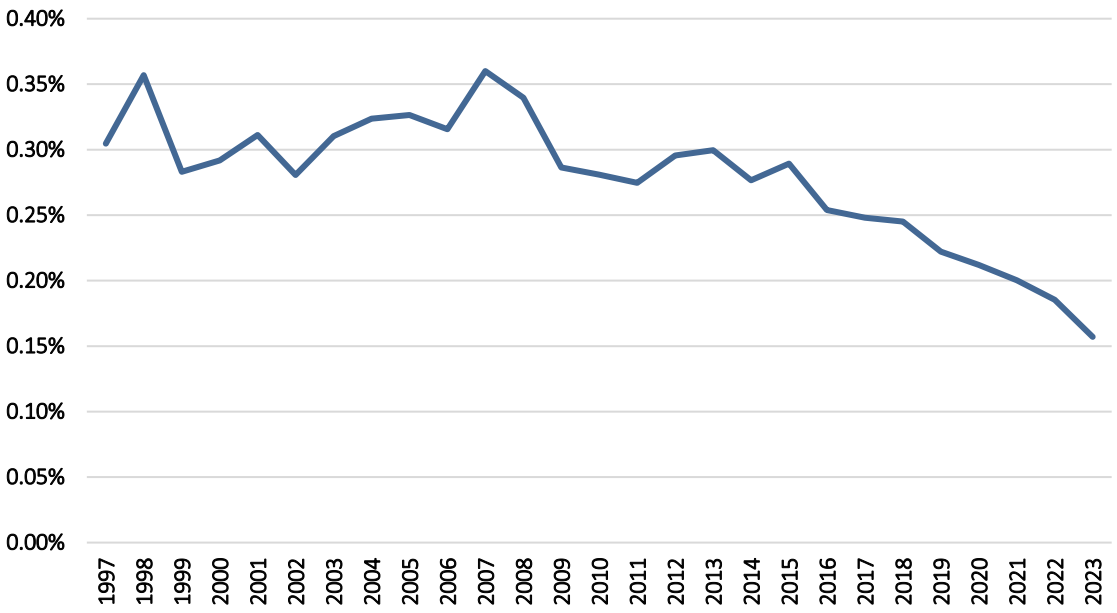

Figure 70. Share of Washington State GDP from Nonmetallic Mineral Product Manufacturing (NAICS 327). Source: U.S. Bureau of Economic Analysis

Employment

As seen in Figure 71, employment in Washington's cement and concrete industry has declined modestly over the past ten years, from a high of around 4,000 workers in 2016 to around 3,500 in 2022. Washington's lime and gypsum product industry has seen a slight increase in employment, from about 350 workers in 2013 to roughly 400 workers in 2022. Figure 72 shows that the states with the most

employment in these industries in 2022 were Texas, California, Florida, Pennsylvania, and Georgia. Washington ranked twentieth compared to other states, with about two percent of total U.S. employment in the cement, concrete, lime, and gypsum product industries.

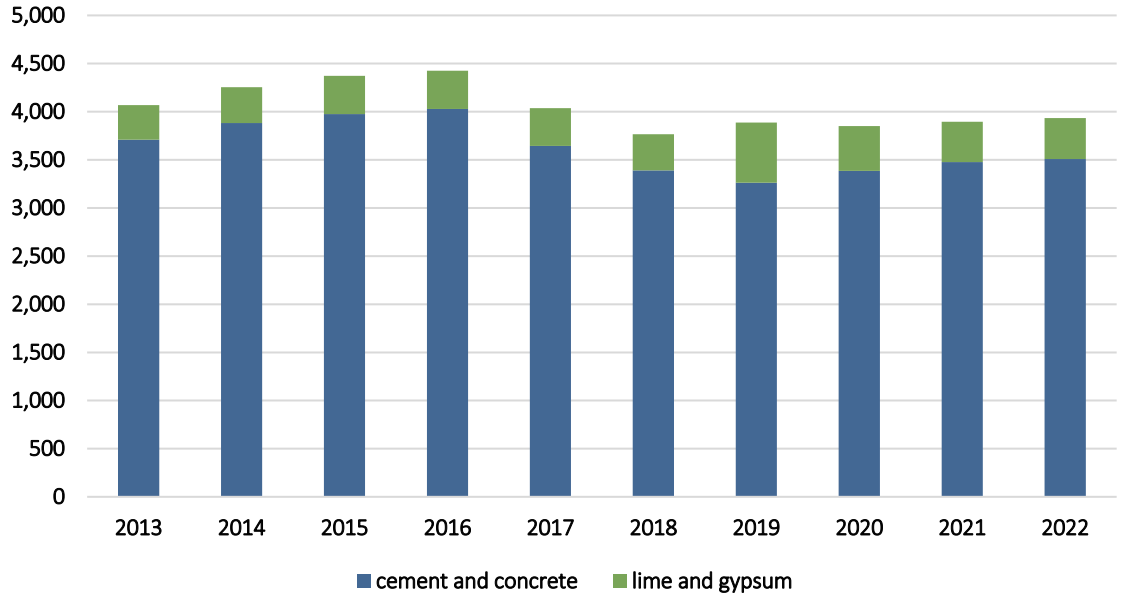

Figure 71. Total Washington State Cement, Concrete, Lime, and Gypsum Manufacturing Industries Employment (NAICS 3273 and 3274). Source: U.S. County Business Patterns

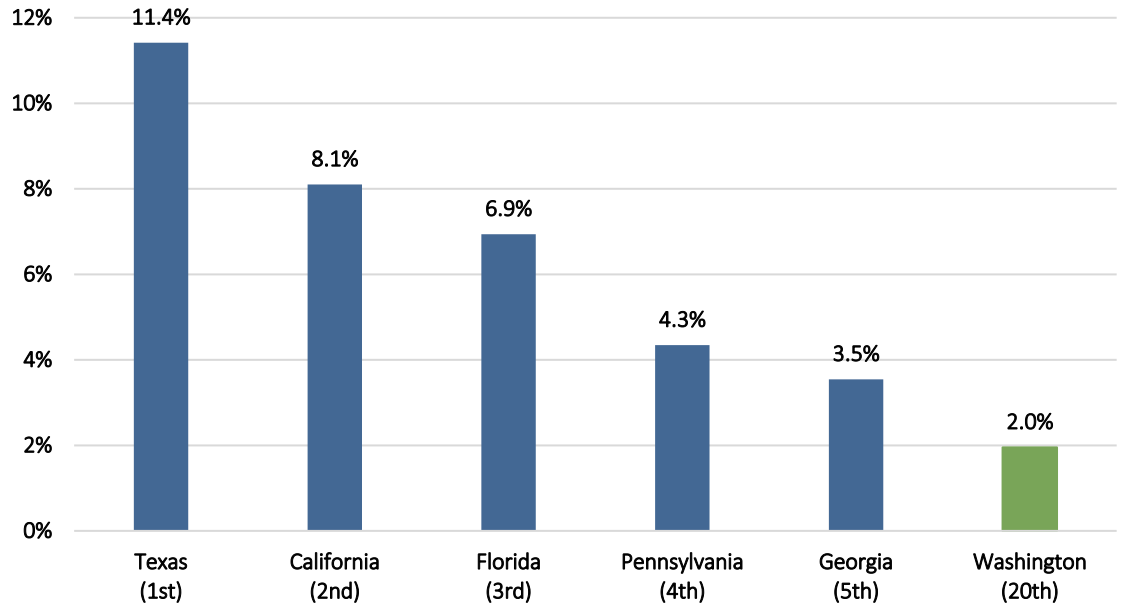

Figure 72. Share of U.S. Cement, Concrete, Lime, and Gypsum Manufacturing Industries Employment, Top Five States and Washington 2022 (NAICS 3273 and 3274). Source: U.S. County Business Patterns

Revenue

In terms of revenue, Figure 73 and Figure 74 show that Texas had the highest share of U.S. revenue in 2021 in both the cement and concrete industry (thirteen percent) and the lime and gypsum product industry (nine percent). California, Florida, and Pennsylvania also ranked in the top five states for both industries. In comparison, Washington ranked nineteenth in its share of U.S. cement and concrete revenue (1.9 percent) and fifteenth in its share of U.S. lime and gypsum product revenue (2.6 percent).

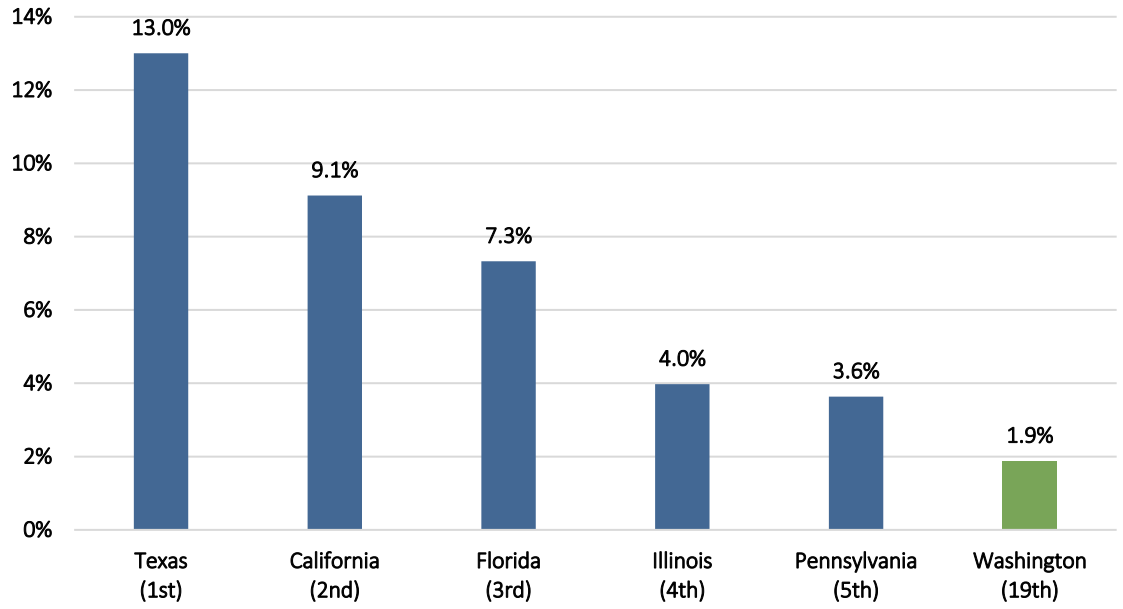

Figure 73. Share of U.S. Cement and Concrete Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 3273). Source: Annual Survey of Manufactures

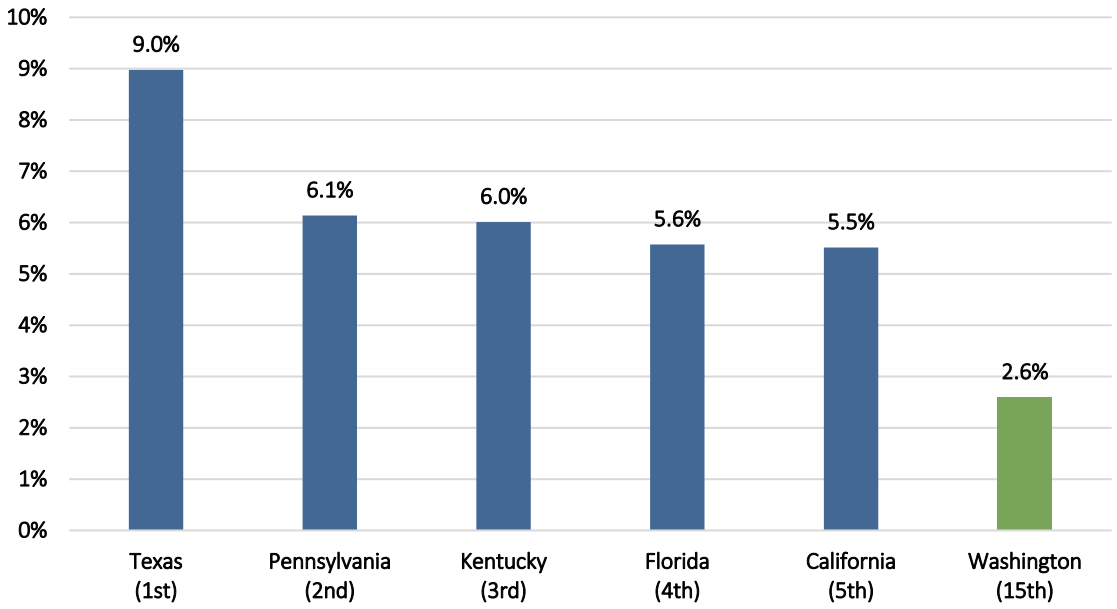

Figure 74. Share of U.S. Lime and Gypsum Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 3274). Source: Annual Survey of Manufactures

Supply Chains

Table 42 and Table 43 show the potential indirect impact on other industries of a $1 million reduction in output in the cement manufacturing industry and gypsum product manufacturing industry, respectively. Most of the top impacted industries fall under transportation, electricity, or raw materials used in the manufacturing processes (e.g., starch from wet corn milling used in gypsum product manufacturing). The projected impacts on individual industries are relatively small, with no single industry experiencing more than a $50,000 indirect impact. The impacts across all industries however would be substantial, at around $500,000 in both scenarios.

Table 42. Impact of $1 Million Reduction in Output from Cement Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Electric Power Transmission and Distribution	$(47,177)
Local Government Electric Utilities	$(27,460)
Rail Transportation	$(27,417)
Wholesale – Other Durable Goods Merchant Wholesalers	$(26,425)
Stone Mining and Quarrying	$(21,875)
All Industries	**($501,079)**

Table 43. Impact of $1 Million Reduction in Output from Gypsum Product Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Rail Transportation	$(38,681)
Wet Corn Milling	$(31,628)
Truck Transportation	$(30,047)
Management of Companies and Enterprises	$(21,360)
Ground or Treated Mineral and Earth Manufacturing	$(19,742)

All Industries	($508,525)

Domestic Competition

Market Structure

The U.S. markets for cement and gypsum product manufacturing are moderately concentrated; data from the Census Bureau's County Business Patterns show that there were 186 cement manufacturing establishments and 184 gypsum product manufacturing establishments in the U.S. in 2022. There are some challenges involved with shipping cement, as it is both dense and perishable[lxv], which adds to the cost of importing cement. However, neither cement nor gypsum products face prohibitive shipping barriers and both are internationally traded, meaning that the market for these products in Washington is exposed to both domestic and foreign sources of competition.

Of the three Washington EITEs in these industries, Ash Grove Cement and Georgia-Pacific are large, multinational companies based in the U.S. CertainTeed is owned by Saint-Gobain, a large multinational corporation headquartered in France.

Domestic Carbon Pricing

Of the top states by revenue, only California has a carbon price in place (Table 44). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction.

Table 44. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Cement, Concrete, Lime, and Gypsum Manufacturing Industries. Sources: Washington State Department of Ecology; California Air Resources Board

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
California	$25.87	Yes
Texas	N/A	N/A
Florida	N/A	N/A
Pennsylvania	N/A	N/A
Kentucky	N/A	N/A
Illinois	N/A	N/A

Washington Exports

Figure 75 shows that Washington exports of concrete and cement as well as lime and gypsum products have increased dramatically over the past twenty years. Exports of concrete and cement have increased more than twelvefold, from about $6 million in 2002 to about $76 million in 2024. Lime and gypsum product exports from the state grew by more than ninefold over the same period, from around $2 million in 2002 to around $19 million in 2024. It is important to note that the export data shown in Figure 75 includes the value of products produced outside of Washington but exported from the state, which is likely driving at least some of the growth in exports for these industries.

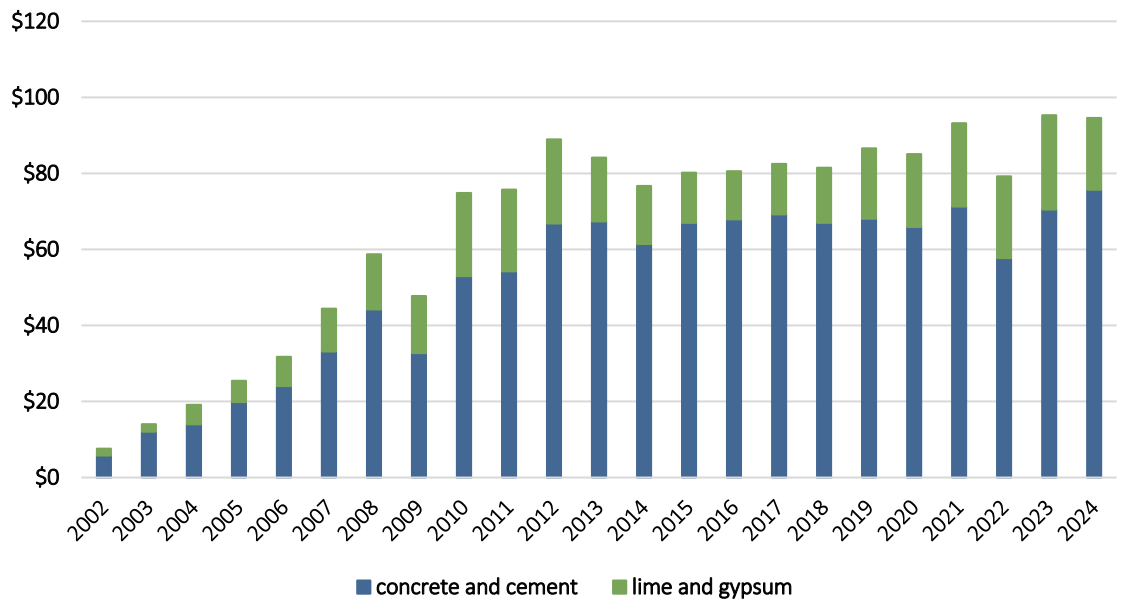

Figure 75. Washington State Cement, Concrete, Lime, and Gypsum Manufacturing Exports (Millions $) (NAICS 3273 and 3274). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 76 and Figure 77 show data on the value over time and 2024 share of cement, concrete, lime, and gypsum product exports from the top six states. Exports from the top exporting states grew substantially during the late 2000s and early 2010s, but have since declined precipitously for all of the top exporters besides Washington. In 2024, Washington was by far the largest exporter of cement, concrete, lime, and gypsum products, with a 16.4 percent share of total U.S. exports. That was more than double the share of the second largest exporter, California (seven percent).

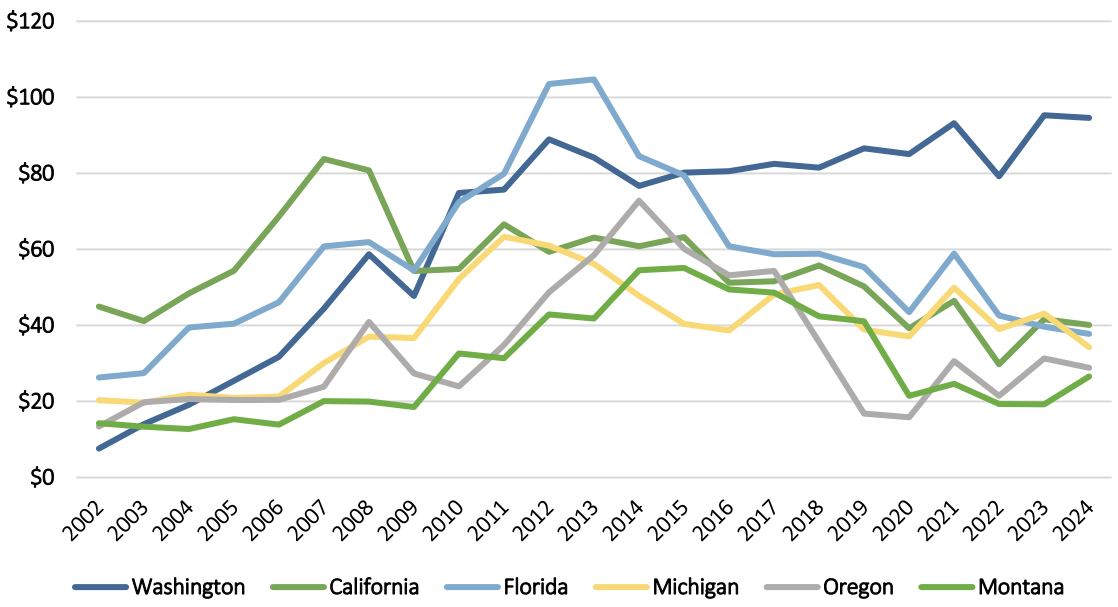

Figure 76. Cement, Concrete, Lime, and Gypsum Manufacturing Exports, Top Six States (Millions $) (NAICS 3273 and 3274). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

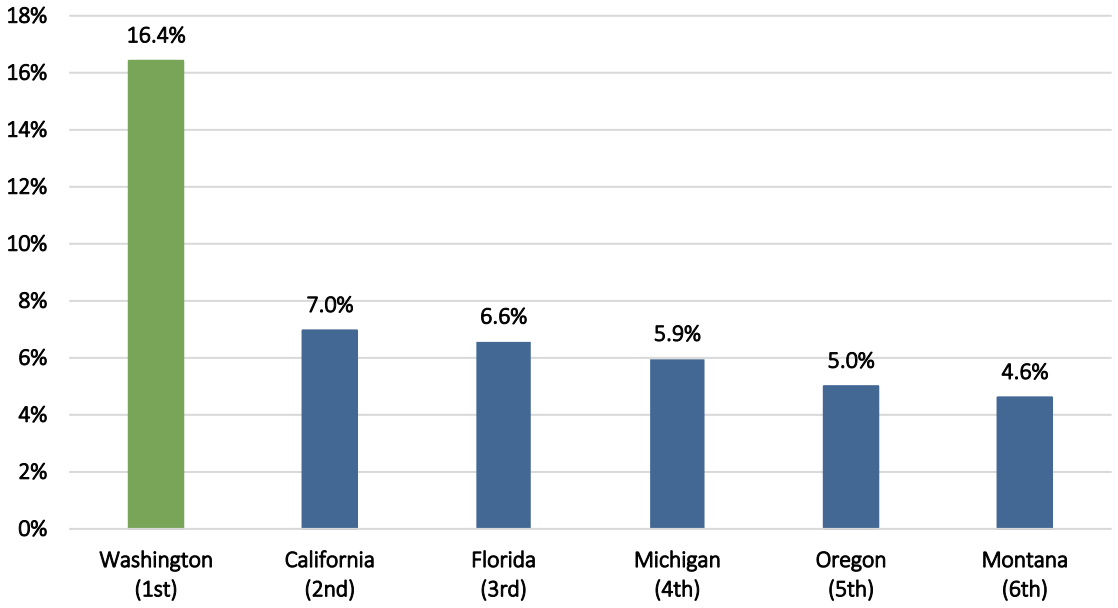

Figure 77. Share of U.S. Cement, Concrete, Lime, and Gypsum Manufacturing Exports, Top Six Exporters 2024 (NAICS 3273 and 3274). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Although Washington is the leading U.S. exporter of cement and concrete, Figure 78 shows that the U.S. as a whole is not major exporter of cement. In 2023, Turkey and Vietnam were the leading exporters of cement, with Turkey having a 10.6 percent share of global exports and Vietnam having a 10.1 percent share. In contrast, the U.S. ranked twenty-sixth in cement exports in 2023, with only a 1.1 percent share. For gypsum board, Figure 79 shows that Mexico had by far the largest share of global exports in 2023 (18.7 percent), more than double the second largest exporter, Spain (8.0 percent). The U.S. ranked fourth, with a 6.8 percent share of global gypsum board exports in 2023.

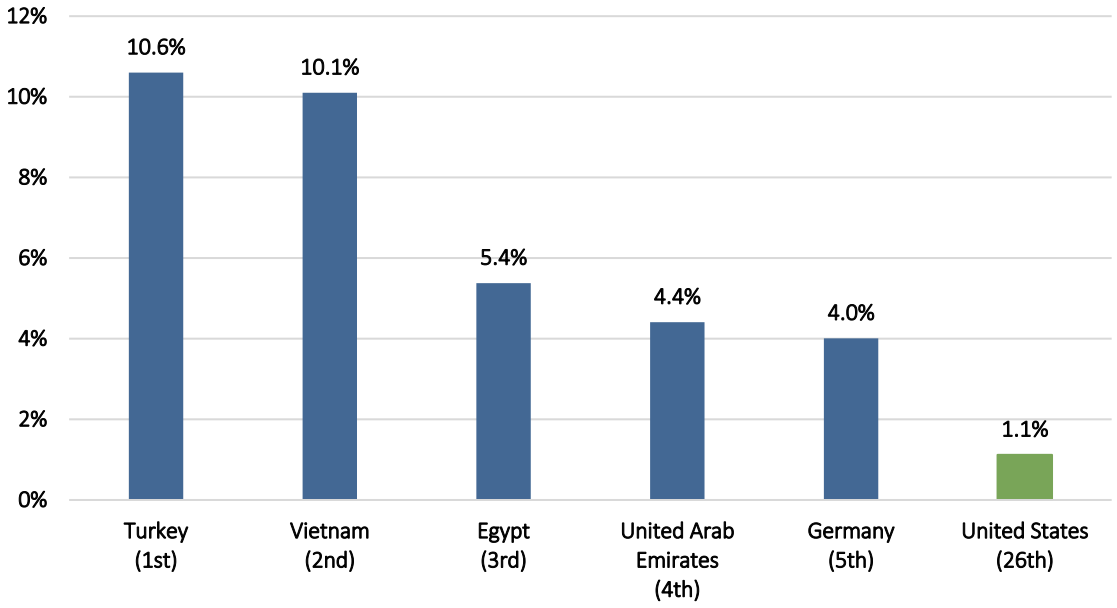

Figure 78. Share of International Cement Exports (HS 2523), Top Five Exporters and U.S. 2023. Source: Observatory of Economic Complexity

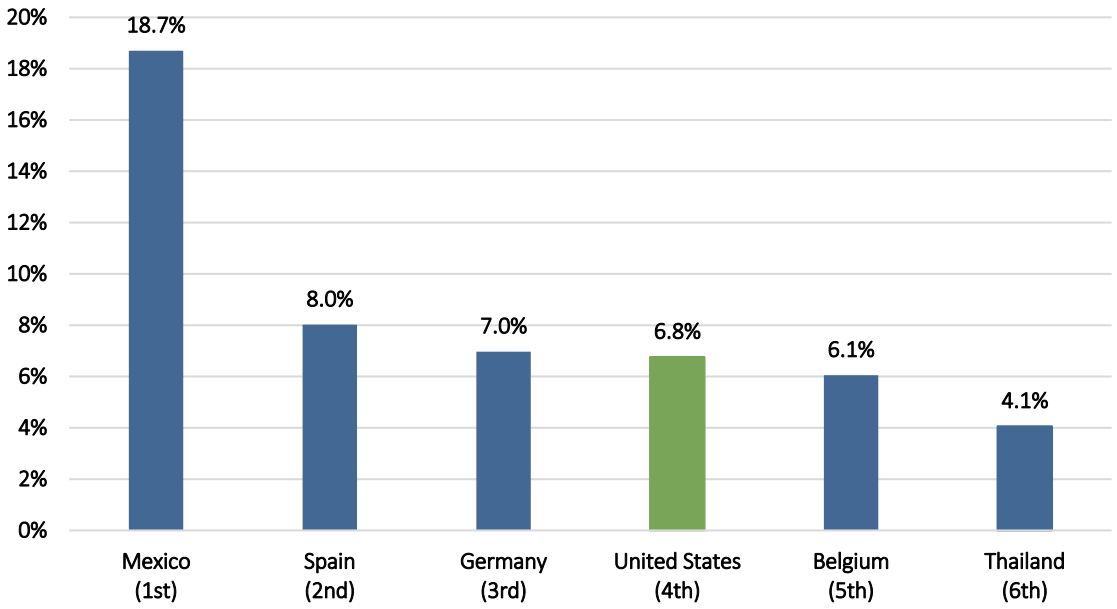

Figure 79. Share of International Gypsum Board Exports (HS 680911), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Table 45 shows the carbon pricing of the top international exporters of cement and gypsum board. Germany, Spain, and Belgium have carbon prices, with facilities covered by either the European Union emissions trading system or domestic carbon pricing policies. Mexico has a national carbon tax of 80 MXN ($4.24), but it exempts emissions from natural gas. Mexico also has eleven subnational carbon taxes in place, which range in price from 58 MXN ($3.07) to 668 MXN ($35.38), and is working on implementing an emissions trading system. The carbon policies for the European countries all include some form of carbon leakage mitigation for their EITEs, while only some jurisdictions in Mexico have leakage mitigation policies.

Table 45. International Carbon Pricing for Top Exporters of Cement and Gypsum Board. Sources: World Bank; International Carbon Action Partnership

Country/Region	Building Material Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
European Union	Both	64.74 EUR ($72.70)	Yes
Germany	Both	55.00 EUR ($61.76)	Yes
Spain	Gypsum Board	15.00 EUR ($16.83)	Yes
Mexico	Gypsum Board	58 to 668 MXN ($3.07 to $35.38)	Varies by jurisdiction
Belgium	Gypsum Board	EU ETS only	Yes
United States	**Gypsum Board**	**N/A**	**N/A**
Turkey	Cement	N/A	N/A
Vietnam	Cement	N/A	N/A
Egypt	Cement	N/A	N/A
United Arab Emirates	Cement	N/A	N/A
Thailand	Gypsum Board	N/A	N/A

Outlook

Projections

Data from the U.S. Geologic Survey show that U.S. cement production grew slightly from 2014 to 2022, from about 91 million tons to 100.5 million tons, but declined to 94.8 million tons in 2024. U.S. imports of cement grew far more quickly, from 8.4 million tons in 2014 to 26.5 million tons in 2024[lxvi]. These past trends suggest that U.S. cement production could remain relatively stagnant while imports could play an increasing role in meeting U.S. demand.

A forecast from a market research firm projects that the global cement industry will grow from around $506 billion in 2024 to around $686 billion in 2032, a compound annual growth rate of 3.9 percent[lxvii]. A different market research report forecasts that the U.S. cement industry will grow from $18.7 billion in 2024 to $24.0 billion in 2032, a compound annual growth rate of 3.2 percent[lxviii]. While not publicly available, the American Cement Association produces five-year forecasts at the county, state, regional, and national levels that could provide additional insight on the outlook for the industry[lxix].

For gypsum board, the global market was worth around $59.5 billion in 2024 and is forecasted to grow to $171.1 billion in 2033 at a compound annual growth rate of 8.5 percent[lxx]. The U.S. gypsum board market was worth around $15.6 billion in 2023 and is projected to grow at a 9.1 percent compound annual growth rate from 2024 to 2030[lxxi].

Cost Pass Through

Based on IRS tax returns data, profitability within the cement, concrete, lime, and gypsum manufacturing industries nationwide stands at 10.8 percent as of 2021. This suggests that Washington's cement and gypsum manufacturing EITEs could potentially absorb a small portion of the cost of carbon pricing. However, Washington's building materials industry is relatively small and faces high levels of competition both from abroad and from within the U.S., which would likely limit the ability of the EITEs to pass costs through to their customers.

Cement manufacturing is a challenging industry to decarbonize, as most of the emissions are inherent to the manufacturing process (e.g., from superheating limestone in kilns). While many of the largest cement companies are working on ways to decarbonize, it remains unclear how successful these efforts will be[lxxii]. The primary source of emissions from gypsum product manufacturing is energy usage, particularly the drying process[lxxiii].

Key Takeaways

- Washington is not a leading producer of cement or gypsum products in the U.S., but it is the top U.S. exporter for those industries by a wide margin.
- Texas, California, Florida, and Pennsylvania have the largest shares of U.S. revenue in the cement and gypsum product industries. Internationally, Turkey and Vietnam are the top cement exporters, while Mexico is the dominant exporter of gypsum board.
- A couple countries have carbon pricing comparable to Washington's, but most domestic and international competitors have low or no carbon pricing. Those that have carbon prices generally offer free allowances or other forms of leakage mitigation policies for their EITEs.
- The U.S. cement market is expected to grow, but trends from the past ten years suggest that the increased demand could drive up imports of cement more than domestic production. Both the

global and U.S. markets for gypsum board are expected to grow substantially over the medium term.

- There are some logistical challenges with transporting cement that could offer some room for Washington's cement EITE to pass through carbon pricing costs. However, both the cement and gypsum product industries are highly competitive and have middling profit margins, which increases the risk of carbon leakage.

Chemical Manufacturing

Industry Overview

There are about 255 chemical manufacturing facilities located in Washington, three of which are classified as EITEs. Two of the facilities are located in Cowlitz County (Lanxess Corporation and Solvay Chemicals) and one is located in Benton County (Nutrien US – Kennewick). The Lanxess facility produces chemicals derived from the hydrocarbon toluene, the Solvay Chemicals facility makes hydrogen peroxide, and the Nutrien facility manufactures nitrogen-based fertilizers. Figure 80 shows the locations of the chemical manufacturing EITEs in Washington.

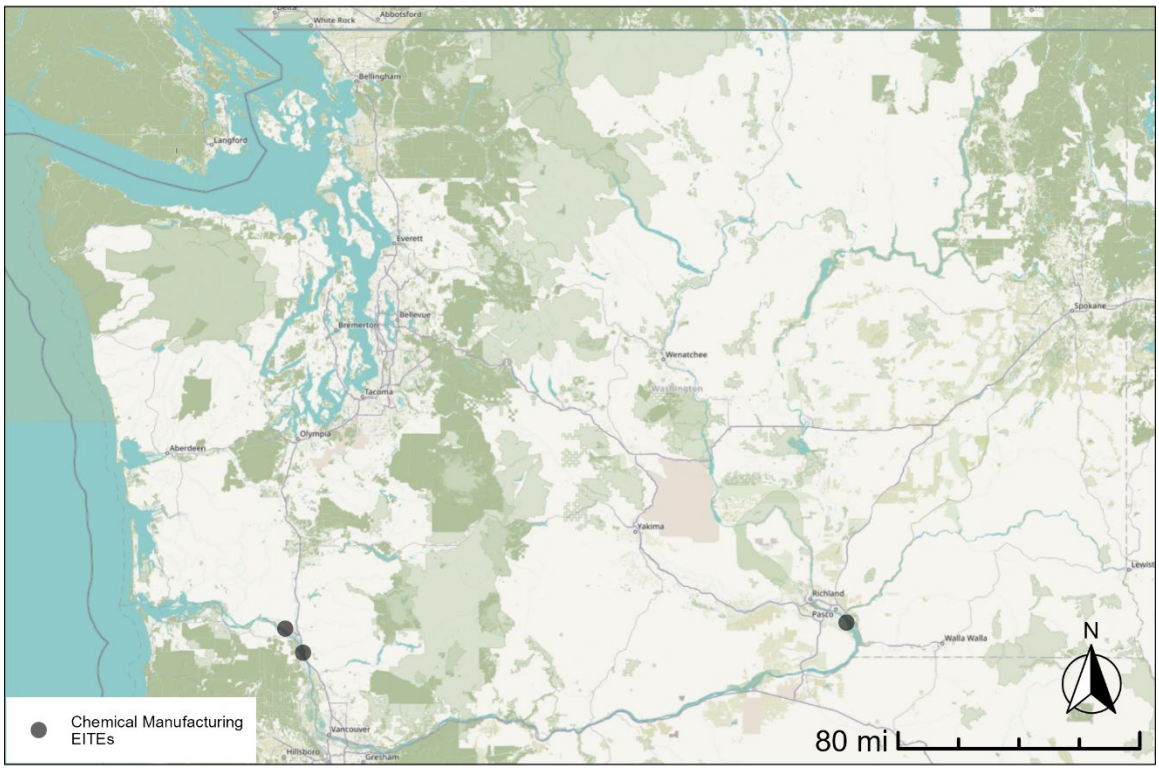

Figure 80. Map of Chemical Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 81 shows that Washington's real GDP from chemical manufacturing was relatively stable prior to 2014 (with the exception of some major swings in the early 2000s). However, since 2014 the industry's contribution to the state's GDP has grown substantially and in 2023 was more than double its 2014

level. The share of Washington's GDP from chemicals manufacturing has declined slightly over the past twenty-five years, from around 0.5 percent in 1997 to around 0.4 percent in 2023 (see Figure 82)

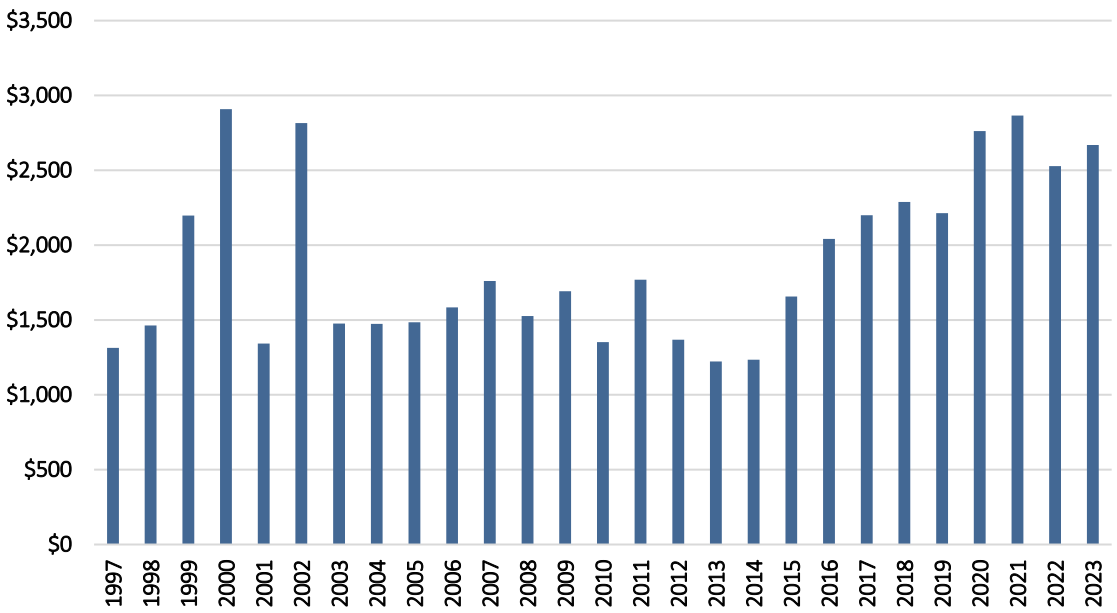

Figure 81. Washington State Chemical Manufacturing Real GDP (Millions 2017 $) (NAICS 325). Source: U.S. Bureau of Economic Analysis

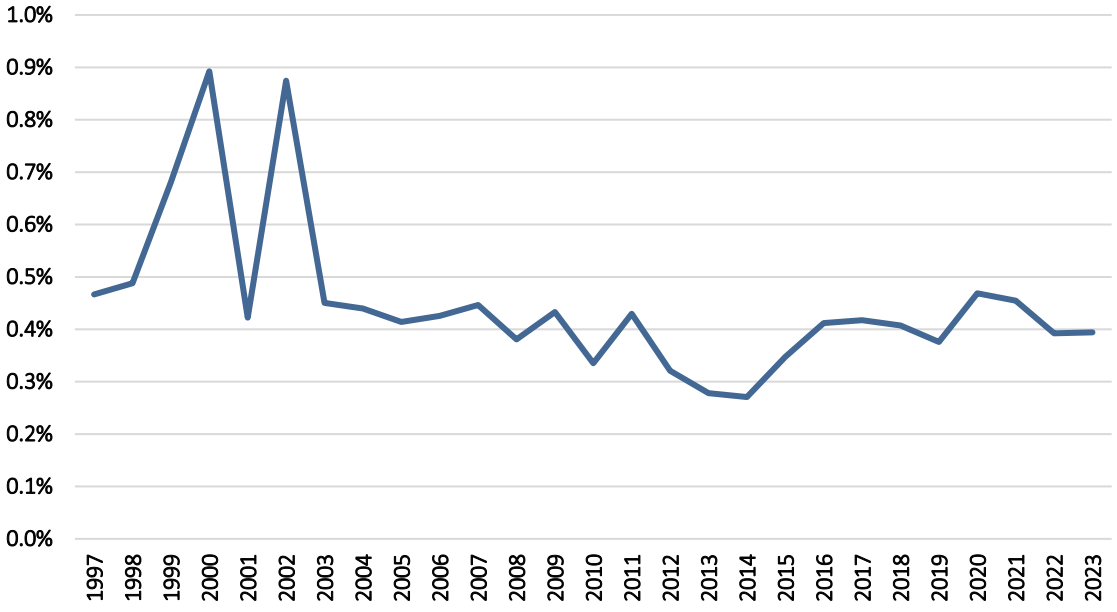

Figure 82. Share of Washington State GDP from Chemical Manufacturing (NAICS 325). Source: U.S. Bureau of Economic Analysis

Employment

As seen in Figure 83, employment in Washington's chemical manufacturing industry has increased over the past ten years, going from around 6,500 workers in 2013 to around 9,700 workers in 2022. However,

Figure 84 shows that Washington has a relatively small share of U.S. employment in the chemical manufacturing industry. Washington ranked twenty-seventh compared to other states in 2022 with a 1.1 percent share of total U.S. employment in the industry. California and Texas had the largest shares of U.S. employment in the industry in 2022 (10.6 percent and 8.7 percent, respectively), while Ohio, North Carolina, and Pennsylvania each had around five or six percent.

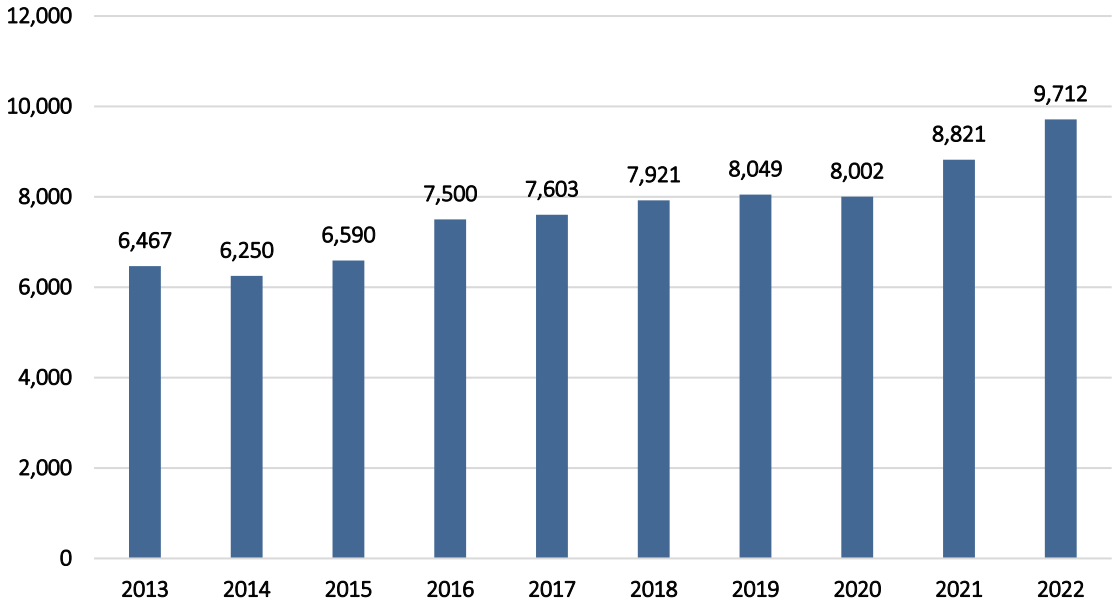

Figure 83. Total Washington State Chemical Manufacturing Industry Employment (NAICS 325). Source: U.S. County Business Patterns

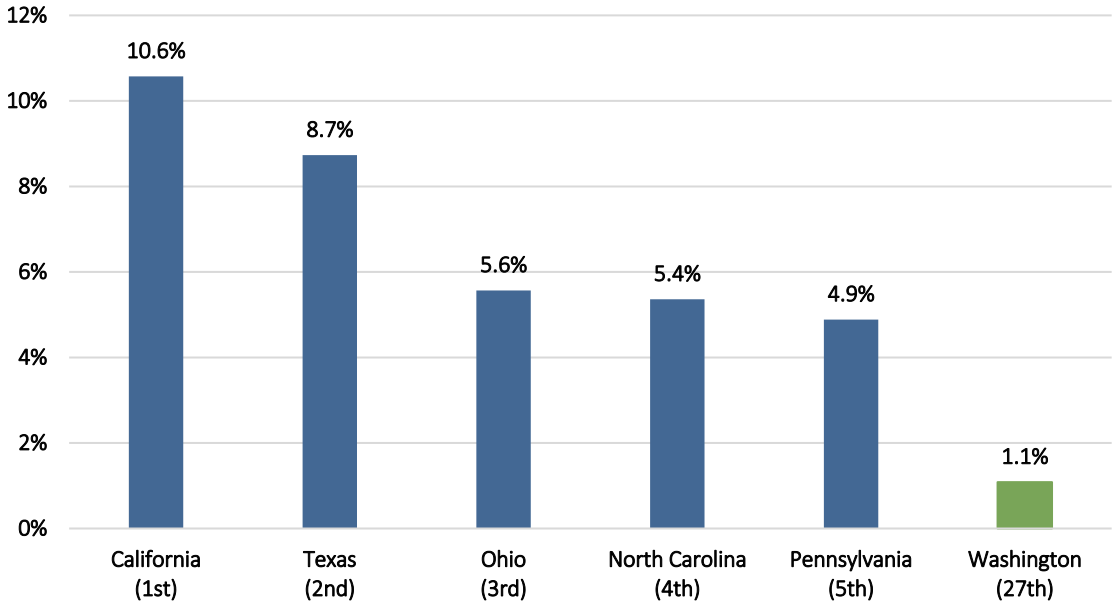

Figure 84. Share of U.S. Chemical Manufacturing Industry Employment, Top Five States and Washington 2022 (NAICS 325). Source: U.S. County Business Patterns

Revenue

Washington had a very small of total U.S. revenue in the chemical manufacturing industry in 2021, ranking thirty-fourth compared to other states with just a 0.5 percent share (Figure 85). Texas had the largest share of U.S. revenue in the industry (17.6 percent), substantially more than California (10.7 percent) and Louisiana (7.9 percent), the second and third ranking states. New York and Illinois ranked fourth and fifth, each with around five percent shares.

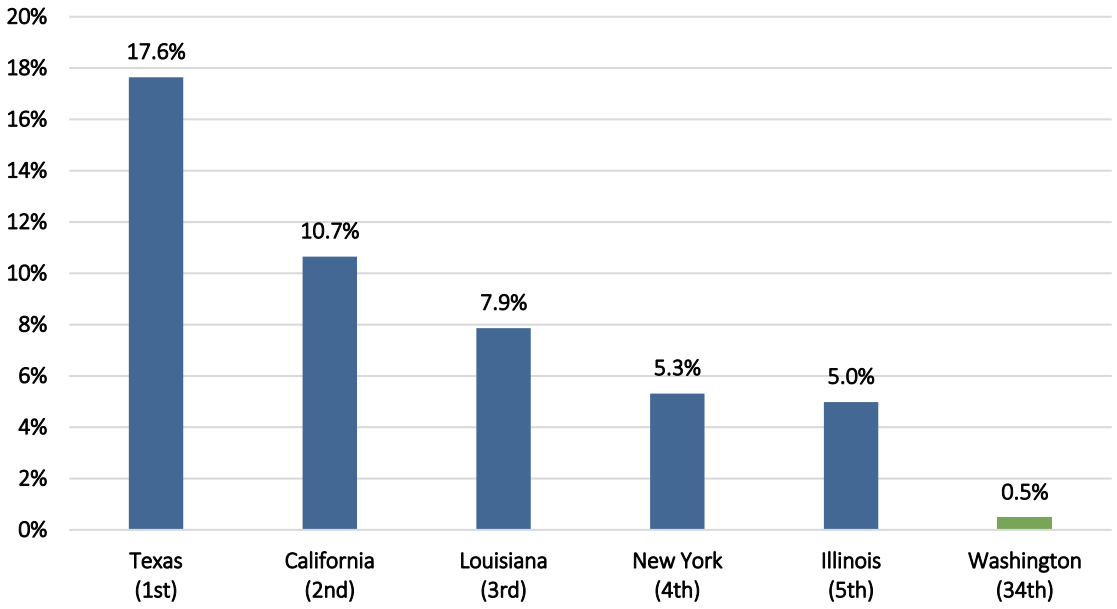

Figure 85. Share of U.S. Chemical Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 325). Source: Annual Survey of Manufactures

Supply Chains

Table 46, Table 47, and Table 48 show the potential indirect impact on other industries of a $1 million reduction in output in the segments of the chemical manufacturing industry represented by Washington's EITEs. In all three scenarios, the two industries that would be most affected by the decreased output are petroleum refining and nondurable goods wholesalers. Indirect impacts to those two industries could potentially be consequential, being greater than $50,000 in two of the three scenarios. Electricity and truck transportation are also in the top five impacted industries under two of the three scenarios. Total indirect impacts across all industries would likely be substantial, at around $500,000 in the scenarios of reduced output from inorganic and organic chemical manufacturing, and around $600,000 in the reduced nitrogenous fertilizer manufacturing scenario.

Table 46. Impact of $1 Million Reduction in Output from Nitrogenous Fertilizer Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Petroleum Refineries	$(66,821)
Wholesale – Other Nondurable Goods Merchant Wholesalers	$(54,565)
Natural Gas Distribution	$(45,957)
Electric Power Transmission and Distribution	$(37,223)
Truck Transportation	$(35,129)
All Industries	**($598,213)**

Table 47. Impact of $1 Million Reduction in Output from Other Basic Inorganic Chemical Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Petroleum Refineries	$(49,014)
Wholesale - Other Nondurable Goods Merchant Wholesalers	$(31,608)
Electric Power Transmission and Distribution	$(31,254)
Local Government Electric Utilities	$(18,122)
Management of Companies and Enterprises	$(17,958)
All Industries	($495,272)

Table 48. Impact of $1 Million Reduction in Output from Other Basic Organic Chemical Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Petroleum Refineries	$(79,290)
Wholesale - Other Nondurable Goods Merchant Wholesalers	$(69,133)
Grain Farming	$(40,719)
Petrochemical Manufacturing	$(32,308)
Truck Transportation	$(21,453)
All Industries	($545,904)

Domestic Competition

Market Structure

Market research reports suggest that the chemical manufacturing industry as a whole is moderately competitive[lxxiv]. However, the nitrogen fertilizer industry in the U.S. is highly concentrated, with a Texas A&M report showing that about three-fourths of U.S. production of nitrogenous fertilizers in 2019 was controlled by just four companies[lxxv]. There are some challenges involved with shipping the chemical products produced by Washington's EITEs. Hydrogen peroxide is classified as a hazardous material if it is highly concentrated[lxxvi], and some products with toluene (e.g., paints, pharmaceuticals) also require careful transport. However, it is still feasible to ship most chemicals domestically and internationally, and most of the shipping challenges involved apply equally to Washington's chemical manufacturing EITEs and to out of state competitors. All three of the Washington EITEs in the chemical manufacturing industry are large, multinational corporations based outside of the United States: Lanxess is a German company, Solvay Chemicals is a Belgian company, and Nutrien is a Canadian company.

Domestic Carbon Pricing

Of the top states by revenue, California and New York have carbon pricing policies in place (Table 49). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction. New York's price of $19.63 per MTCO2e only applies to the electricity sector, so its chemical manufacturing industry is only impacted indirectly by any pass through of the carbon price in electricity prices.

Table 49. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Chemical Manufacturing Industry. Sources: Washington State Department of Ecology; California Air Resources Board; Regional Greenhouse Gas Initiative

State	Price per MTCO2e	EITE Leakage Mitigation Policies

Washington	$58.51	Yes
California	$25.87	Yes
New York*	$19.63	N/A
Texas	N/A	N/A
Louisiana	N/A	N/A
Illinois	N/A	N/A

* Only applies to the electricity sector

Washington Exports

Figure 86 shows that Washington's chemical manufacturing exports generally increased during the 2000s, then declined somewhat during the 2010s, and then jumped up from 2022-2024. The state's exports for the industry totaled $638 million in 2002, while the 2024 total was nearly three times higher at about $1.7 billion.

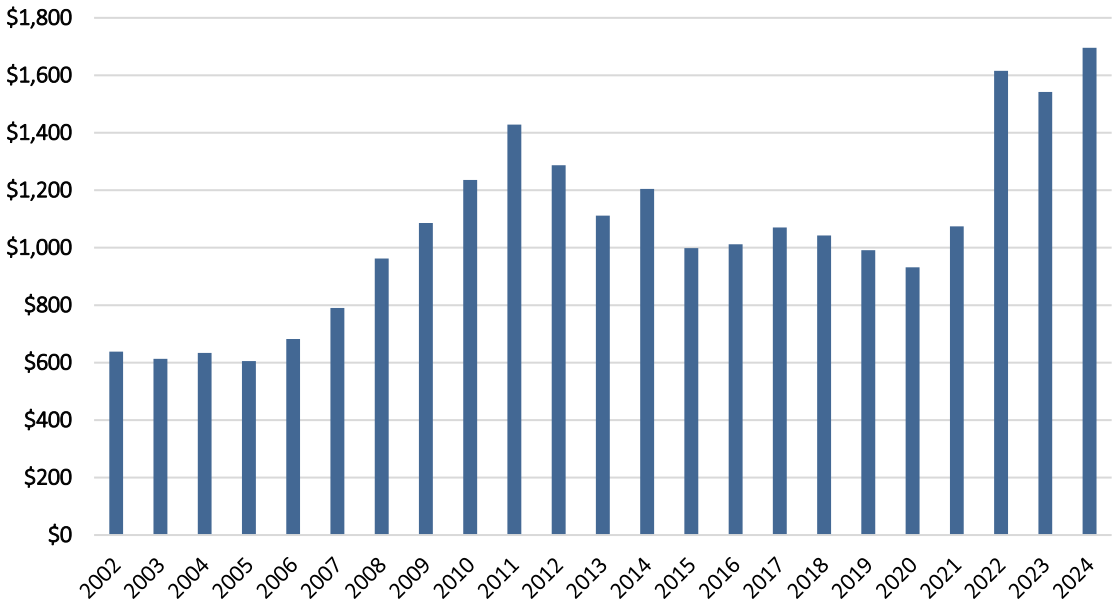

Figure 86. Washington State Chemical Manufacturing Exports (Millions $) (NAICS 325). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Although Washington's chemical manufacturing exports have increased substantially, Figure 87 shows that exports increased by even more for the top exporting states. Figure 88 shows that in 2024, Washington ranked twenty-seventh in exports from the industry compared to other states, with just a 0.5 percent share of total U.S. exports. The top exporter by a wide margin was Texas, which had a twenty percent share of total U.S. exports for the industry in 2024. In comparison, the second largest exporter was Indiana with a 8.7 percent share.

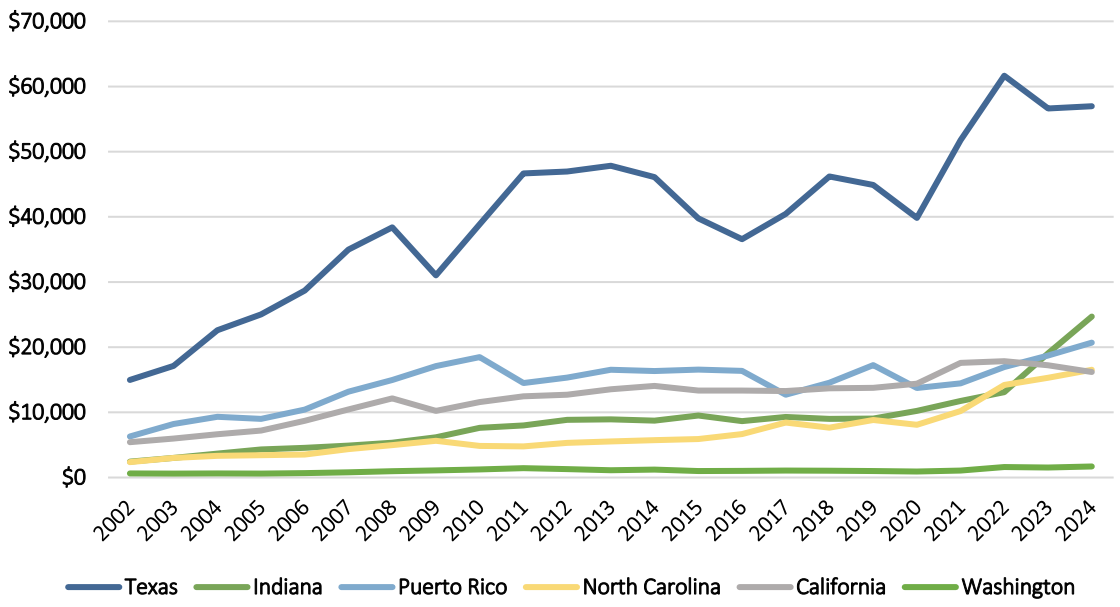

Figure 87. Chemical Manufacturing Exports, Top Five States/Territories and Washington (Millions $) (NAICS 325). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

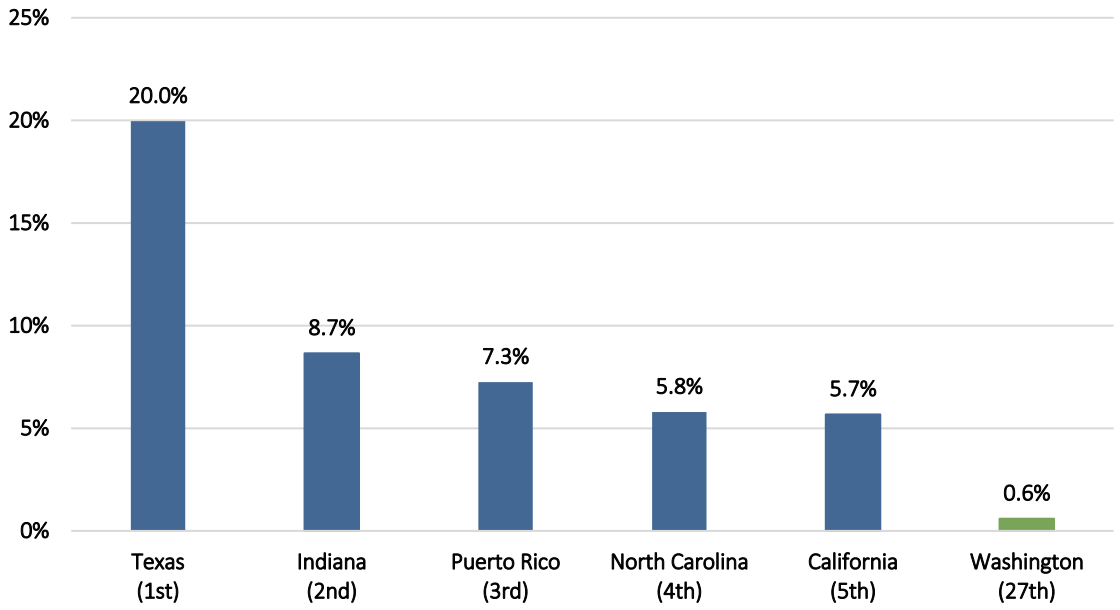

Figure 88. Share of U.S. Chemical Manufacturing Exports, Top Five Exporters and Washington 2024 (NAICS 325). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 89, Figure 90, and Figure 91 show the top international exporters of hydrogen peroxide, organic chemicals, and nitrogenous fertilizers. For hydrogen peroxide, Belgium had the largest share of global exports (12.5 percent), with other top exporters having shares roughly around seven to nine percent. For organic chemicals, China was the largest exporter in 2023 by a wide margin, with a 19.1 percent share of total exports. The U.S., which ranked second, had a 9.9 percent share. For nitrogenous fertilizers, Russia (13.6 percent) and China (12.9 percent) were the top two exporters.

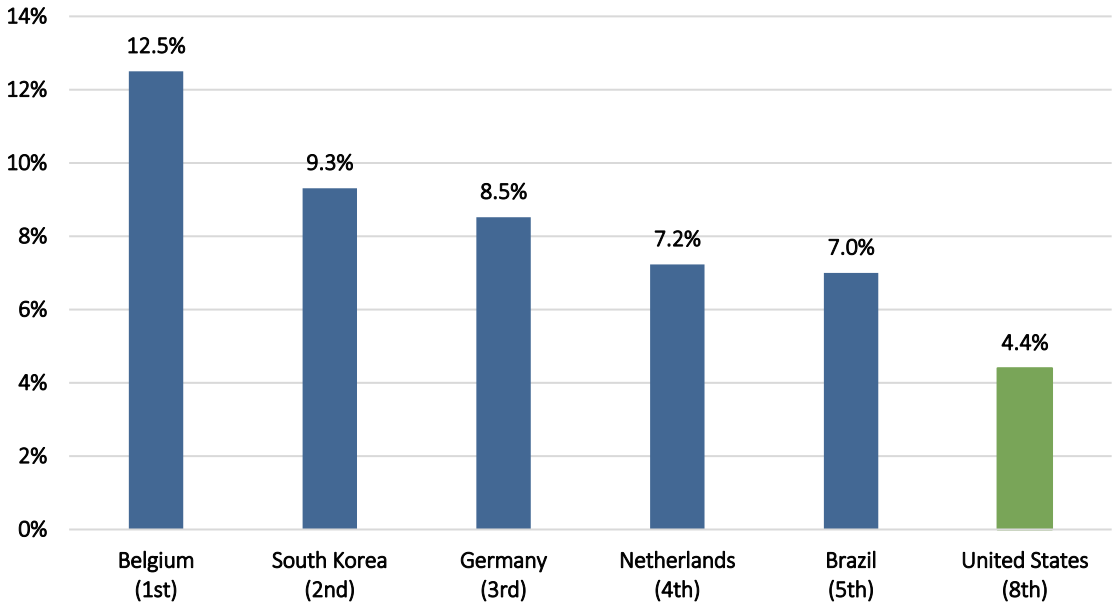

Figure 89. Share of International Hydrogen Peroxide Exports (HS 2847), Top Five Exporters and U.S. 2023. Source: Observatory of Economic Complexity

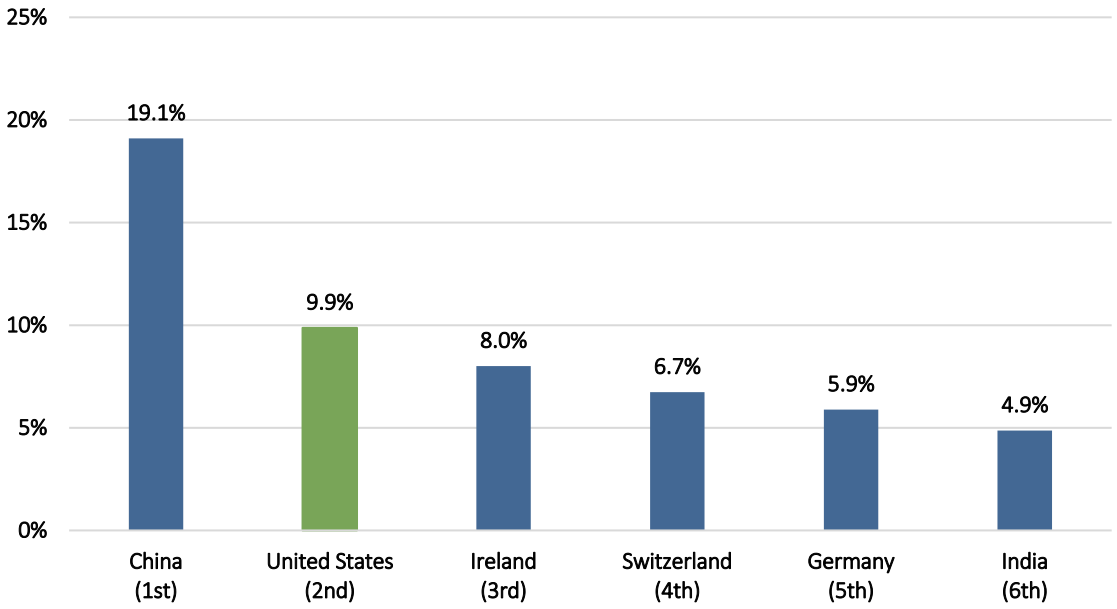

Figure 90. Share of International Organic Chemical Exports (HS 29), Top Six Exporters 2023. Source: Observatory of Economic Complexity

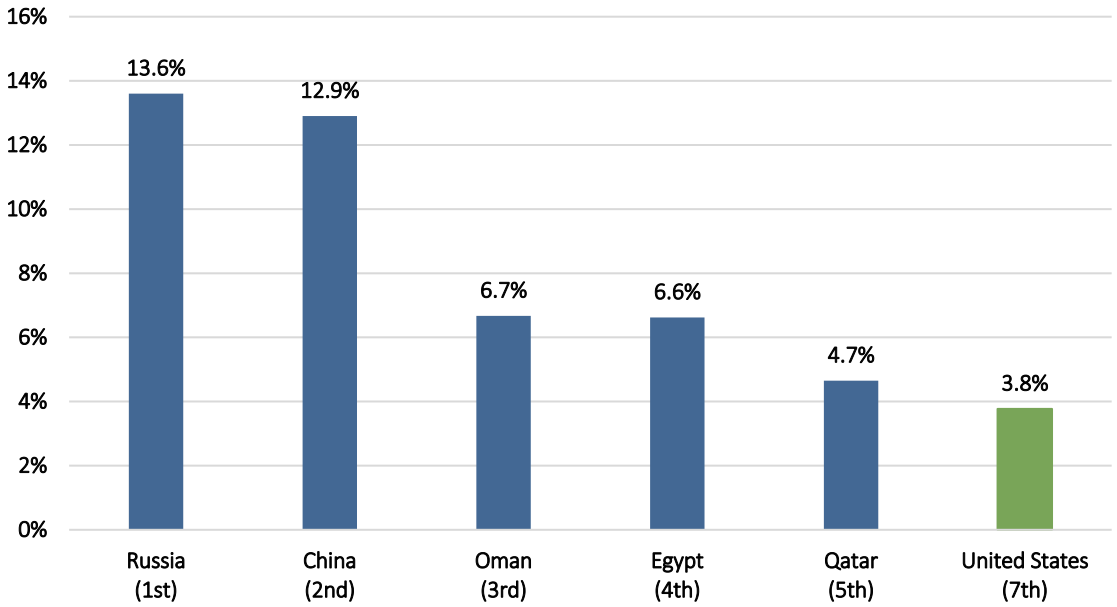

Figure 91. Share of International Nitrogenous Fertilizer Exports (HS 3102), Top Five Exporters and U.S. 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

As seen in Table 50, several of the top exporters have carbon pricing policies in place, with the European countries in particular having carbon prices comparable to Washington's. South Korea has a low carbon price, while China's carbon price is low and only indirectly impacts its chemical manufacturing industry

via any pass through of costs through energy prices. The countries with carbon pricing policies in place all have carbon leakage mitigation policies for their EITEs.

Table 50. International Carbon Pricing for Top Exporters of Chemical Manufacturing Products. Sources: World Bank; International Carbon Action Partnership

Country/Region	Chemical Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
Netherlands	Hydrogen Peroxide	66.50 EUR ($74.60)	Only if covered by EU ETS
European Union	Hydrogen Peroxide, Organic Chemicals	64.74 EUR ($72.70)	Yes
Ireland	Organic Chemicals	63.50 EUR ($71.31)	Only if covered by EU ETS
Switzerland*	Organic Chemicals	60.19 EUR ($67.59)	Yes
Germany	Hydrogen Peroxide, Organic Chemicals	55.00 EUR ($61.76)	Yes
China**	Organic Chemicals, Nitrogenous Fertilizers	95.96 CNY ($13.32)	Yes
South Korea	Hydrogen Peroxide	10,355 SKW ($7.37)	Yes
Belgium	Hydrogen Peroxide	EU ETS only	Yes
United States	**Organic Chemicals**	**N/A**	**N/A**
Brazil	Hydrogen Peroxide	N/A	N/A
India	Organic Chemicals	N/A	N/A
Russia	Nitrogenous Fertilizers	N/A	N/A
Oman	Nitrogenous Fertilizers	N/A	N/A
Egypt	Nitrogenous Fertilizers	N/A	N/A
Qatar	Nitrogenous Fertilizers	N/A	N/A

* Switzerland has both a carbon tax and an emissions trading system. The price for the emissions trading system is listed in the table because that is the rate paid by large and medium industrial facilities.

** Only applies to the electricity, cement, steel, and aluminum sectors

Outlook

Projections

Chemicals manufacturing has historically been a high growth industry, but the industry's growth rate has slowed considerably in recent years following the COVID-19 pandemic[lxxvii]. However, market forecasts for the chemicals produced by Washington's EITEs suggest continued growth in those segments. For example, the U.S. hydrogen peroxide market is expected to grow at a rate of 5.8 percent per year from 2025 to 2030[lxxviii], and the U.S. nitrogenous fertilizer market is expected to grow at a rate of 6.6 percent per year from 2024 to 2032[lxxix].

Cost Pass Through

Based on IRS tax returns data, profitability within the chemical manufacturing industry nationwide stands at 25.6 percent as of 2021. The high profit margins suggest that the chemical manufacturing EITEs may be able to absorb some of the cost from carbon pricing. The U.S. nitrogenous fertilizer industry is highly concentrated, which could provide additional room for cost pass through. However, the chemicals market is exposed to both domestic and foreign competition, which would likely limit the amount of cost pass through to customers.

Decarbonizing chemical manufacturing faces a number of challenges. The traditional methods for making hydrogen peroxide are highly energy intensive[lxxx], which could make it difficult to decarbonize

without a significant increase in the supply of renewable energy available. Toluene is generally derived from petroleum, so long-term decarbonization strategies for toluene product manufacturing will require either alternative feedstocks (e.g., biomass, recovered plastic) or a substitute for toluene[lxxxi]. Nitrogenous fertilizer manufacturing could also be challenging to decarbonize, as the process used to produce the fertilizer is heavily dependent on natural gas as a feedstock[lxxxii]. There are some lower emissions alternatives such as biogas[lxxxiii], but it is unlikely that the industry could fully decarbonize using currently available technologies.

Key Takeaways

- Washington's chemical manufacturing industry has grown over the past ten years, but it is relatively quite small compared to other states.
- Texas and California are the leading states in chemical manufacturing domestically. Internationally, Belgium is the leading hydrogen peroxide exporter, China leads in organic chemical exports, and Russia and China lead in nitrogenous fertilizers.
- Top European exporters in chemical manufacturing have carbon pricing policies comparable to Washington's but other international and domestic competitors have low or no carbon prices. Jurisdictions that have carbon prices offer free allowances or other forms of leakage mitigation policies for their EITEs.
- Although the U.S. chemical manufacturing industry has slowed in recent years, the market is expected to continue to grow in the segments that Washington's EITEs compete in.
- The high level of concentration in the U.S. nitrogenous fertilizer market and high profit margins in the U.S. chemical manufacturing industry as a whole could allow Washington's chemical manufacturing EITEs to partially absorb or pass through carbon costs. However, the industry is exposed to global competition, increasing the risk of carbon leakage.

Food Manufacturing

Industry Overview

Washington's food manufacturing EITEs are primarily in the frozen fruit, juice, and vegetable sector, with a particular focus on potato products such as fries and tater tots. A few are involved in other sectors, including dried and dehydrated foods, cheese, and meat. One of them focuses on perishable prepared food manufacturing, which is grouped in public data sets under a miscellaneous food manufacturing category that also includes products such as snacks, condiments, and spices.

There are about 867 food manufacturing facilities located in Washington, ten of which are classified as EITEs. Four of the facilities are located in Grant County (Basic American Foods, J.R. Simplot Company – Moses Lake, Lamb Weston – Quincy, and Washington Potato Company), two are located in Adams County (J.R. Simplot Company – Othello and McCain Foods), one is located in Benton County (Lamb Weston – Richland), one is located in Franklin County (Lamb Weston – Pasco), one is located in Walla Walla County (Tyson Fresh Meats), and one is located in Yakima County (Darigold). Figure 92 shows the locations of the food manufacturing EITEs in Washington.

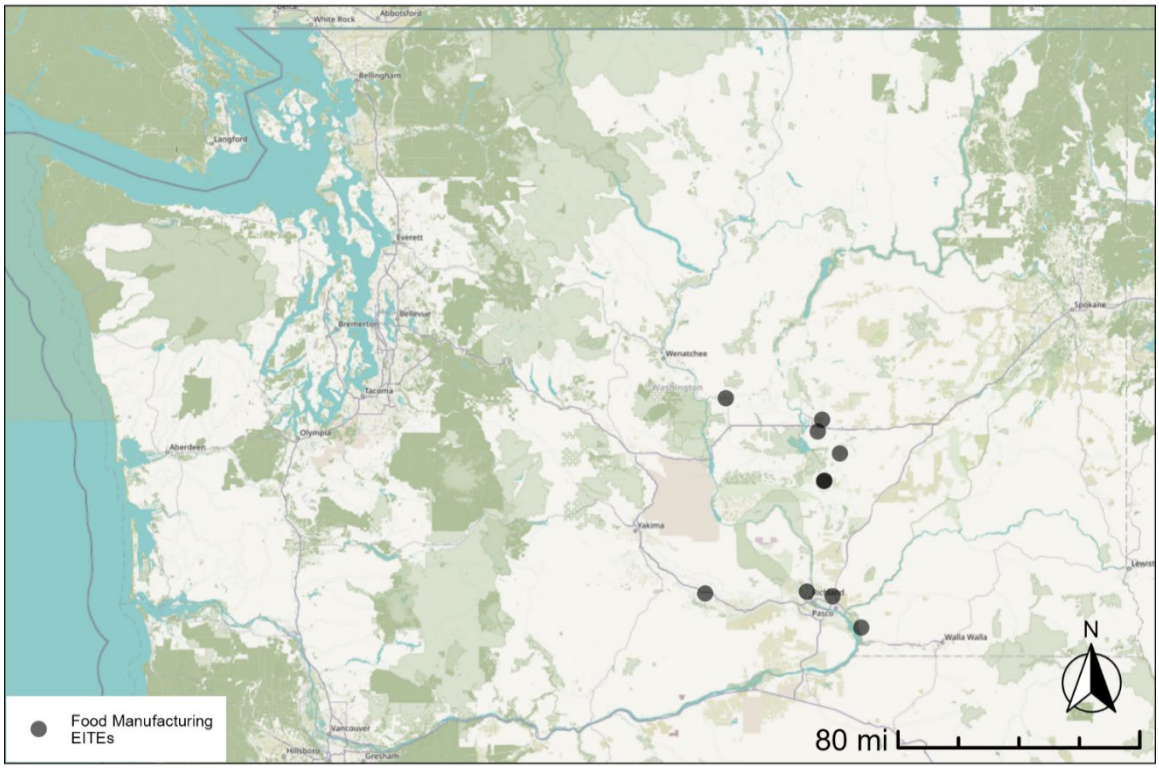

Figure 92. Map of Food Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 93 shows that real GDP for Washington's food, beverage, and tobacco product manufacturing industries declined during the early 2000s but has since rebounded and grown, growing by around sixty percent from 2003 to 2023. However as seen in Figure 94, the total share of Washington's GDP from these industries has declined from about 1.5 percent in 1997 to around 0.8 percent in 2023.

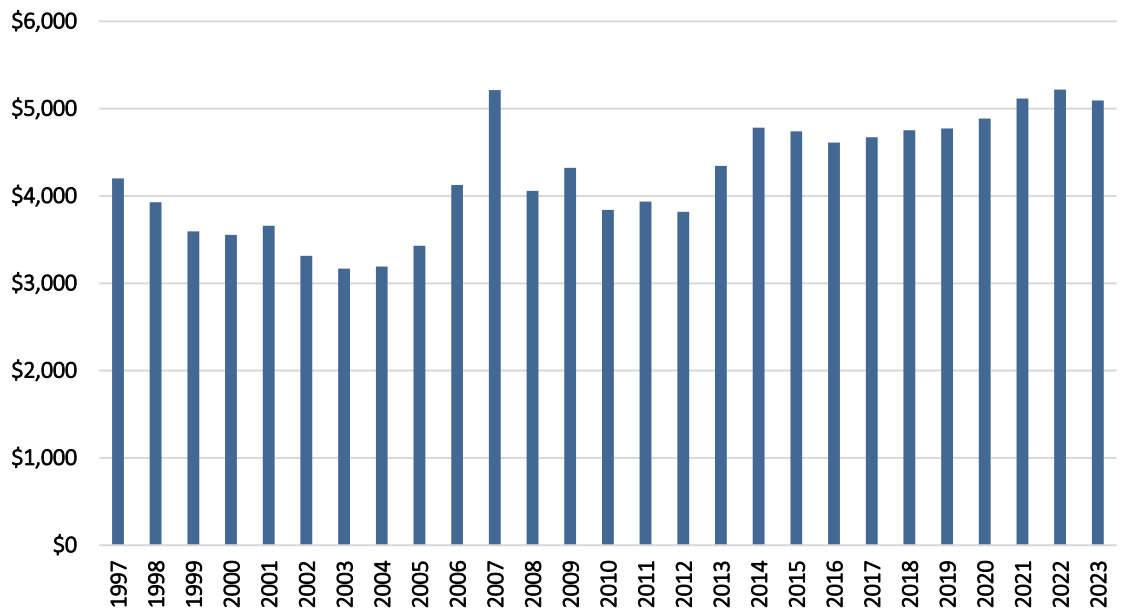

Figure 93. Washington State Food, Beverage, and Tobacco Product Manufacturing Real GDP (Millions 2017 $) (NAICS 311 and 312). Source: U.S. Bureau of Economic Analysis

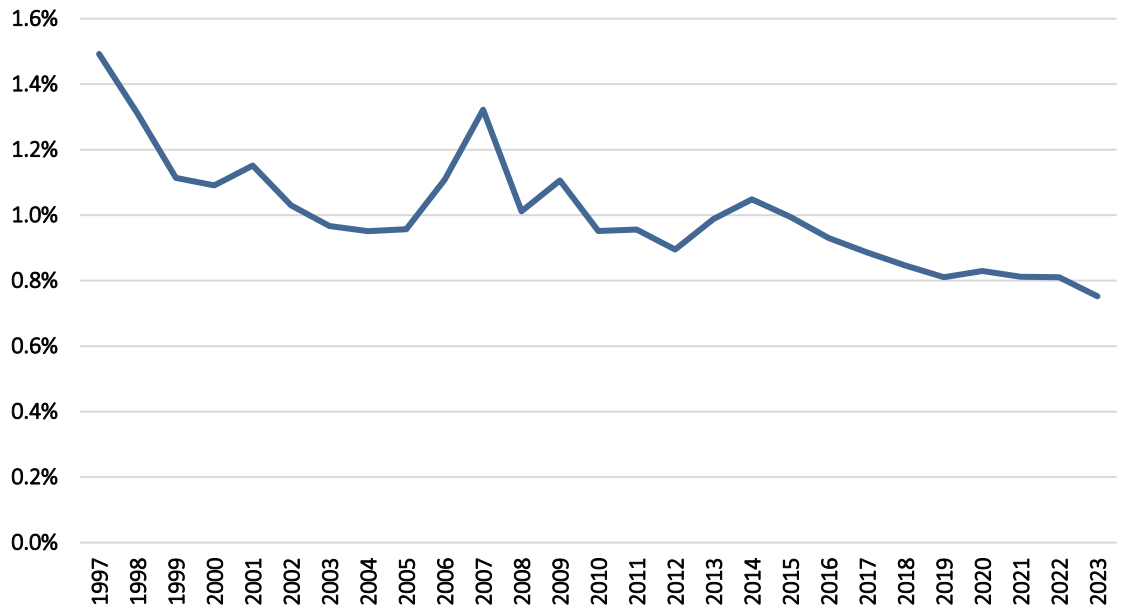

Figure 94. Share of Washington State GDP from Food, Beverage, and Tobacco Product Manufacturing (NAICS 311 and 312). Source: U.S. Bureau of Economic Analysis

Employment

Employment in Washington's food manufacturing industry has grown in recent years, going from around 34,000 workers in 2013 to about 36,000 workers in 2022 (Figure 95). Figure 96 shows the states with the most employment in the industry in 2022 as well as Washington. California had the largest share at 10.1 percent of the total U.S. workforce in the industry, while Texas, Illinois, Wisconsin, and Pennsylvania had

between four and six percent shares each. In comparison, Washington ranked eighteenth and employed 2.2 percent of the total U.S. food manufacturing workforce.

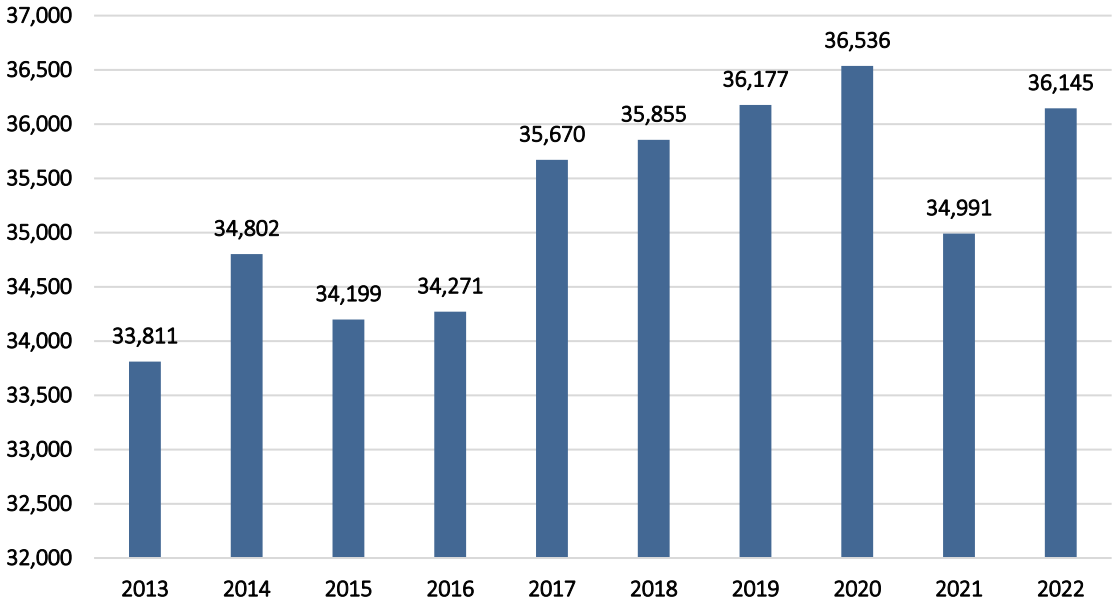

Figure 95. Total Washington State Food Manufacturing Industry Employment (NAICS 311). Source: U.S. County Business Patterns

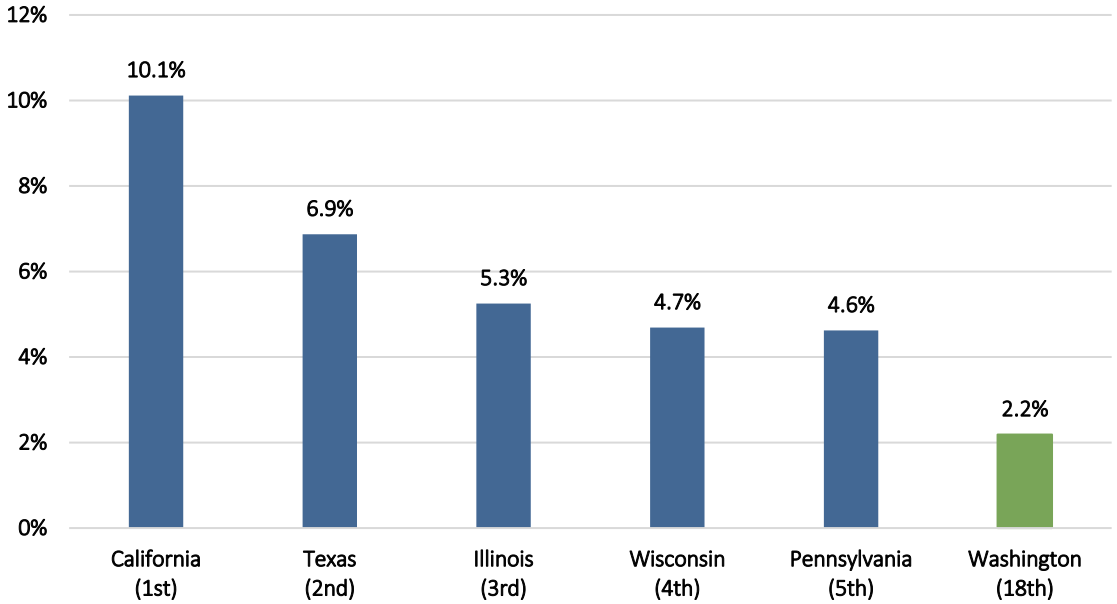

Figure 96. Share of U.S. Food Manufacturing Industry Employment, Top Five States and Washington 2022 (NAICS 311). Source: U.S. County Business Patterns

Revenue

As seen in Figure 97, California had the highest share of U.S. revenue in the food manufacturing industry in 2021, at 9.4 percent. Texas, Illinois, Wisconsin, and Iowa were the other top states, with shares

between five and seven percent. Washington ranked twentieth compared to other states, with a modest 1.8 percent share of total U.S. revenue in the industry in 2021.

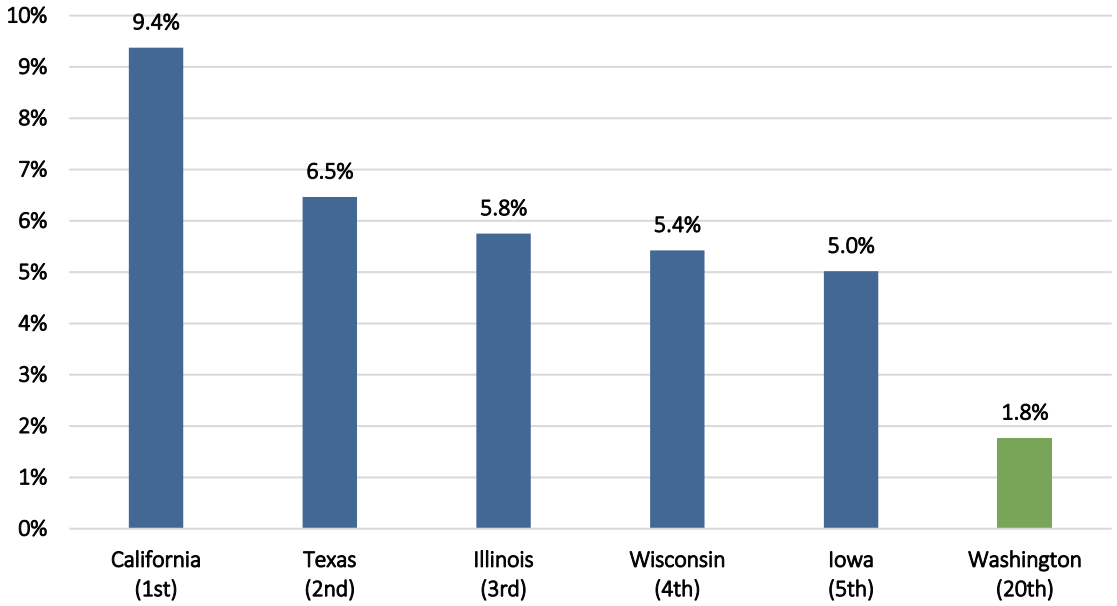

Figure 97. Share of U.S. Food Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 311). Source: Annual Survey of Manufactures

Supply Chains

Table 51, Table 52, Table 53, Table 54, and Table 55 show the potential impact of a $1 million reduction in output in the food manufacturing sectors that the EITEs fall under. The industries that would suffer the largest indirect impacts are generally the supplies of key inputs to the food manufacturing industry (e.g., dairy cattle and milk production, beef cattle ranching and farming, vegetable and melon farming). Truck transportation and wholesalers of grocery products would also face significant impacts. The total indirect impacts in most of these scenarios would be substantial, at well over $500,000. For animal slaughtering, the indirect impacts of about $1.1 million would exceed the direct $1 million reduction in output.

Table 51. Impact of $1 Million Reduction in Output from Cheese Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Dairy Cattle and Milk Production	($316,790)
Wholesale – Grocery and Related Product Wholesalers	($85,196)
Truck Transportation	($52,237)
Other Animal Food Manufacturing	($47,365)
Wholesale – Other Nondurable Goods Merchant Wholesalers	($39,681)
All Industries	**($872,298)**

Table 52. Impact of $1 Million Reduction in Output from Animal (Except Poultry) Slaughtering, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Beef Cattle Ranching and Farming	($570,605)
Truck Transportation	($107,320)
Wholesale – Other Nondurable Goods Merchant Wholesalers	($66,454)
Animal Production, Except Cattle and Poultry and Eggs	($61,028)
Other Animal Food Manufacturing	($52,566)
All Industries	**($1,121,526)**

Table 53. Impact of $1 Million Reduction in Output from Frozen Fruits, Juices, and Vegetables Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Grocery and Related Product Wholesalers	($103,825)
Vegetable and Melon Farming	($66,151)
Wholesale – Other Nondurable Goods Merchant Wholesalers	($55,191)
Fruit Farming	($50,887)
Management of Companies and Enterprises	($50,454)
All Industries	**($697,285)**

Table 54. Impact of $1 Million Reduction in Output from Dehydrated Food Products Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Management of Companies and Enterprises	($46,994)
Wholesale – Grocery and Related Product Wholesalers	($35,430)
Coffee and Tea Manufacturing	($12,901)
Truck Transportation	($12,843)
Other Real Estate	($11,021)
All Industries	**($328,024)**

Table 55. Impact of $1 Million Reduction in Output from Miscellaneous Food Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Grocery and Related Product Wholesalers	($83,535)
Vegetable and Melon Farming	($47,073)
Fruit Farming	($46,148)
Management of Companies and Enterprises	($37,404)
Truck Transportation	($35,768)
All Industries	**($659,047)**

Domestic Competition

Market Structure

Washington's ten food manufacturing EITEs are owned by seven different companies. All seven of those companies are large, U.S. based food companies that export their goods globally and have international offices or production facilities. Shipping fresh and frozen foods is more costly than shipping shelf-stable foods, as fresh foods need to be transported in a timely manner and frozen foods require specialized cold storage logistics[lxxxiv]. That gives Washington's food manufacturers in those segments a slight competitive advantage in local markets, but it conversely makes exporting slightly more of a challenge. Overall however food manufacturing is a globalized industry, and as such Washington's companies in the industry face competition from both other parts of the U.S. and from other countries.

Domestic Carbon Pricing

Of the top states by revenue, only California has a carbon price in place (Table 56). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction.

Table 56. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Food Manufacturing Industry. Source: Washington State Department of Ecology

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
California	$25.87	Yes
Texas	N/A	N/A
Illinois	N/A	N/A
Wisconsin	N/A	N/A
Iowa	N/A	N/A

Washington Exports

Figure 98 shows Washington state exports for the food manufacturing sectors that the EITEs fall under. Exports have generally grown over the past twenty years, driven by an increase in fruit and vegetable preserve exports. Dairy exports grew nearly eight-fold from 2002 to 2024, and miscellaneous food product exports more than tripled over that same period. Meat exports also grew, but only by a relatively modest thirty-seven percent. Total exports from these sectors grew from around $1 billion in 2002 to almost $3 billion in 2024.

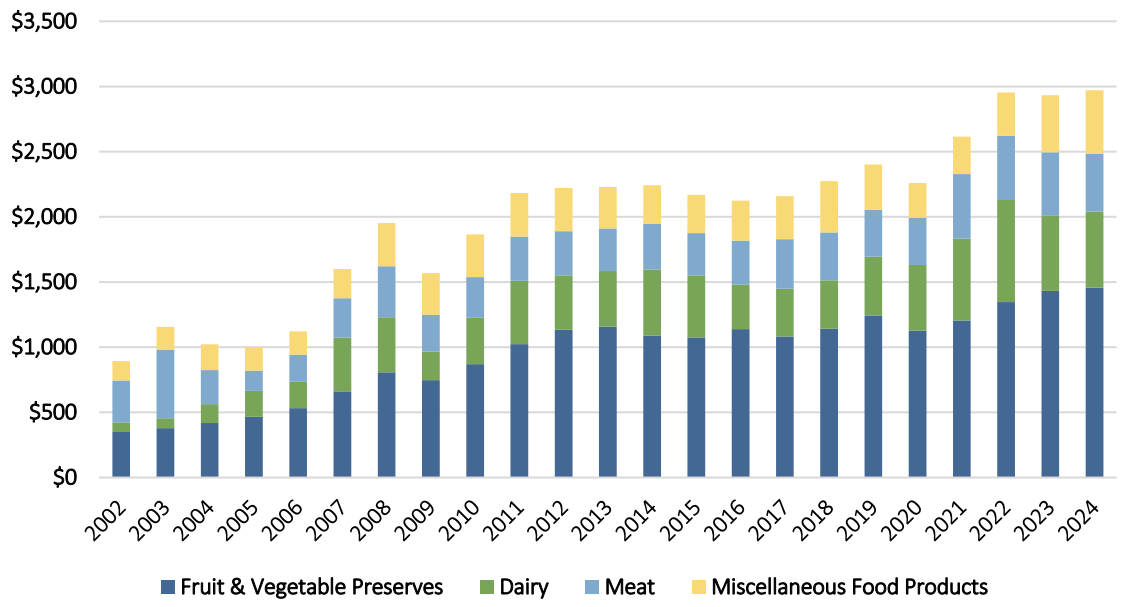

Figure 98. Washington State Food Manufacturing Exports for Select Industries (Millions $) (NAICS 3114, 3115, and 3116, and 3119). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 99 and Figure 100 show data on the value over time and 2024 share of food manufacturing exports from the top six states. Exports from all six states have generally grown over the past twenty years, with particularly strong growth in California and Texas. California had the highest share of U.S. food manufacturing exports in 2024 at 13.2 percent, and Texas's share was 8.4 percent. Washington ranked fourth compared to other states with a 5.6 percent share of total U.S. food manufacturing exports.

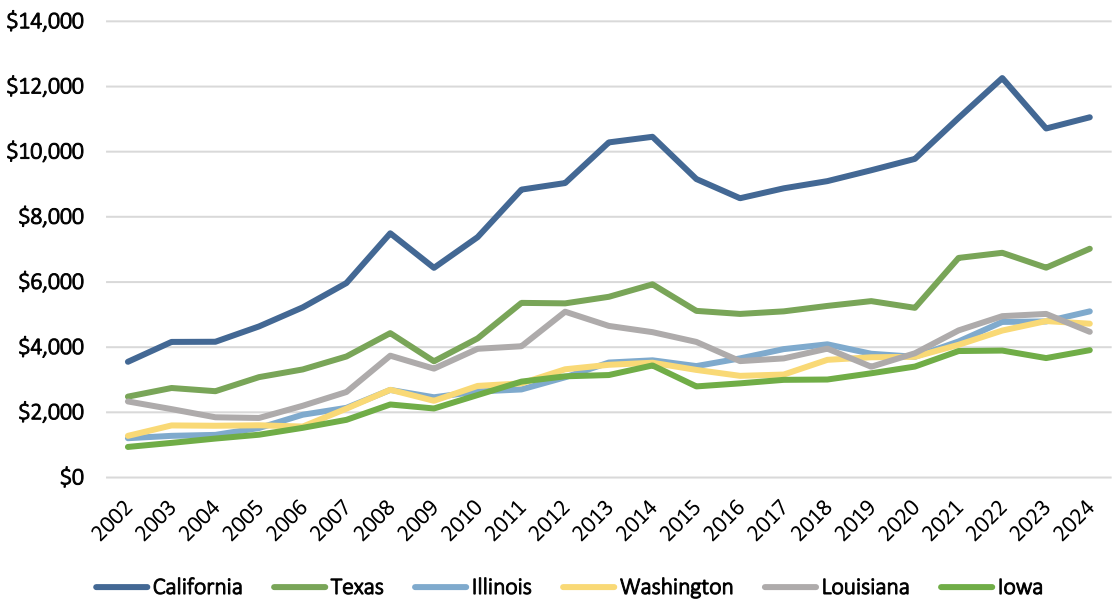

Figure 99. Food Manufacturing Exports, Top Six States (Millions $) (NAICS 311). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

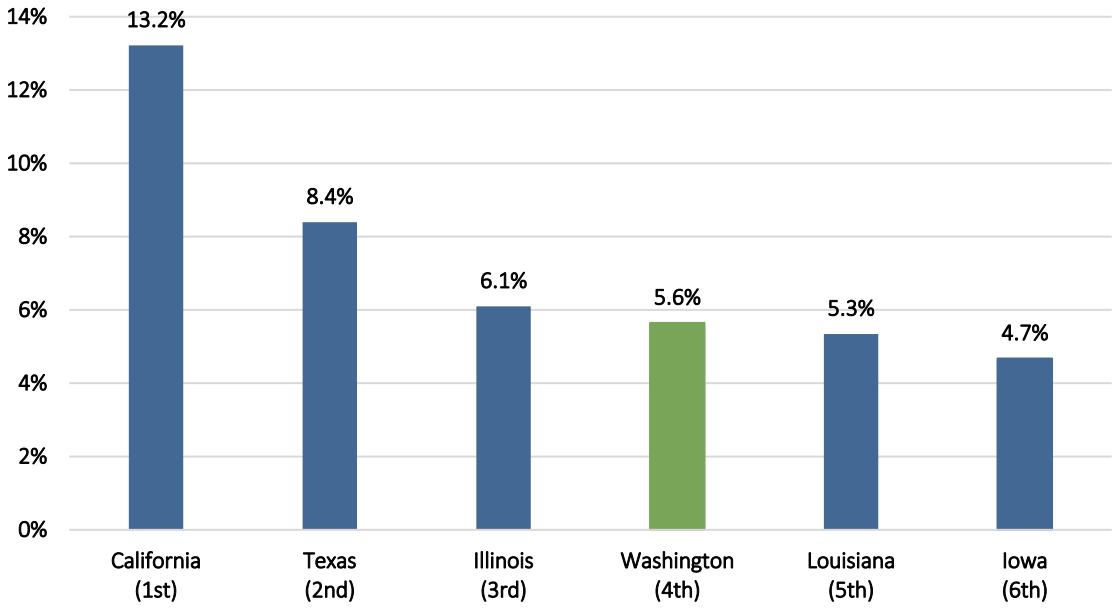

Figure 100. Share of U.S. Food Manufacturing Exports, Top Six Exporters 2024 (NAICS 311). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 101, Figure 102, Figure 103, and Figure 104 show the share of international exports for the top exporters of meat, dairy and eggs, prepared fruits and vegetables, and miscellaneous food products, respectively. The United States is a top exporter in all four sectors, with particularly high shares in meat exports and miscellaneous food product exports. Most of the other top exporters are European countries, but Brazil ties the U.S. in leading meat exports and China is the top exporter of prepared fruits and vegetables.

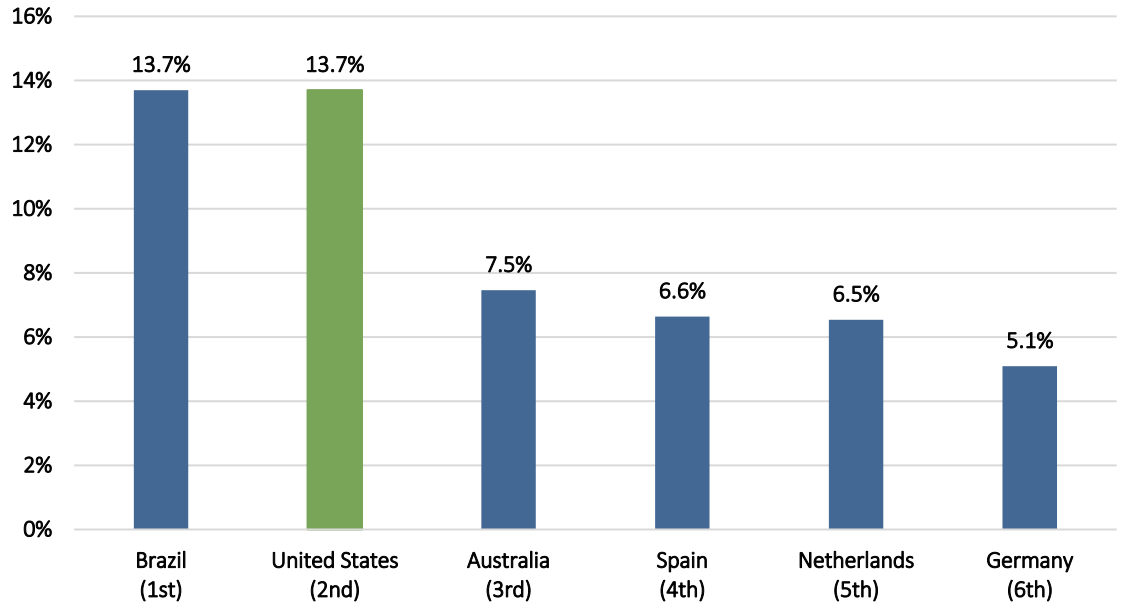

Figure 101. Share of International Meat Product Exports (HS 02), Top Six Exporters 2023. Source: Observatory of Economic Complexity

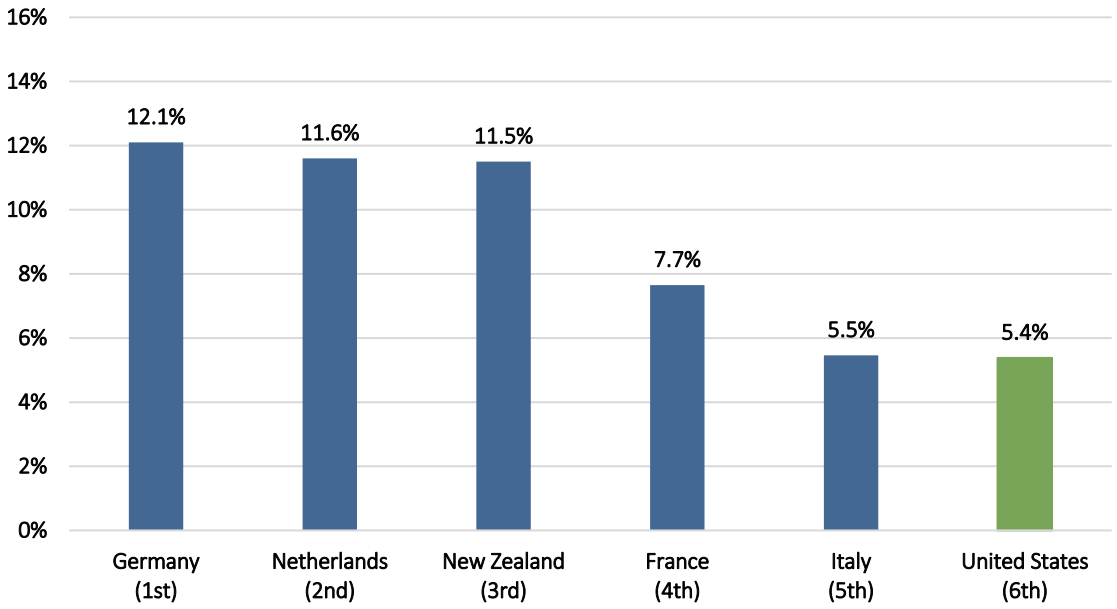

Figure 102. Share of International Dairy, Egg, and Other Animal Product Exports (HS 04), Top Six Exporters 2023. Source: Observatory of Economic Complexity

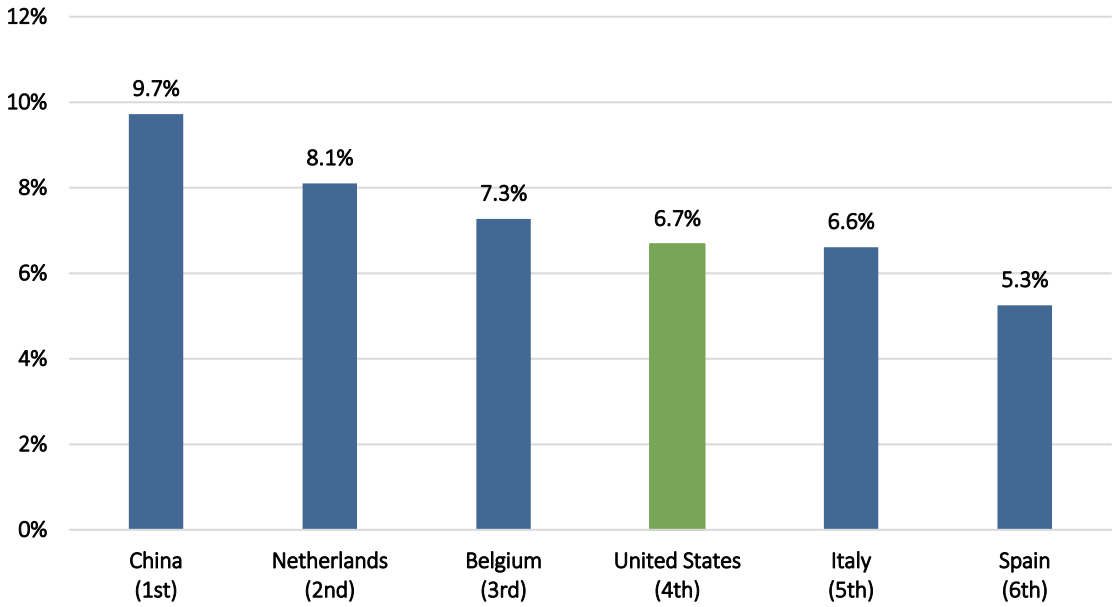

Figure 103. Share of International Prepared Fruit and Vegetable Exports (HS 20), Top Six Exporters 2023. Source: Observatory of Economic Complexity

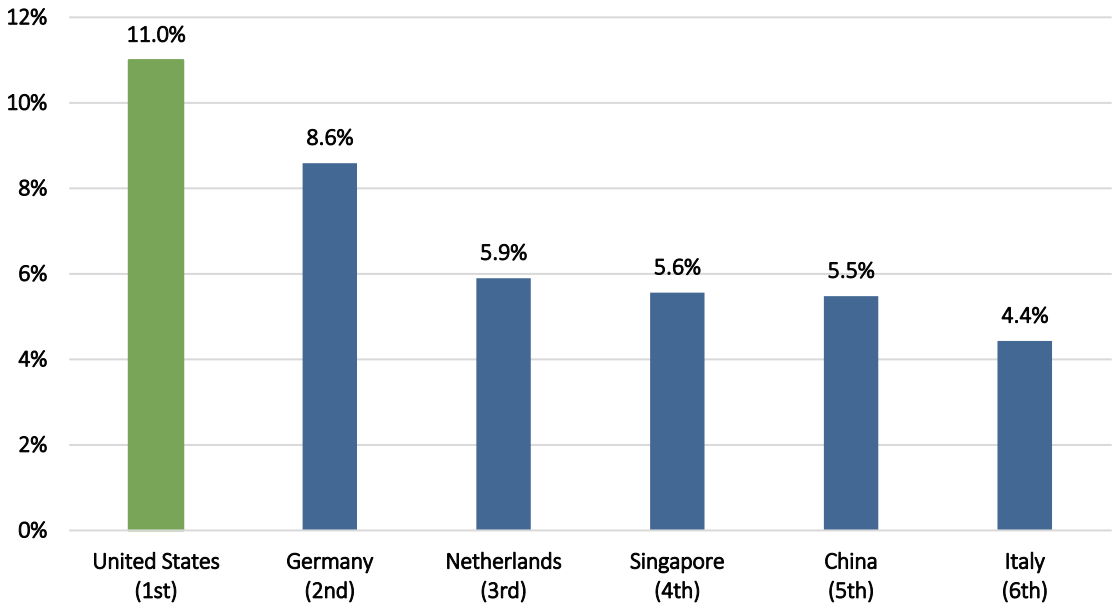

Figure 104. Share of International Miscellaneous Food Product Exports (HS 21), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Table 57 shows carbon pricing for the top exporters in the four food manufacturing sectors shown above. Several of the top exporters are covered by the European Union's emissions trading system, which currently has a higher price per MTCO2e than Washington ($72.70 compared to $58.51). Countries outside of Europe however have lower carbon prices than Washington, and Brazil has no carbon pricing policy in place. China's carbon pricing only indirectly impacts its food manufacturing industry via any pass through of its carbon price through electricity prices. All of the top exporters that have carbon pricing policies also have carbon leakage mitigation policies for their EITEs.

Table 57. International Carbon Pricing for Top Exporters of Food Manufacturing Products. Sources: World Bank; International Carbon Action Partnership

Country/Region	Food Manufacturing Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
Netherlands	All Four Industries	66.50 EUR ($74.60)	Only if covered by EU ETS
European Union	All Four Industries	64.74 EUR ($72.70)	Yes
Germany	Meat, Dairy & Eggs, Miscellaneous	55.00 EUR ($61.76)	Yes
France	Dairy & Eggs	44.60 EUR ($50.08)	Yes
New Zealand	Dairy & Eggs	64.00 NZD ($37.67)	Yes
Australia	Meat	35.25 AUD ($22.53)	Yes
Singapore	Miscellaneous	25.00 SGD ($19.20)	Yes
Spain	Meat, Prepared Fruits & Vegetables	15.00 EUR ($16.83)	Yes
China*	Prepared Fruits & Vegetables, Miscellaneous	95.96 CNY ($13.32)	Yes
Italy	Dairy & Eggs, Prepared Fruits & Vegetables, Miscellaneous	EU ETS only	Yes

Belgium	Prepared Fruits & Vegetables	EU ETS only	Yes
United States	All Four Industries	**N/A**	**N/A**
Brazil	Meat	N/A	N/A

* Only applies to the electricity, cement, steel, and aluminum sectors

Outlook

Projections

Publicly available forecasts for the food manufacturing industry appear to be rather limited. One report projected that job growth in the U.S. food manufacturing industry through 2027 would slightly outpace job growth in the U.S. economy as a whole (8.0 percent compared to 7.1 percent)[lxxxv].

Cost Pass Through

Based on IRS tax returns data, profitability within the food manufacturing industry nationwide stands at 9.1 percent as of 2021. This suggests that Washington's food manufacturing EITEs could only absorb a small portion of the cost of carbon pricing. Washington's EITEs might be able to pass on some costs in local markets because of lower shipping costs than more distant competitors, particularly for fresh and frozen foods where shipping costs are more significant. However, cost pass through in local markets would still be limited by domestic and international competition, and it would be even more limited for the EITEs exports to more distant markets.

One potential challenge for decarbonizing the food manufacturing industry is the current widespread use of fluorinated gases in refrigeration and cold storage, which are potent greenhouse gases. There are lower-emission alternatives to fluorinated gases for refrigeration[lxxxvi], and the U.S. EPA has a number of programs to incentivize using these lower-emission alternatives[lxxxvii]. However, it is unclear whether it will be possible to fully eliminate emissions from cold storage in the long run.

In November 2023, the Washington Department Ecology adopted a rule supporting the transition away from using hydrofluorocarbons in products and equipment. Some EITEs may operate air conditioning or refrigeration equipment that fall under the scope of the HFC rule. However, the emissions associated with this rule are not reported by EITEs when reporting their GHG emissions to Ecology or subject to compliance obligations under the Cap-and-Invest Program.

Key Takeaways

- Washington is home to several large food manufacturing companies, and the industry employs around 36,000 workers in the state. However, other states have substantially larger shares of total U.S. employment and revenue in the industry.
- California, Texas, Illinois, and Wisconsin are the top states for food manufacturing. Top exporters internationally are mostly countries in the European Union, but Brazil is a top exporter of meat and China is the top exporter of prepared fruits and vegetables.
- The European Union's carbon pricing policy is comparable to Washington's, but other domestic and international competitors have low or no carbon prices. Jurisdictions with carbon pricing all offer free allowances or other forms of leakage mitigation policies for their EITEs.
- Reduced output from Washington's food manufacturing industry could have substantial adverse effects on local supply chains, particularly on agriculture.

- Relatively low profit margins and high levels of competition could make it challenging for Washington's food manufacturing EITEs to absorb or pass through costs from carbon pricing.

Glass

Industry Overview

Glass manufacturing is the process of transforming raw materials such as sand, soda ash, and limestone into glass products used in construction, packaging, automotive, and consumer goods. Washington's glass manufacturing facilities produce a range of products including flat glass, fiberglass insulation, container glass, and specialty glass for industrial applications.

There are about fifty glass and glass product manufacturing facilities located in Washington, two of which are classified as EITEs. One of the facilities is located in Cowlitz County (Owens-Brockway Glass Container), and the other one is located in Lewis County (Cardinal FG Company). Figure 105 shows the locations of the glass manufacturing EITEs in Washington.

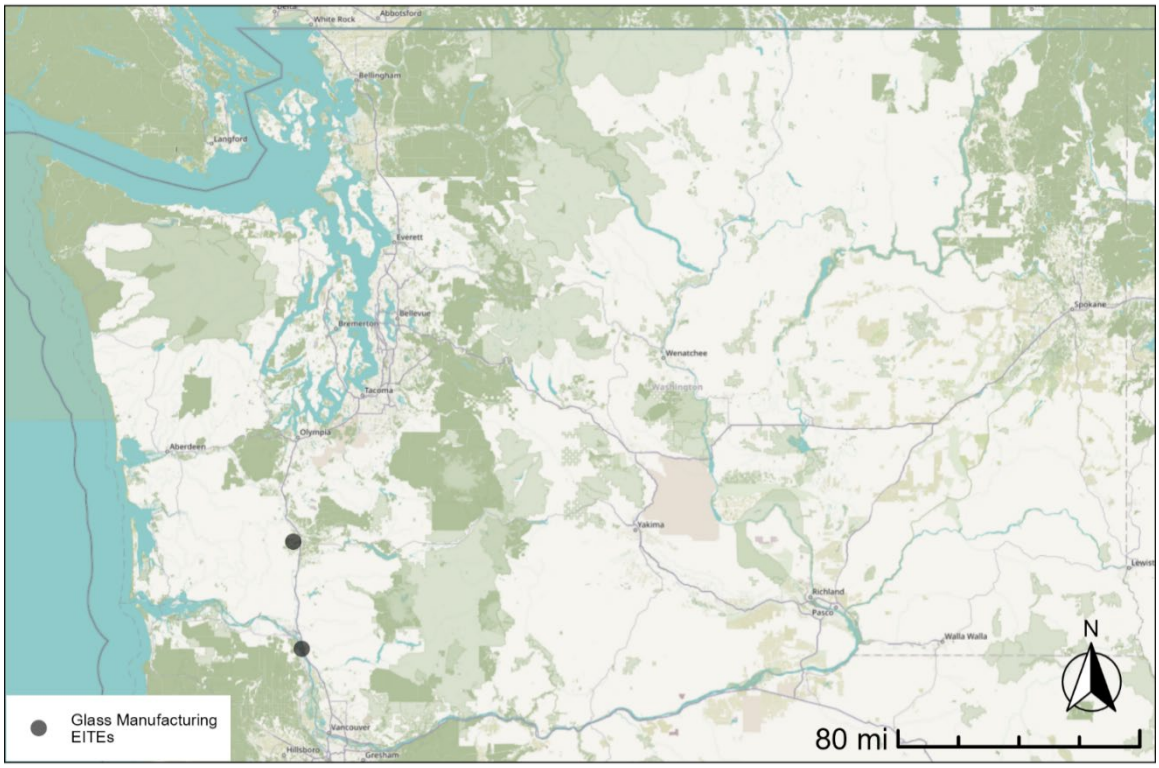

Figure 105. Map of Glass Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 106 shows that economic activity in the nonmetallic mineral manufacturing[40] in Washington has increased overall over the past twenty-five years. Since a peak of $1.4 billion in 2007, though, the

[40] The Bureau of Economic Analysis (BEA) does not provide real GDP figures for glass manufacturing on its own, instead estimating broader industry GDP figures.

industry has been cut by a quarter. Meanwhile, nonmetallic mineral manufacturing has decreased as a percentage of overall Washington state GDP, as shown in Figure 107.

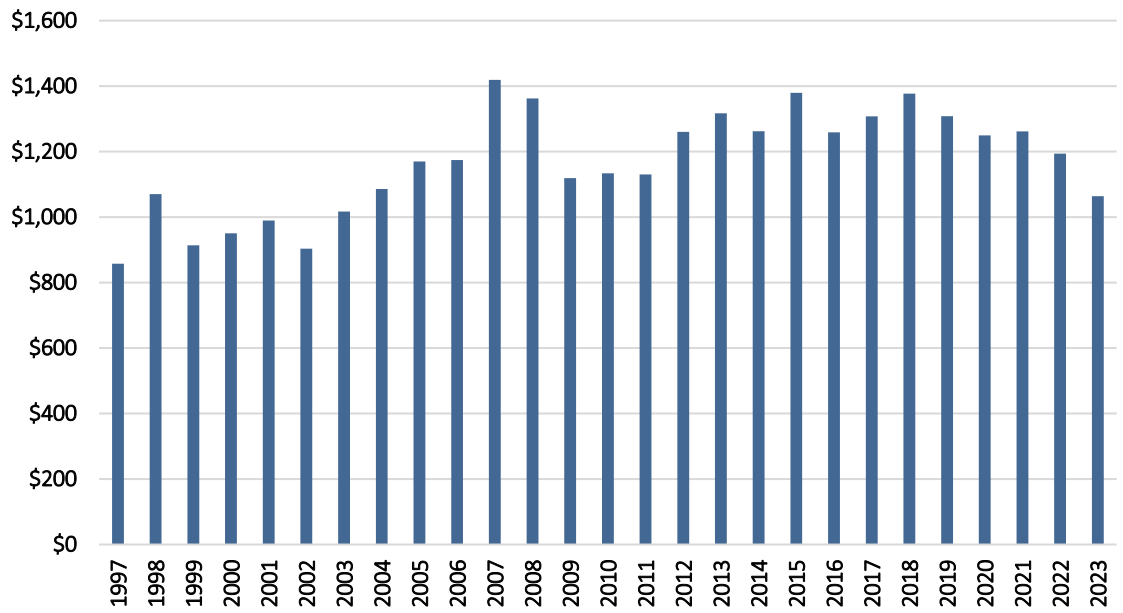

Figure 106. Washington State Nonmetallic Mineral Product Manufacturing Real GDP (Millions 2017 $) (NAICS 327). Source: U.S. Bureau of Economic Analysis

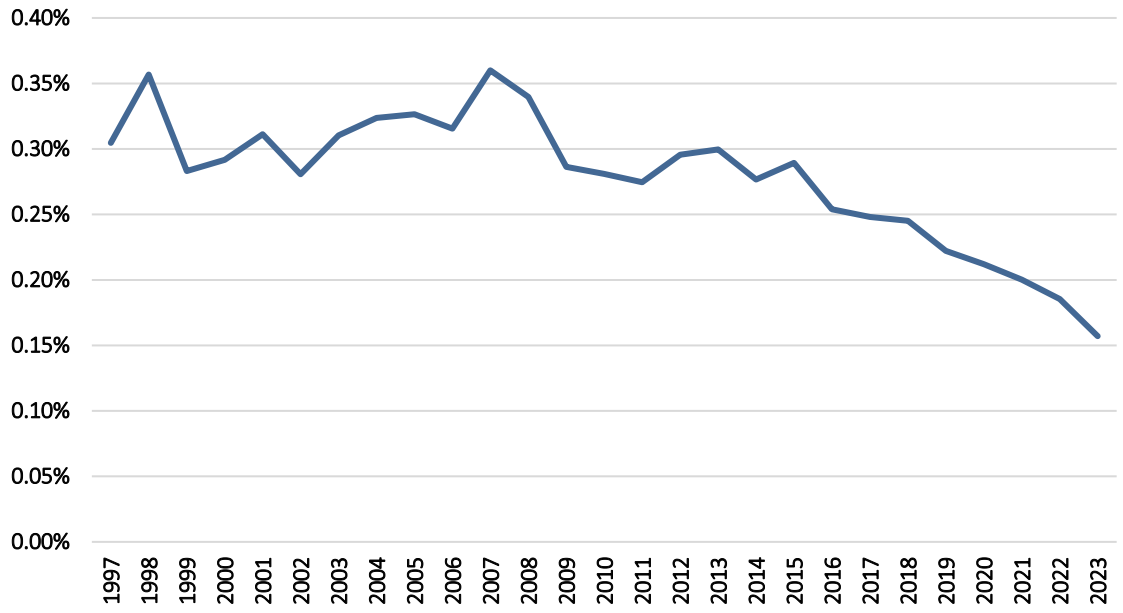

Figure 107. Share of Washington State GDP from Nonmetallic Mineral Product Manufacturing (NAICS 327). Source: U.S. Bureau of Economic Analysis

Employment

Figure 108 shows a decrease in employment in glass manufacturing over the last decade. After reaching a highpoint of 2,600 employees in 2017, the industry has cut a quarter of its workforce in Washington,

compared to about 4 across the U.S. overall. Figure 109 shows that Washington employed approximately 2.2 percent of all glass manufacturing employees in 2022 according to County Business Patterns data. Some of the Midwestern states (Indiana, Michigan, Ohio, and Pennsylvania) have consistently employed the most people in the glass manufacturing industry. California is also regularly a top five employer within the glass manufacturing.

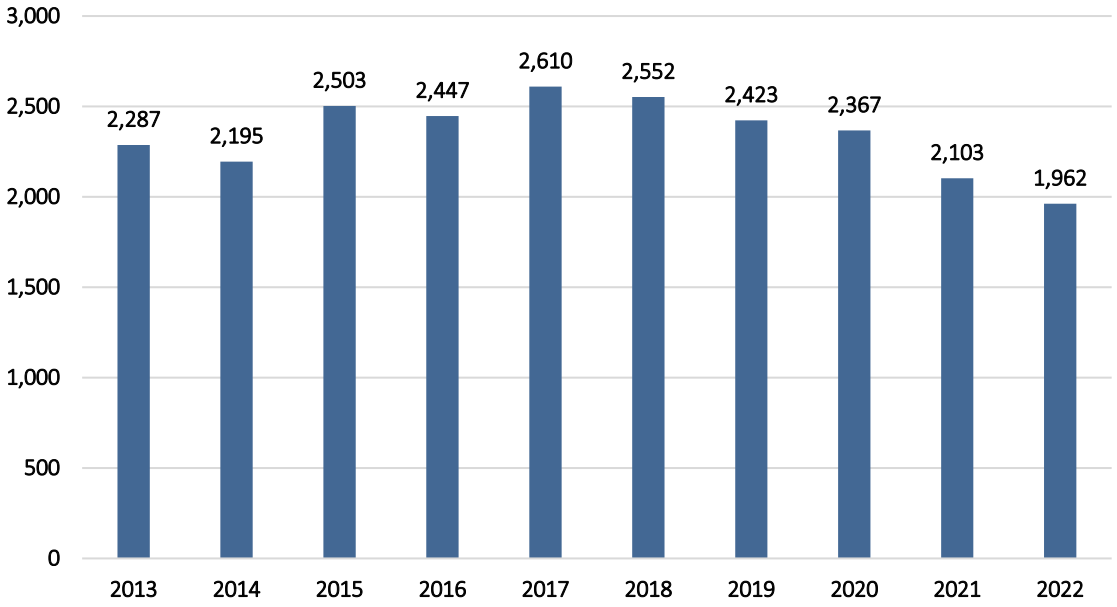

Figure 108. Total Washington State Glass Manufacturing Industry Employment (NAICS 3272). Source: U.S. County Business Patterns

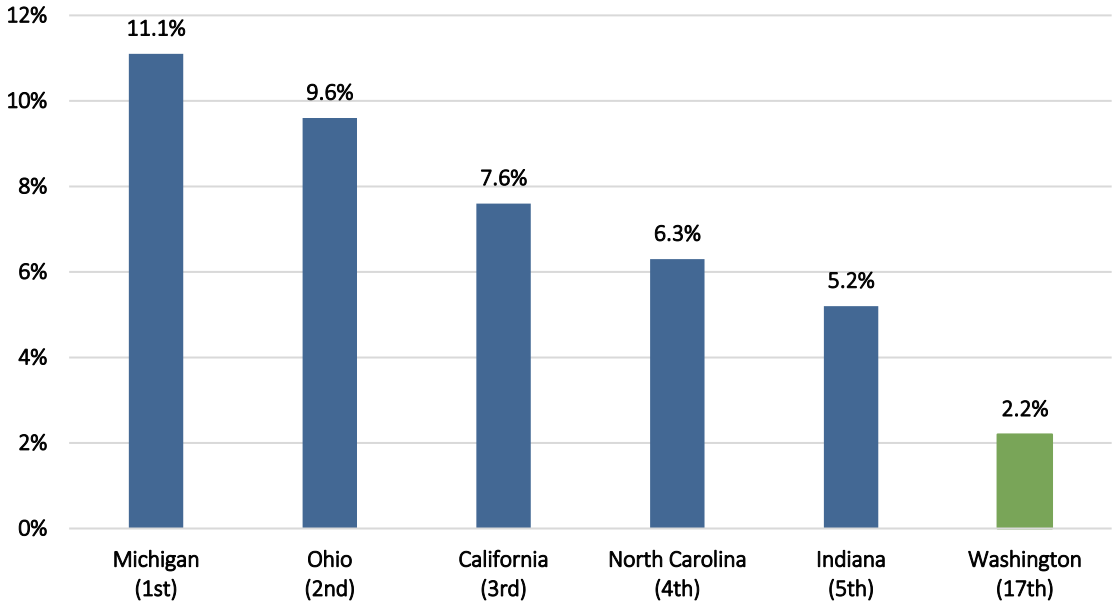

Figure 109. Share of U.S. Glass and Glass Product Manufacturing Industry Employment, Top Five States and Washington 2022 (NAICS 3272). Source: U.S. County Business Patterns

Revenue

Figure 110 shows facilities in Washington generated about 2.5 percent of total U.S. revenue in the glass manufacturing industry, ranking 16th compared to all other states. The top 4 states are the same for revenue as for employment figures, while Tennessee jumps into fifth among all states.

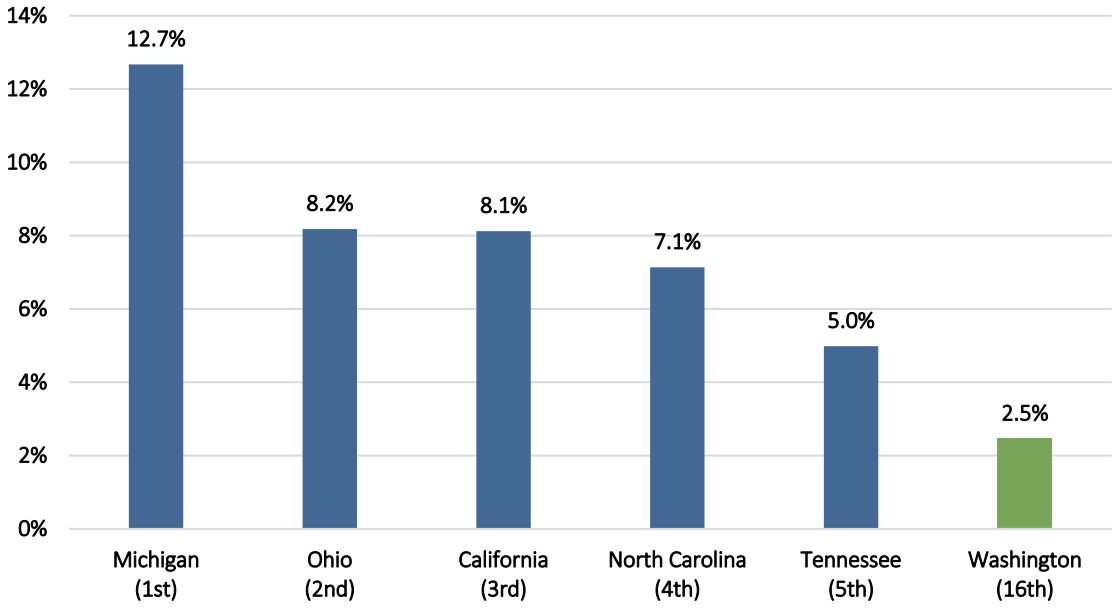

Figure 110. Share of U.S. Glass Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 3272). Source: Annual Survey of Manufactures

Supply Chains

Glass manufacturing requires sand, soda ash, and limestone, which the mining industry provides. Glass manufacturers in Washington source their silica sand in-state, as this is the only real economically feasible option. Silica sand is otherwise prominently sourced from the Midwestern U.S. The production of glass also requires inorganic chemicals like magnesium and calcium oxide, which are produced from chemical manufacturers. To reduce energy consumption levels, recycled glass (also called 'cullet') is mixed in with these raw materials[lxxxviii].

Table 58 and Table 59 show the five industries that would be most impacted by a $1 million reduction in output from flat glass and glass container manufacturing, respectively. These tables also include estimates for the total impact of these $1 million reductions on all industries. Both simulations show that rail transportation and electric power distribution are some of the most heavily impacted industries.

Table 58. Impact of $1 Million Reduction in Output from Flat Glass Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Rail Transportation	($35,887)
Electric Power Transmission and Distribution	($29,449)

Management of Companies and Enterprises	($26,786)
Truck Transportation	($25,493)
Other Basic Inorganic Chemical Manufacturing	($21,337)
All Industries	**($480,137)**

Table 59. Impact of $1 Million Reduction in Output from Glass Container Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Paperboard Container Manufacturing	($35,131)
Electric Power Transmission and Distribution	($29,623)
Rail Transportation	($24,095)
Management of Companies and Enterprises	($23,889)
Warehousing and Storage	($20,184)
All Industries	**($451,520)**

Domestic Competition

Market Structure

The glass manufacturing industry has seen a contraction of float glass facilities nationwide, going from 48 facilities prior to the Great Recession to about 34 facilities now. Segmentation of the glass industry is prominent, with facilities generally having their own niche product lines. Washington's glass manufacturing industry tends to be regional, with raw materials used in the production largely sourced locally. Transportation can also prove difficult due to the fragility of most glass products, with related transportation costs then difficult to warrant long-distance shipments.

Domestic Carbon Pricing

Of the top states by revenue, only California has a carbon price in place (Table 60). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction.

Table 60. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Glass Manufacturing Industry. Sources: Washington State Department of Ecology; California Air Resources Board

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	**$58.51**	**Yes**
California	$25.87	Yes
Michigan	N/A	N/A
Ohio	N/A	N/A
North Carolina	N/A	N/A
Tennessee	N/A	N/A

Washington Exports

Figure 111 shows glass product exports from Washington state from 2002 to 2024. Exports of glass products from Washington have generally increased over the past two decades, although there are three clear dividing points. Over the first decade in this timeframe, the value of glass exports tripled. From 2011 to 2017, there was instead a 49 percent decrease in these exports. Then from 2017 to 2024, exports effectively stay flat (a 1 percent decrease over that period).

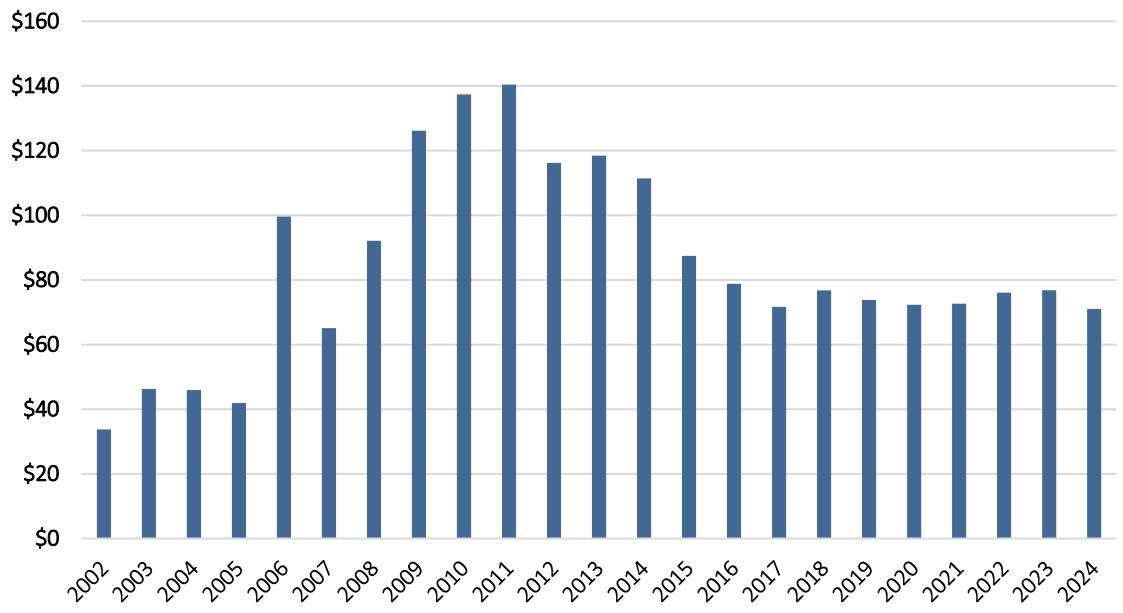

Figure 111. Washington State Glass and Glass Product Exports (Millions $) (NAICS 3272). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 112 compares global exports of glass products from select states beginning in 2002, while Figure 113 shows the percentage of 2024 glass export value from each of these states. Washington has more than doubled its glass exports value during this time, while most others experience smaller growth rates (except for Michigan, which actually tripled the value of glass exports. Only 1.3 percent of all exported glass products from U.S. ports leave Washington state ports.

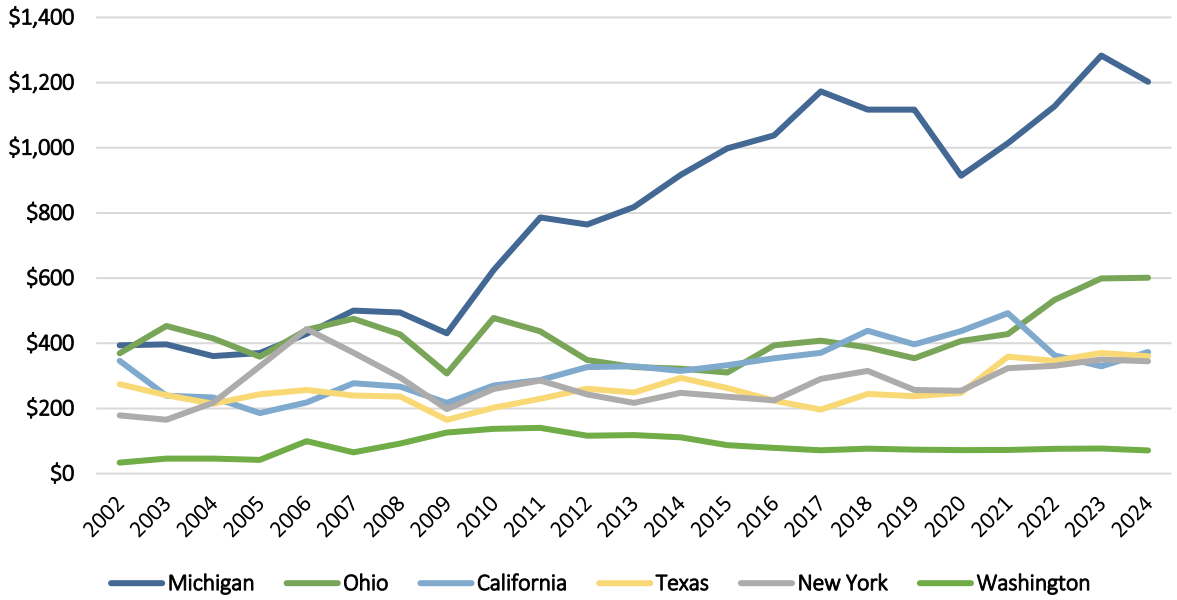

Figure 112. Glass and Glass Product Exports, Top Five States and Washington (Millions $) (NAICS 3272). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

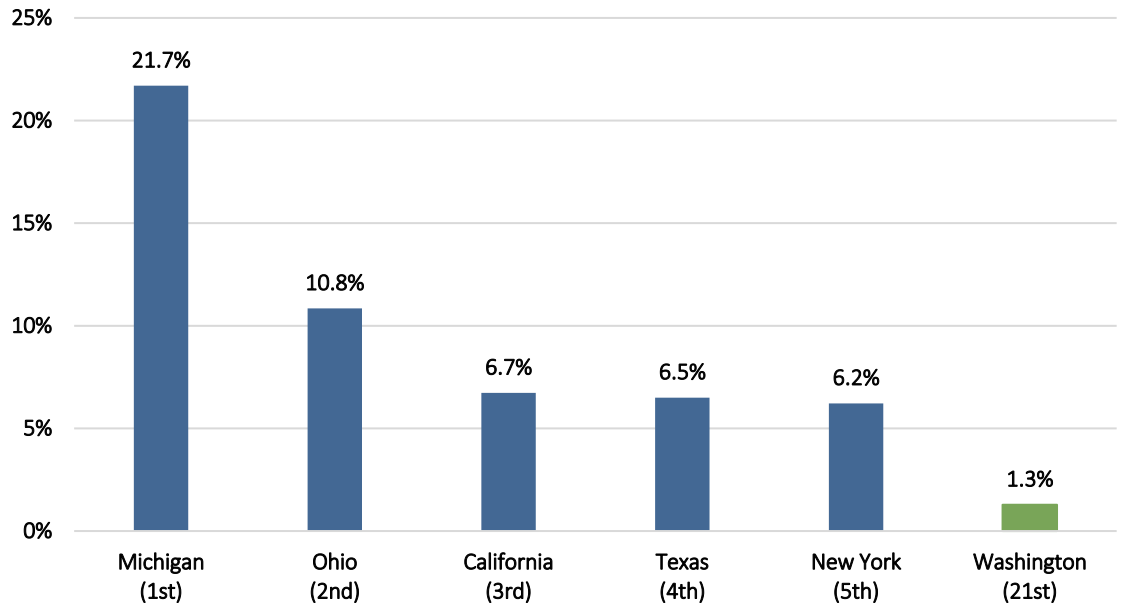

Figure 113. Share of U.S. Glass and Glass Product Exports, Top Five Exporters and Washington 2024 (NAICS 3272). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 114 shows the share of global exports for glass products in 2023 for the six largest exporting nations. The U.S. represents a close third to Germany based on this data, representing 7.4 percent ($6.4 billion) of all glass export value. China is far more significant than the U.S. in the glass trade, with three times great export value than the U.S.

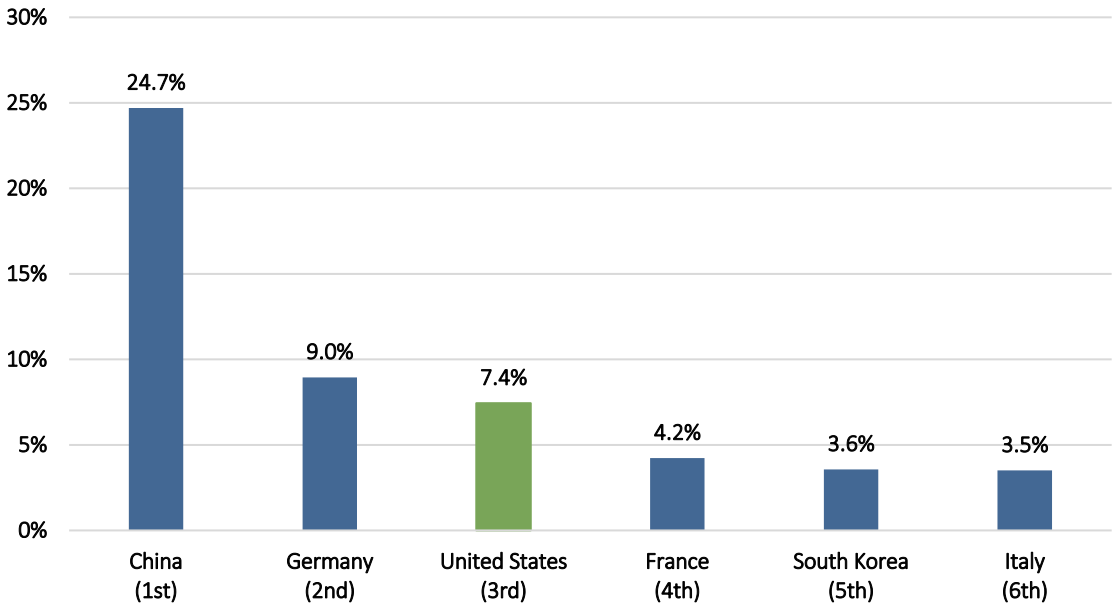

Figure 114. Share of International Glass and Glassware Exports (HS 70), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Table 61 summarizes carbon pricing for each of the top glass-exporting nations. Most of these countries have carbon pricing policies in place. The EU has the highest cost for carbon emissions of these top competitors, with Germany also instituting a carbon price higher than Washington's. Only the U.S. and Italy do not have a set price of carbon emissions (although Italy is covered by the EU's carbon pricing, and China's policy only applies to electricity and other metals manufacturing).

Table 61. International Carbon Pricing for Top Exporters of Glass and Glassware Products. Sources: World Bank; International Carbon Action Partnership

Country/Region	Price per MTCO2e	EITE Leakage Mitigation Policies
European Union	64.74 EUR ($72.70)	Yes
Germany	55.00 EUR ($61.76)	Yes
France	44.60 EUR ($50.08)	Yes
China*	95.96 CNY ($13.32)	Yes
South Korea	10,355 SKW ($7.37)	Yes
Italy	EU ETS only	Yes
United States	N/A	N/A

* Only applies to the electricity, cement, steel, and aluminum sectors

Outlook

Projections

Glass manufacturing is anticipated to increase in the U.S., with demand for more high-quality display screens for electronics coupled with greater consumer preference for more sustainable production practices[lxxxix]. From 2025 to 2030, the industry is expected to grow at a compound annual growth rate of 5.6 percent globally, although this could be impacted by tariffs in the near future.

Cost Pass Through

Based on IRS tax returns data, profitability within the glass manufacturing industry nationwide stands at 12.5 percent as of 2021. Glass manufacturers in Washington operate in a competitive environment. Many products—such as container and flat glass—face price pressures from out-of-state and international producers. A carbon price of $58.51 per metric ton of CO_2e could increase production costs, and while some of those costs may be passed on to customers, the ability to do so is limited by market dynamics. The impact may be less severe within the West Coast region, where similar carbon policies exist, but competition at home (particularly in states like Michigan and Ohio) and abroad (especially China) may pose risks.

Key Takeaways

- Washington has generally seen a modest increase in economic activity in the glass manufacturing industry over the last two decades, although it represents a slightly smaller percentage of the state's overall GDP.
- The industry is geographically oriented toward the Midwest, with Michigan representing a fairly significant leading state in terms of revenue, employment, and exported product.
- Most of the top competing nations have carbon pricing policies in place. At the same time, they also generally offer free allowances or other forms of support for EITEs. China, the most significant exporter glass products, does not have an applicable carbon price program for manufacturing.
- Glass manufacturing is expected to grow globally in the medium term. U.S. tariffs could offer some protection from foreign competition and allow Washington's glass manufacturing EITEs to pass through some of their carbon compliance costs, although this could be limited if U.S. tariffs impact the inputs used in glass manufacturing.

Metals

Industry Overview

Steel is typically manufactured in one of two ways: superheating iron ore, limestone, and coke inside a blast furnace to produce pig iron, or by using an electric arc furnace to produce molten steel from iron or scrap steel[xc]. Primary aluminum manufacturing uses a chemical process to extract alumina from bauxite ore. The alumina then gets melted and undergoes additional chemical processes to create aluminum ingots, which can then be shaped into a variety of products[xci]. Washington's aluminum manufacturers specialize in secondary aluminum manufacturing, which involves melting down scrap and recycled primary aluminum and turning it into new products[xcii].

There are about sixty primary metal manufacturing facilities located in Washington, three of which are classified as EITEs. One of the facilities is located in Cowlitz County (Steelscape), one is located in King County (Nucor Steel Seattle), and one is located in Spokane County (Kaiser Aluminum Washington). Figure 115 shows the locations of the steel and aluminum manufacturing EITEs in Washington.

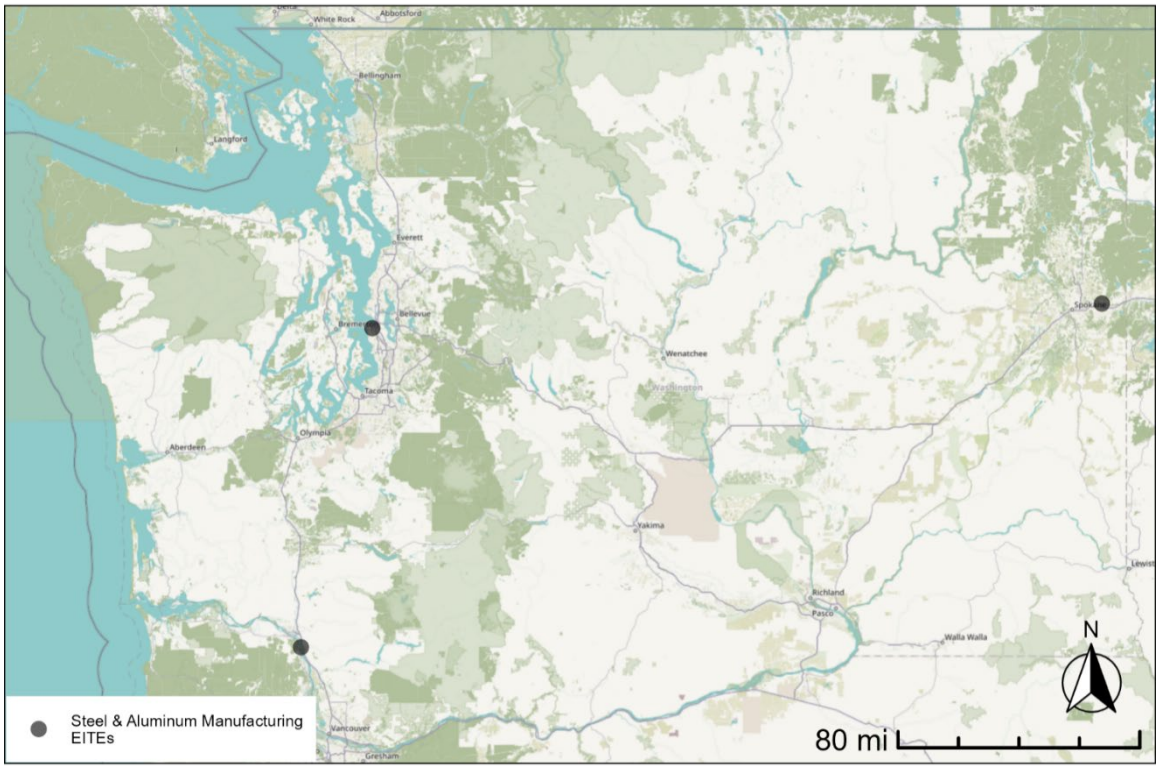

Figure 115. Map of Steel and Aluminum Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 116 shows that real GDP for Washington's primary metal manufacturing industry declined during the 2000s, but it has since rebounded and in 2023 reached its highest level in the past twenty-five years. However, the industry's share of Washington's real GDP has not recovered to its level prior to 2000 and was only 0.15 percent of the state's GDP in 2023 (Figure 117).

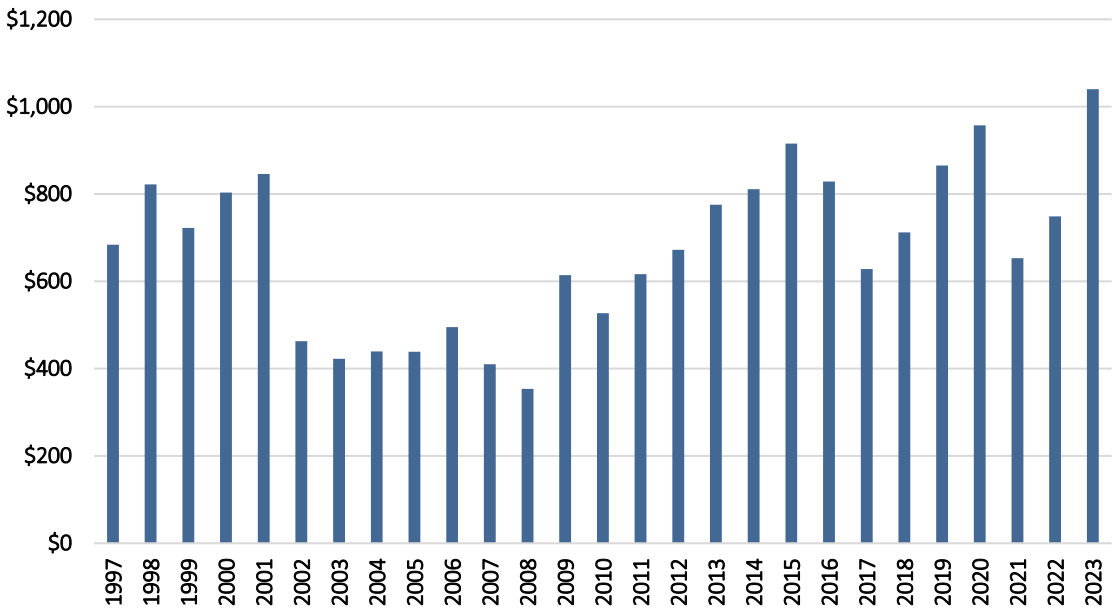

Figure 116. Washington State Primary Metal Manufacturing Real GDP (Millions 2017 $) (NAICS 331). Source: U.S. Bureau of Economic Analysis

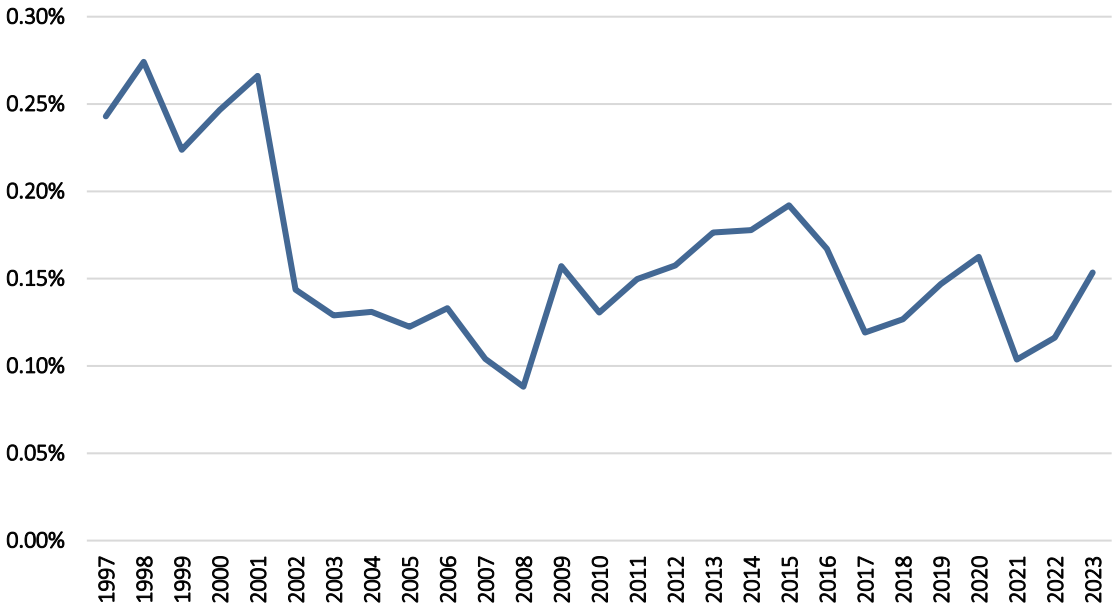

Figure 117. Share of Washington State GDP from Primary Metal Manufacturing (NAICS 331). Source: U.S. Bureau of Economic Analysis

Employment

While real GDP for Washington's primary metal manufacturing industry has grown in recent years, Figure 118 shows that employment by the industry in Washington has decreased substantially, from close to 7,000 workers in 2013 to slightly more than 4,000 workers in 2022. Washington ranked twenty-

fourth in its share of total U.S. employment in the industry in 2022, with only 1.2 percent of industry's total U.S. workforce (Figure 119).

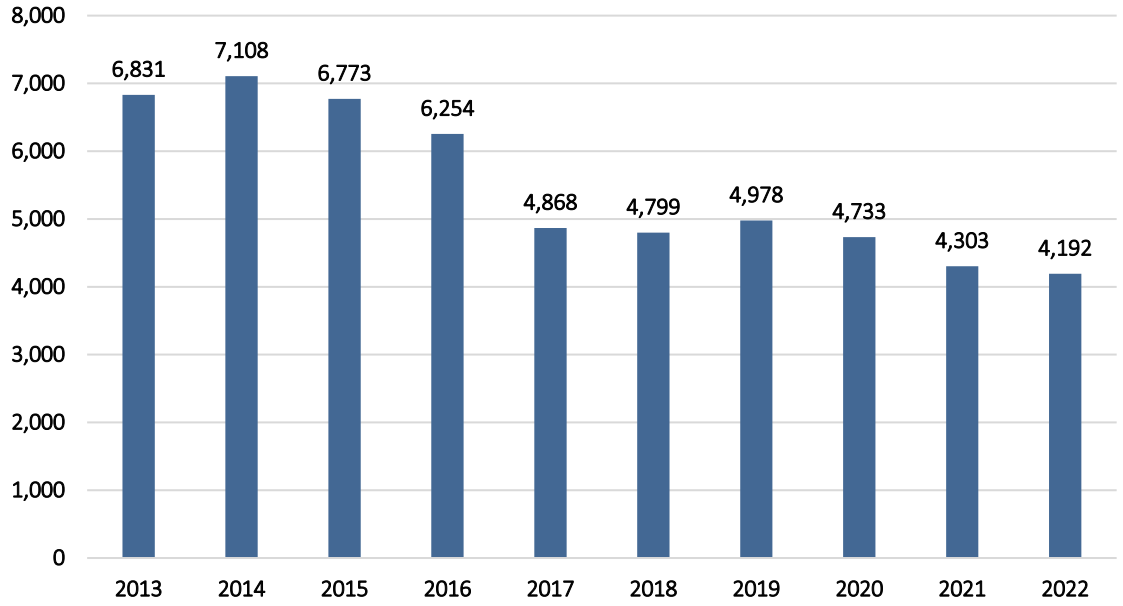

Figure 118. Total Washington State Primary Metal Manufacturing Industry Employment (NAICS 331). Source: U.S. County Business Patterns

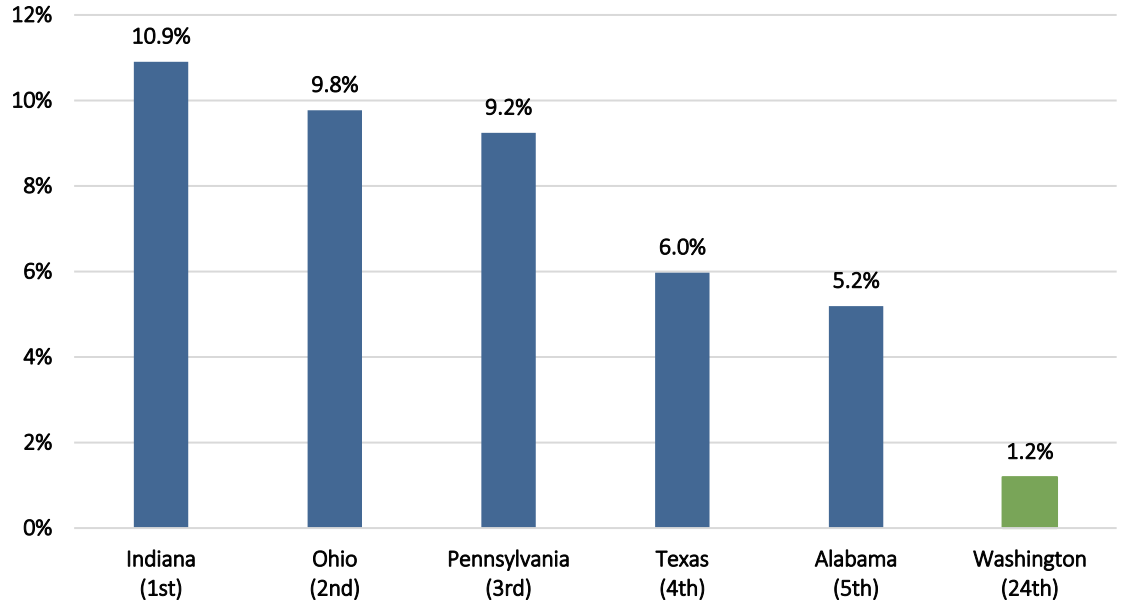

Figure 119. Share of U.S. Primary Metal Manufacturing Industry Employment, Top Five States and Washington 2022 (NAICS 331). Source: U.S. County Business Patterns

Revenue

Figure 120 shows the share of U.S. primary metal manufacturing revenue for the top five states and Washington in 2021. Indiana lead the nation with 13 percent of the industry's revenue, while other top states generated between 6 and 9 percent of U.S. revenue for the industry. In contrast, Washington's primary metal manufacturing industry ranked twenty-ninth in revenue compared to other states, with a 0.7 percent share of the industry's total U.S. revenue in 2021.

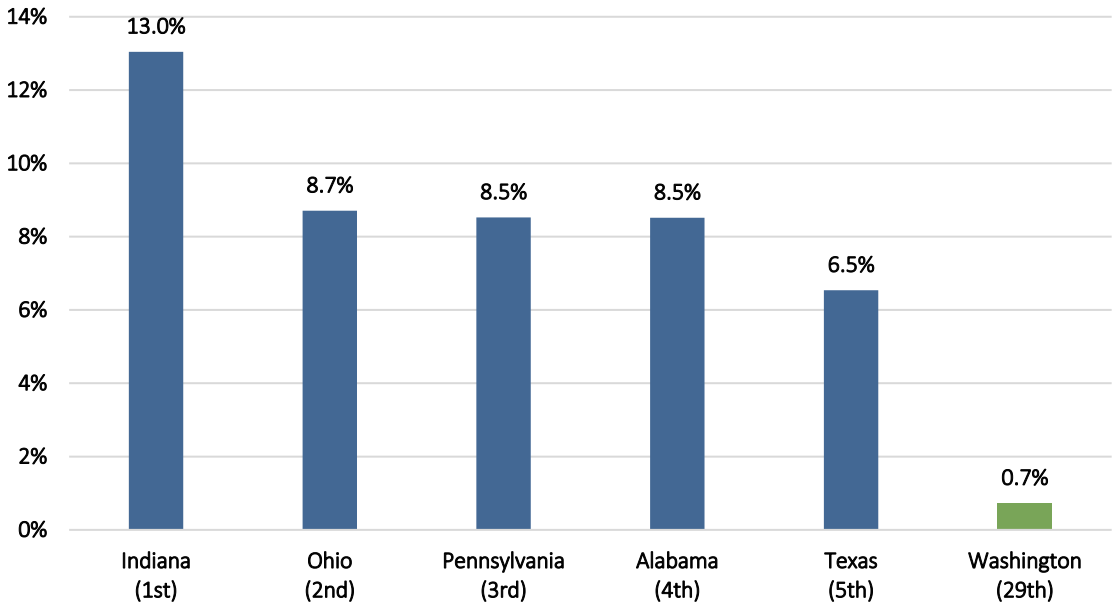

Figure 120. Share of U.S. Primary Metal Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 331). Source: Annual Survey of Manufactures

Supply Chains

Table 62, Table 63, and Table 64 show the potential impact of a $1 million reduction in output from iron and steel mills, rolled steel shape manufacturing, and aluminum manufacturing, respectively. The wholesale of durable goods would be the industry most significantly impacted, while other industries such as truck and rail transportation would face smaller indirect impacts. The total indirect impact across all industries is above $300,000 in all three scenarios, with reduced iron and steel mill output having a total indirect impact close to $550,000.

Table 62. Impact of $1 Million Reduction in Output from Iron and Steel Mills and Ferroalloy Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Other Durable Goods Merchant Wholesalers	($127,452)
Truck Transportation	($49,733)
Rail Transportation	($22,828)
Rolled Steel Shape Manufacturing	($20,960)
Electric Power Transmission and Distribution	($15,237)
All Industries	**($545,684)**

Table 63. Impact of $1 Million Reduction in Output from Rolled Steel Shape Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Other Durable Goods Merchant Wholesalers	($73,072)
Iron and Steel Mills and Ferroalloy Manufacturing	($24,906)
Truck Transportation	($20,602)
Rail Transportation	($9,254)
Insurance Agencies, Brokerages, and Related Activities	($9,098)
All Industries	**($323,979)**

Table 64. Impact of $1 Million Reduction in Output from Aluminum Sheet, Plate, and Foil Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Other Durable Goods Merchant Wholesalers	($121,076)
Truck Transportation	($39,543)
Employment Services	($11,306)
Management of Companies and Enterprises	($10,030)
Other Real Estate	($9,734)
All Industries	**($389,443)**

Domestic Competition

Market Structure

Steel industry stakeholders noted that high ground transportation costs for steel makes the market regional to a certain extent, but a large enough differential in regional prices would allow steel from other regions of the U.S. to be competitive in Washington. They also noted that the relatively low cost of maritime shipping means that there is international competition in the market. Nucor is the largest steel maker in the U.S., with operations all across North America. Steelscape on the other hand is a smaller company with two facilities, one in Washington and the other in California.

Aluminum industry stakeholders commented that they compete globally on price, product differentiation, and other factors. They also noted that the Washington aluminum industry primarily sells to the aerospace industry, but it also sells to other industries (e.g., semiconductor manufacturers) and more generalized engineering end uses. Aluminum is both lightweight and durable[xciii], which makes it less challenging to transport than steel. However, there are a wide variety of products (e.g., sheets, plates, coils) and end uses (e.g., construction, packaging, transportation) for aluminum, meaning that there are different market segments that firms can specialize in[xciv]. Kaiser Aluminum is a large aluminum manufacturing company with thirteen facilities across North America, ten of which are located in the U.S.

Domestic Carbon Pricing

None of the top states by revenue have a carbon price in place (Table 65). Pennsylvania joined the Regional Greenhouse Gas Initiative in 2022, but it is no longer a member following a 2023 ruling by the Pennsylvania Commonwealth Court[xcv]. The carbon price in Washington's most recent auction was $58.51 per MTCO2e.

Table 65. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Primary Metal Manufacturing Industry. Source: Washington State Department of Ecology

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
Indiana	N/A	N/A
Ohio	N/A	N/A
Pennsylvania	N/A	N/A
Alabama	N/A	N/A
Texas	N/A	N/A

Washington Exports

Figure 121 shows that exports of steel and aluminum from Washington generally grew from 2002 to 2013 but then declined somewhat in the following years. In 2024, the state exported substantially more aluminum ($420 million) than iron, steel, and purchased steel products ($87 million), and it has typically been the case that Washington's aluminum exports are greater than its steel exports.

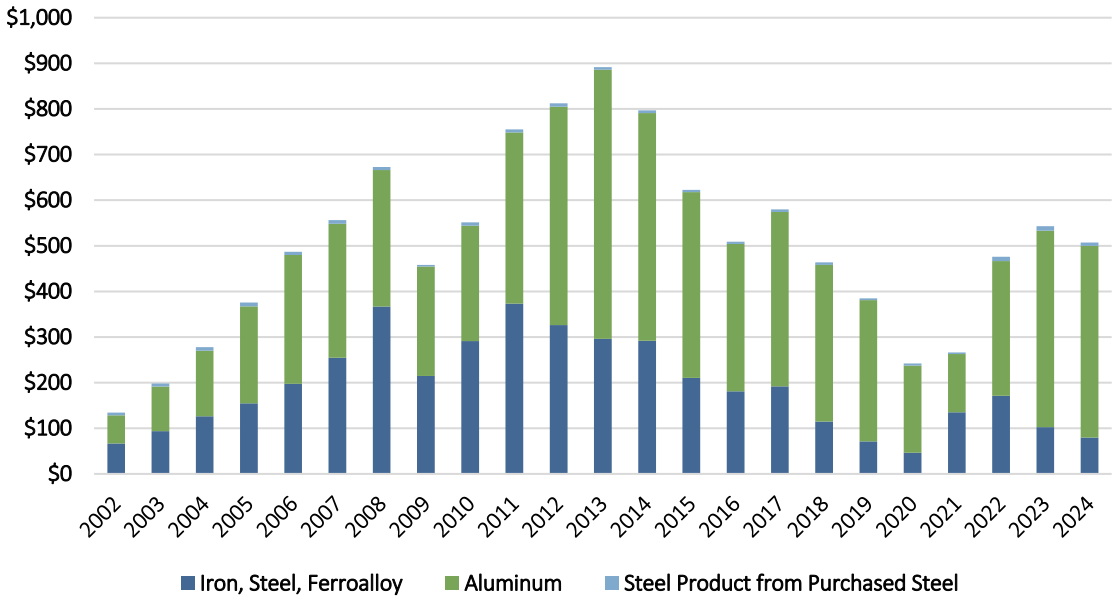

Figure 121. Washington State Steel and Aluminum Exports (Millions $) (NAICS 3311, 3312, and 3313). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 122 and Figure 123 show data on the value over time and 2024 share of steel and aluminum exports from the top five states and Washington. Steel and aluminum exports from the top exporters have generally grown over time. Texas has followed a similar pattern to Washington of exports mostly growing from 2002 to 2014 before declining a fair amount in subsequent years. Texas still leads in steel and aluminum exports, with 12.3 percent of the U.S. total in 2024, while other top exporters had shares between seven and ten percent. Washington ranked twelfth in its share of U.S. steel and aluminum exports, with 2.2 percent of the total.

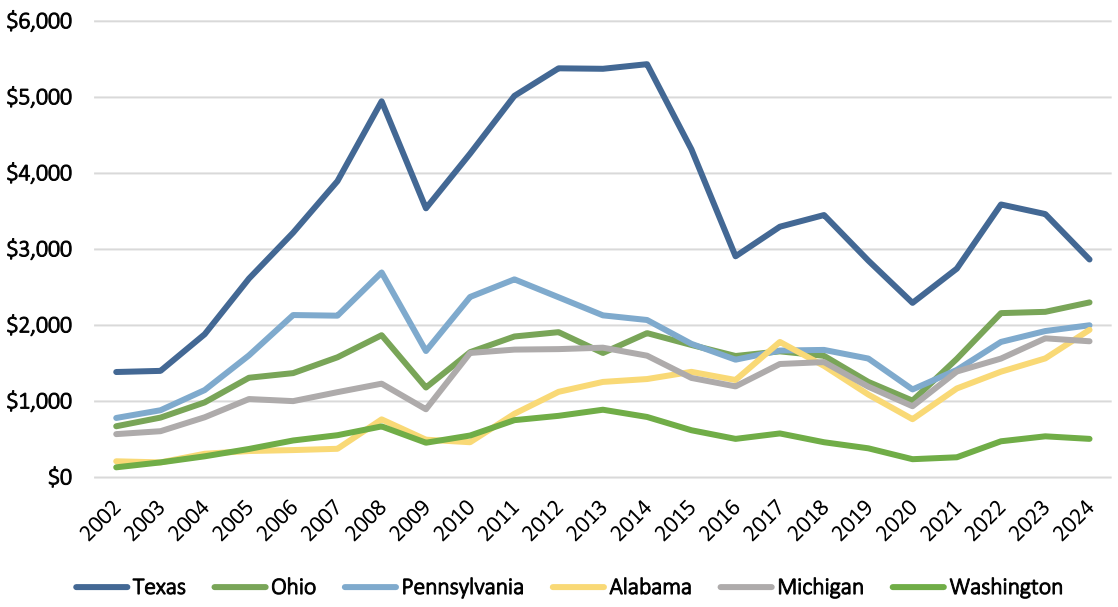

Figure 122. Steel and Aluminum Exports, Top Five States and Washington (Millions $) (NAICS 3311, 3312, and 3313). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

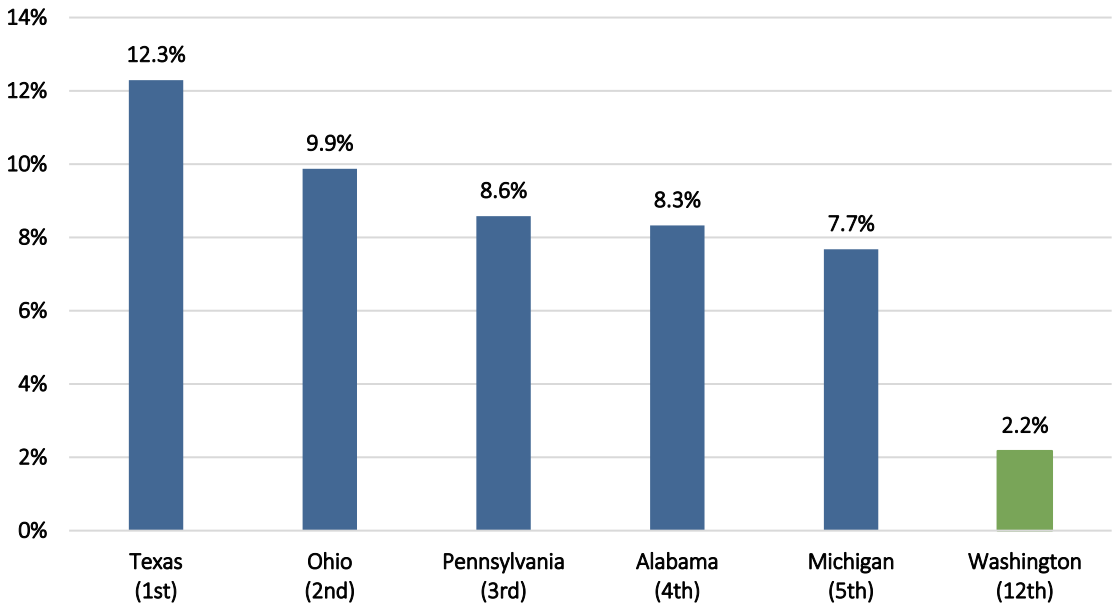

Figure 123. Share of U.S. Steel and Aluminum Exports, Top Five Exporters and Washington 2024 (NAICS 3311, 3312, and 3313). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 124 and Figure 125 show international iron and steel exports and aluminum exports, respectively, in 2023. China is the leading exporter in both markets, with well over ten percent of global exports and around double the share of Germany, the second largest exporter. The U.S. ranked sixth in iron and steel exports with 4.3 percent of the global total, and it ranked third in aluminum exports with 5.7 percent of the total.

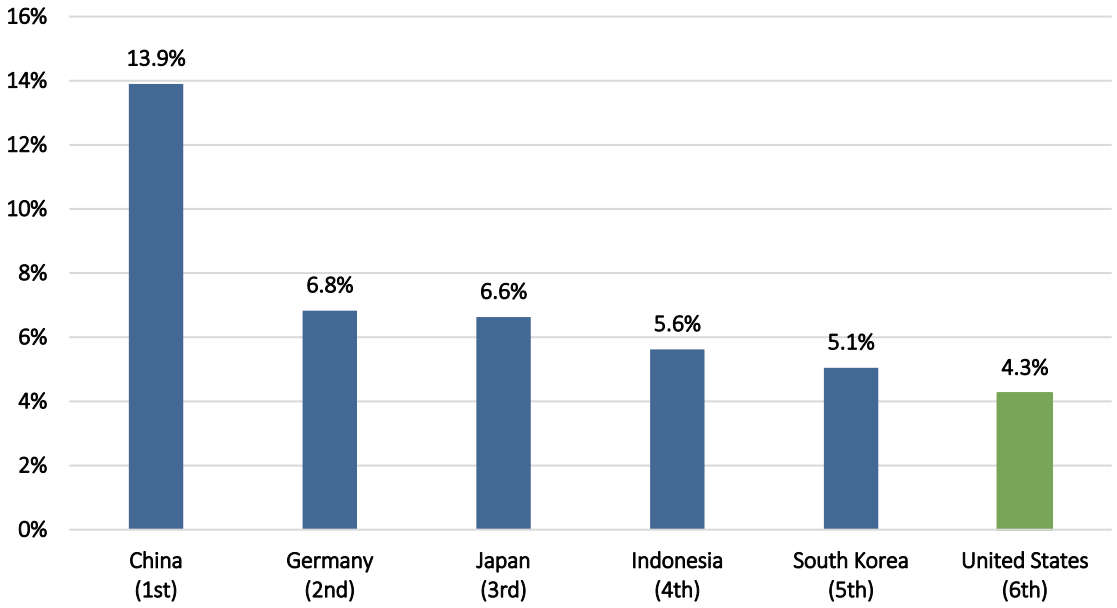

Figure 124. Share of International Iron and Steel Exports (HS 72), Top Six Exporters 2023. Source: Observatory of Economic Complexity

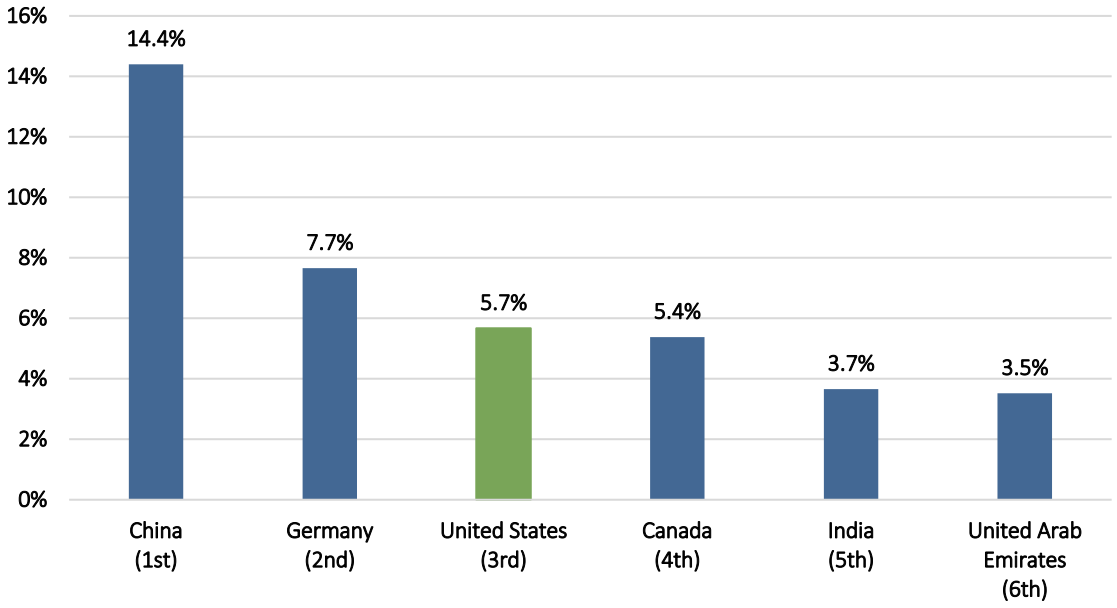

Figure 125. Share of International Aluminum Exports (HS 76), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Table 66 shows the carbon pricing of top exporters of primary metals. Germany's carbon price ($72.70 per MTCO2e if covered by the EU price, $61.76 otherwise) is higher than Washington's current price of $58.51 per MTCO2e. Canada's federal price is also higher ($68.23), but the price in Quebec, which is linked to California's carbon pricing, is much lower at only $25.87. All other major exporters either have low or no carbon prices. With the exception of Japan (which has a very low carbon price), all countries with carbon pricing policies also have carbon leakage mitigation policies for their EITEs.

Table 66. International Carbon Pricing for Top Exporters of Primary Metals. Sources: World Bank; International Carbon Action Partnership

Country/Region	Primary Metal Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
European Union	Both	64.74 EUR ($72.70)	Yes
Canada	Aluminum	95.00 CAD ($68.23)	Yes
Germany	Both	55.00 EUR ($61.76)	Yes
Quebec	Aluminum	$25.87	Yes
China	Both	95.96 CNY ($13.32)	Yes
South Korea	Iron and Steel	10,355 SKW ($7.37)	Yes
Japan	Iron and Steel	289 JPY ($1.98)	No
Indonesia*	Iron and Steel	12,000 IDR ($0.74)	N/A
United States	Both	**N/A**	**N/A**
India	Aluminum	N/A	N/A
United Arab Emirates	Aluminum	N/A	N/A

* Only applies to the electricity sector

Outlook

Projections

The global steel market was worth $1.47 trillion in 2024 and is projected to grow at a compound annual growth rate of 4.6 percent from 2025 to 2030[xcvi]. For the U.S., a 2024 report from The Alliance for Innovation and Infrastructure forecasts that domestic steel jobs and production will remain more or less stable over the next decade[xcvii]. However, Nucor (the parent company of one of the steel manufacturing EITEs in Washington) is making a number of investments in new facilities across the U.S., including in the Pacific Northwest[xcviii]. These investments suggest that the U.S. steel industry could grow over the long term rather than remaining stagnant.

Global demand for aluminum is forecasted to grow in the near term; a report from the International Aluminum Institute projects that global demand will be nearly 40 percent higher in 2030 than it was in 2020[xcix]. U.S. demand for aluminum is also expected to grow over the next decade, with domestic demand being as much as 40 percent higher in 2035 compared to the average domestic demand from 2020-2024[c].

Cost Pass Through

Based on IRS tax returns data, profitability within the primary metal manufacturing industry nationwide stands at 11.9 percent as of 2021. This suggests that Washington's steel and aluminum EITEs could potentially absorb a small portion of the cost of carbon pricing. However, Washington's metals industry is relatively small and faces high levels of competition both from abroad and from within the U.S., which would likely limit the ability of the EITEs to pass costs through to their customers.

Steel industry stakeholders raised concerns about their ability to quickly decarbonize. They noted that implementing efficiency upgrades typically takes several years, and that switching to all-electric furnaces would be challenging given current energy costs and energy production capacity in the state. Aluminum industry stakeholders also cited the limited availability of renewable energy in the state as a concern. Aluminum industry stakeholder also commented that for certain steps in the secondary aluminum manufacturing process, currently available technology is not yet efficient enough to use all-electric methods as opposed to gas powered methods.

Key Takeaways

- Washington's steel and aluminum industries are relatively small compared to other states and have had declining employment in recent years.
- Indiana, Ohio, Pennsylvania, Alabama, and Texas are the top states for primary metals production. China and Germany are the major international exporters in the industry.
- A couple countries have carbon pricing comparable to Washington's, but most domestic and international competitors have low or no carbon pricing. Those that have carbon prices generally offer free allowances or other forms of leakage mitigation policies for their EITEs.
- The steel industry is expected to remain relatively stable or grow modestly over the long term, while the aluminum industry is forecasted to grow quickly over the next decade.
- High ground transportation costs for the steel market and product segmentation in the aluminum market could create some room for EITEs to pass through carbon costs. However, the industries are highly competitive overall and have middling profit margins, which increases the risk of carbon leakage.

Petroleum

Industry Overview

Petroleum refining is the process of converting crude oil into petroleum products that can be used for transportation, heating, paving roads, generating electricity, and in certain chemical manufacturing processes. Washington's refineries primarily produce gasoline, diesel, jet fuel, renewable diesel, and asphalt[ci], and they can collectively process around 650,000 barrels per day, the fifth highest refining capacity of any state[cii].

There are five petroleum refineries located in Washington, all five of which are classified as EITEs. Two of the refineries are located in Skagit County (HF Sinclair Puget Sound and Marathon Anacortes), two are located in Whatcom County (BP Cherry Point and Phillips 66 Ferndale), and one is located in Pierce County (U.S. Oil and Refining Co). Additionally, there are two industrial gas manufacturing EITEs in Skagit County, Air Liquide and Matheson, that produce high purity hydrogen and steam for Washington's

petroleum refineries, as well as other industrial gases. Figure 126 shows the locations of the petroleum EITEs in Washington.

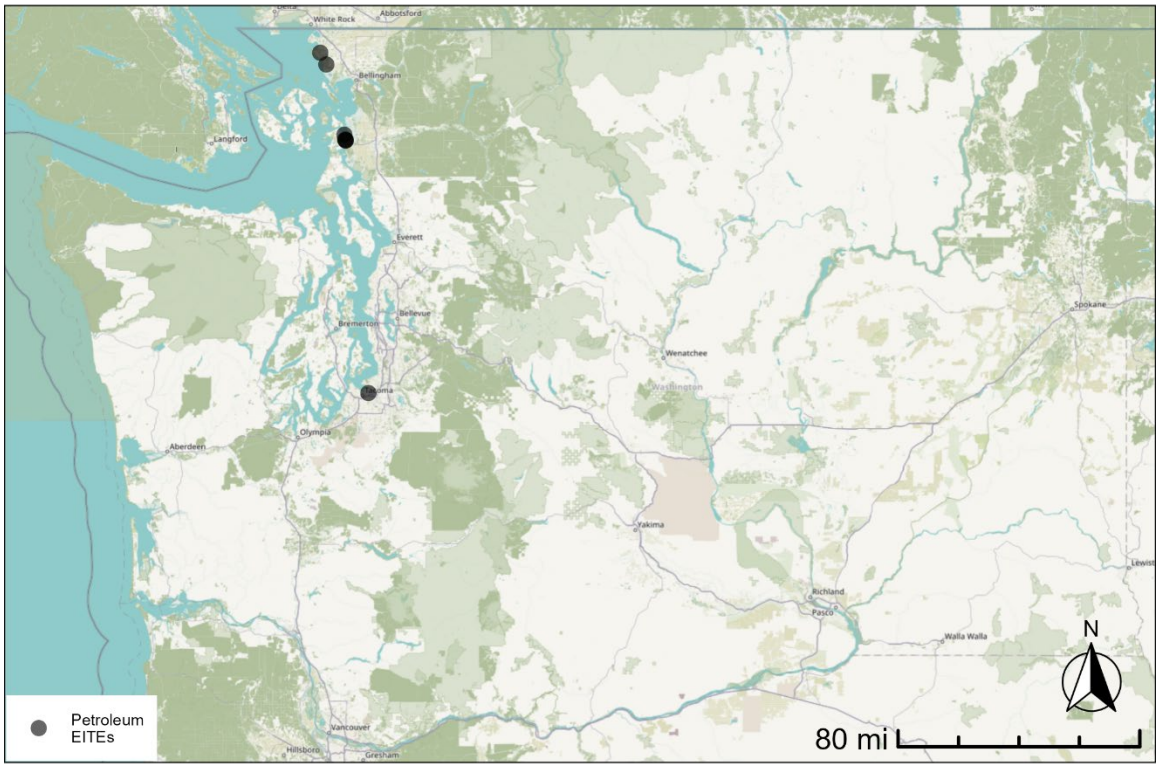

Figure 126. Map of Petroleum EITEs in Washington

Note: The Air Liquide, Matheson, and HF Sinclair facilities are located in close proximity to each other, so they appear as an overlapping dot on the map.

Washington Industry

Gross Domestic Product

Figure 127 shows that real GDP from Washington's petroleum and coal products industry has been somewhat volatile but has generally increased over the past twenty-five years. However, it remains below its 2005 peak. As seen in Figure 128, the industry's current share of Washington's real GDP is only slightly above its share in 1997 (0.61 percent in 1997 compared to 0.69 percent in 2023)[41].

[41] Industrial gas manufacturing falls under the same industrial category for GDP as chemical manufacturing. For the trends in Washington chemical manufacturing GDP, see Figure 81 and Figure 82.

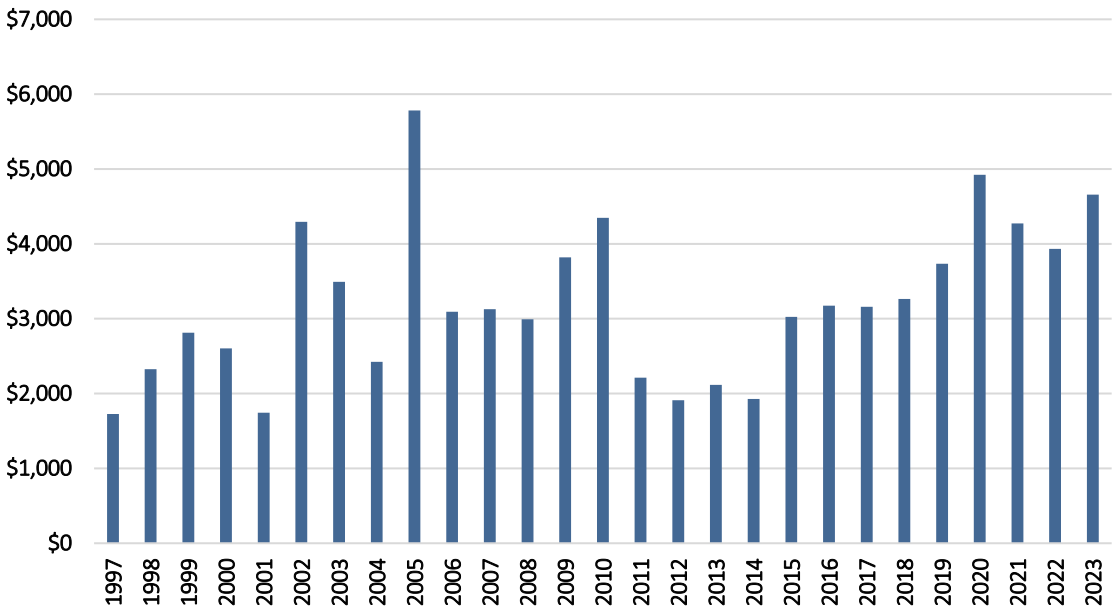

Figure 127. Washington State Petroleum and Coal Products Manufacturing Real GDP (Millions 2017 $) (NAICS 324). Source: U.S. Bureau of Economic Analysis

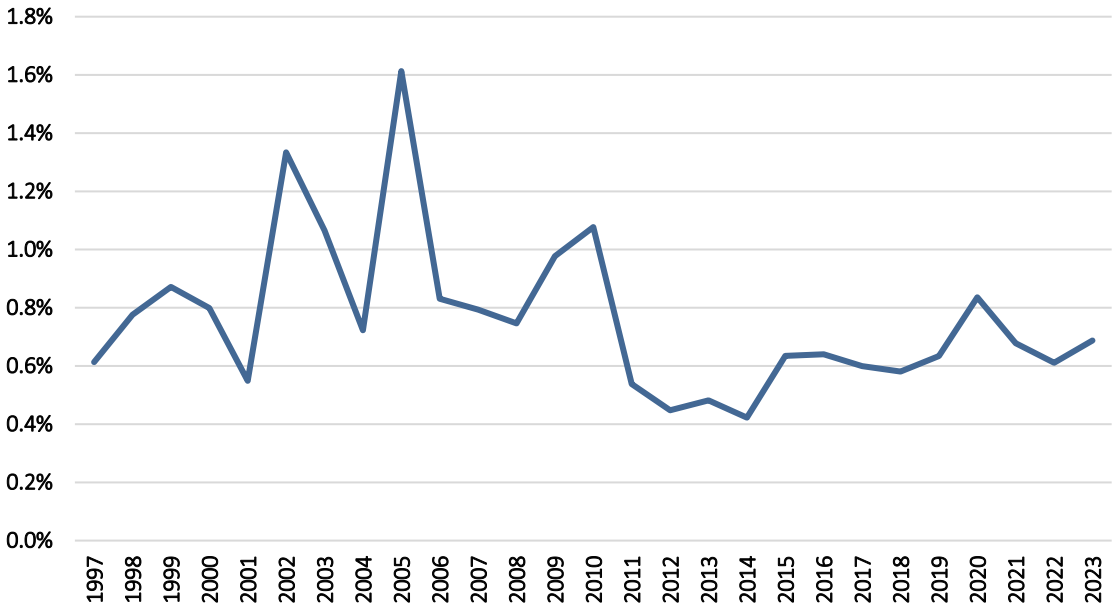

Figure 128. Share of Washington State GDP from Petroleum and Coal Products Manufacturing (NAICS 324). Source: U.S. Bureau of Economic Analysis

Employment

Employment by the petroleum refining industry in Washington has remained relatively stable since 2015 (Figure 129). There was an increase in employment during 2019 and 2020, but that surge was temporary and employment has since stabilized at around 2,000 workers. Washington's industrial gas manufacturing employment has declined from around 290 employees in 2015 to around 170 employees

in 2022. Figure 130 shows that Washington employed about 3.2 percent of petroleum refining industry workers in the U.S., ranking eighth in employment share compared to other states. The majority of employment in the industry is located in Texas, Louisiana, and California, with Texas in particular having an outsized share of 28.3 percent of total U.S. petroleum refining employment. Figure 131 shows that for industrial gas manufacturing, Washington ranked twenty-fifth in employment compared to other states in 2022 at 1.1 percent, while the top two states were Louisiana (11.3 percent) and Texas (10.4 percent).

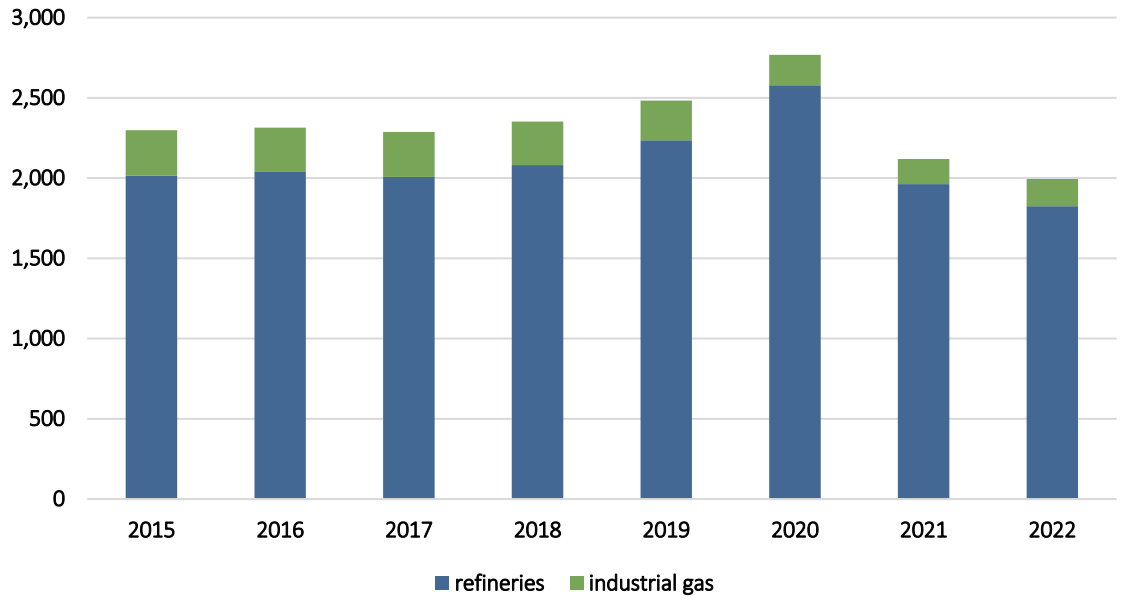

Figure 129. Total Washington State Petroleum Industry Employment (NAICS 324110 and 325120). Source: U.S. County Business Patterns

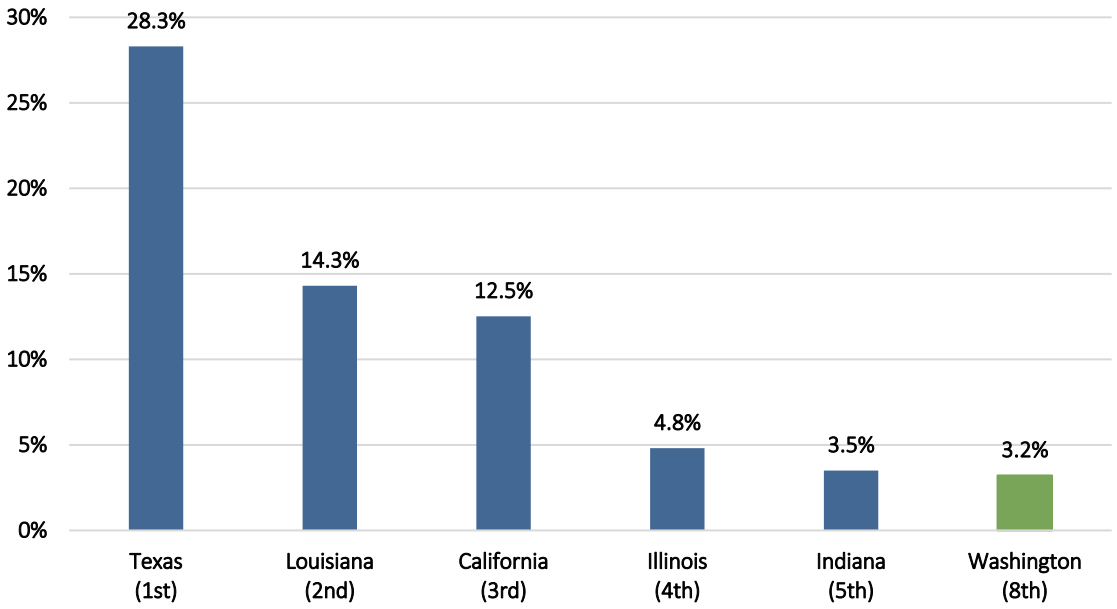

Figure 130. Share of U.S. Petroleum Refining Industry Employment, Top Five States and Washington 2022 (NAICS 324110). Source: U.S. County Business Patterns

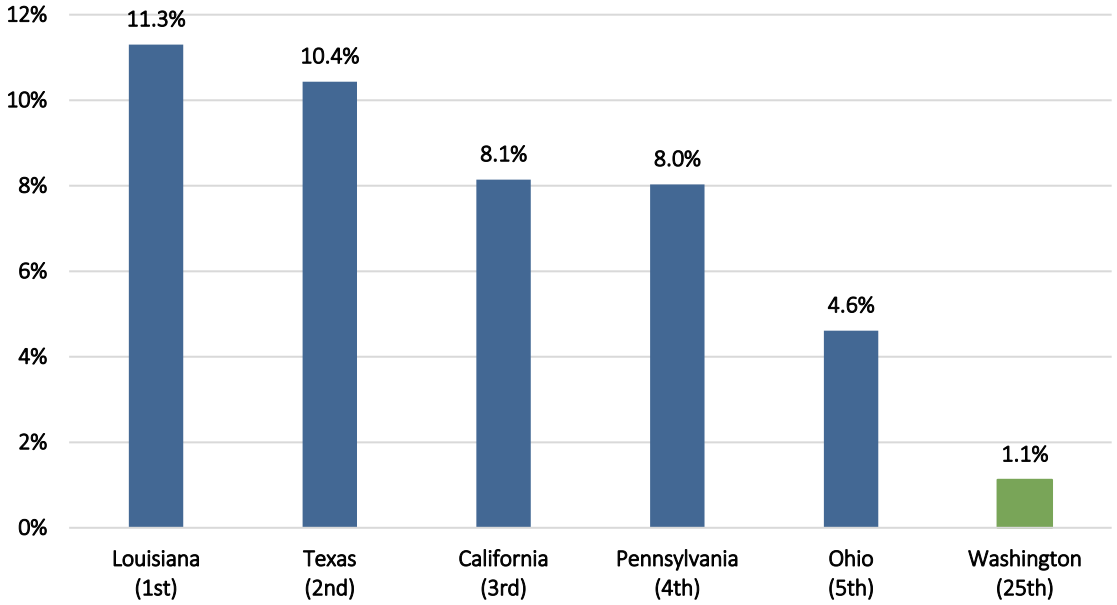

Figure 131. Share of U.S. Industrial Gas Manufacturing Employment, Top Five States and Washington 2022 (NAICS 325120). Source: U.S. County Business Patterns

Revenue

As seen in Figure 132, facilities in Washington generated about 3.0 percent of total U.S. revenue in the petroleum and coal products industry, ranking seventh compared to other states. As with employment, Texas had by far the largest share of U.S. revenue in the industry at 30.5 percent, with Louisiana and California also having large shares of U.S. petroleum and coal products industry revenue. For industrial

gas manufacturing, which falls under the basic chemical manufacturing industry, Figure 133 shows that Washington ranked twenty-eighth in revenue in 2021, with just 0.3 percent. Texas again lead by a wide margin (14.7 percent) followed by Louisiana in a distant second (5.8 percent).

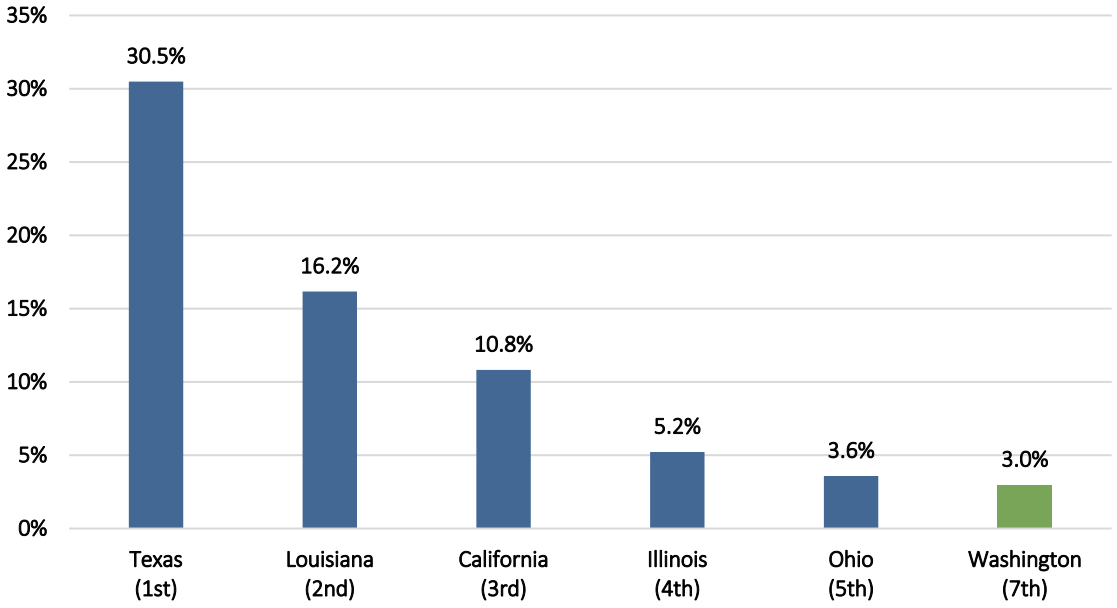

Figure 132. Share of U.S. Petroleum and Coal Products Industry Revenue, Top Five States and Washington 2021 (NAICS 3241). Source: Annual Survey of Manufactures

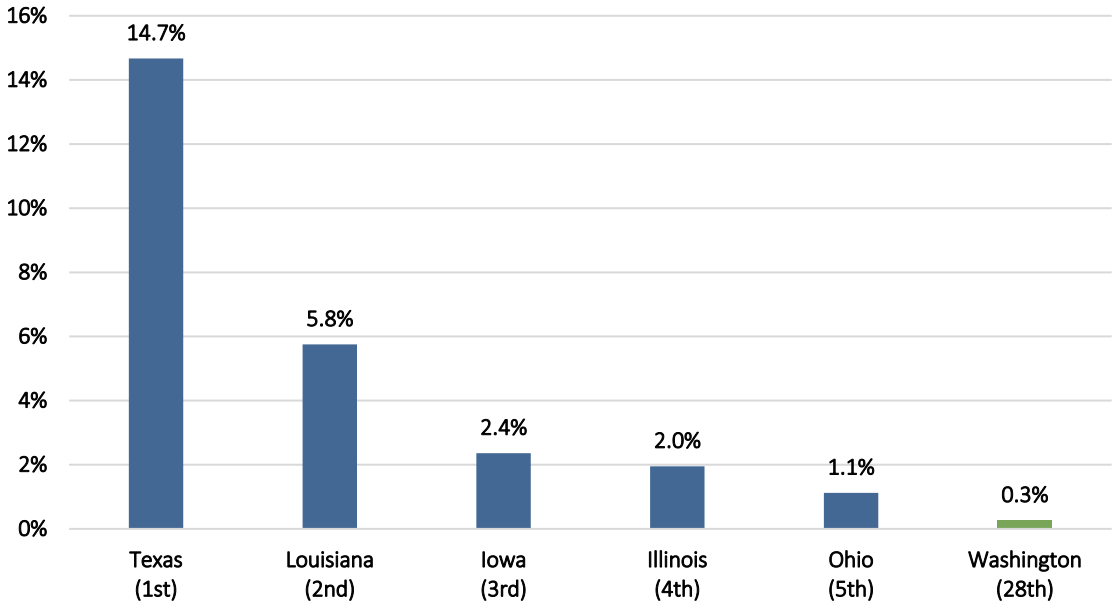

Figure 133. Share of U.S. Basic Chemical Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 3251). Source: Annual Survey of Manufactures

Supply Chains

Crude oil is the key input used by petroleum refineries. However, the state of Washington does not produce any crude oil itself and instead relies on crude oil from outside sources, mainly from Alaska, North Dakota, and Canada[ciii].

Table 67 and Table 68 show the five industries that would be most impacted by a $1 million reduction in output from petroleum refineries and industrial gas manufacturing, as well as the total impact on all industries. The size of the indirect impacts on individual industries would be relatively modest under the petroleum refinery scenario, with the largest impact on the wholesale of petroleum products only around $30,000. However, the impacts from reduced industrial gas manufacturing would be more substantial, with petroleum refineries, management of companies, and electricity all facing indirect impacts greater than $50,000. The total impact on all industries would be around $150,000 for the petroleum refinery scenario, but over $700,000 for the industrial gas manufacturing scenario.

Table 67. Impact of $1 Million Reduction in Output from Petroleum Refineries, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Petroleum and Petroleum Products	($29,806)
Oil and Gas Extraction	($17,694)
Maintenance and Repair Construction of Nonresidential Structures	($13,111)
Truck Transportation	($11,079)
Management of Companies and Enterprises	($6,419)
All Industries	**($152,619)**

Table 68. Impact of $1 Million Reduction in Output from Industrial Gas Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Petroleum Refineries	$(87,664)
Management of Companies and Enterprises	$(85,599)
Electric Power Transmission and Distribution	$(83,653)
Local Government Electric Utilities	$(50,048)
Insurance Agencies, Brokerages, and Related Activities	$(36,500)
All Industries	**($732,365)**

Domestic Competition

Market Structure

There are only a limited number of petroleum pipelines connecting the west coast states with rest of the continental U.S. because of the natural barrier formed by the Rocky Mountains[civ]. As such, the market for refined petroleum on the west coast is somewhat insulated from competition from the rest of the U.S. However, competitors from outside the region do have access to the market because of the region's port capacity. In 2024, the west coast region[42] imported an average of 122,000 barrel per day of finished petroleum products from other countries[cv].

[42] As defined by the U.S. Energy Information Administration. The region (known as PADD 5) includes Washington, Oregon, California, Nevada, Arizona, Alaska, and Hawaii.

The industrial gas manufacturing industry is highly concentrated, with a relatively small number of large companies (such as Air Liquide) controlling a majority of the market[cvi]. High purity hydrogen is also very difficult to transport across long distances due to its low density, the large amount of energy needed to cool and compress the hydrogen, and its high risk of leakage[cvii]. Because of these factors, it is likely that Washington's industrial gas manufacturing EITEs face less competition from out of state competitors compared to the other chemical manufacturing EITEs in the state.

Four of the refineries in Washington are owned by large, multinational corporations (BP, HF Sinclair, Marathon Oil, and Phillips 66). U.S. Oil and Refining Co. is owned by a company called Par Pacific, which owns two other refineries in the U.S. and focuses on the western U.S. market. The two industrial gas manufacturing EITEs are operated by large, multinational corporations: Air Liquide is a French company, and Matheson is owned by a Japanese holding company.

Domestic Carbon Pricing

Of the top states by revenue in the petroleum and coal products industry and the basic chemical manufacturing industry, only California has a carbon price in place (Table 69). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction.

Table 69. Domestic Carbon Pricing for Washington and Top States by Revenue, Petroleum and Coal Products Industry and Basic Chemical Manufacturing Industry. Sources: Washington State Department of Ecology; California Air Resources Board

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
California	$25.87	Yes
Texas	N/A	N/A
Louisiana	N/A	N/A
Illinois	N/A	N/A
Iowa	N/A	N/A
Ohio	N/A	N/A

Washington Exports

Figure 134 shows petroleum and coal product exports as well as basic chemical manufacturing exports from Washington state from 2002 to 2024. Exports of petroleum and coal products from Washington generally increased during the 2000s, then surged from 2011 to 2014 before dropping back down to their prior growth path. Basic chemical exports from Washington have generally been between $400 and $500 million a year, but some years had a greater volume, particularly in 2011 when basic chemical exports exceeded $1 billion. Total exports of petroleum and coal products from Washington in 2024 were roughly $3.4 billion, and for basic chemicals the amount was around $500 million.

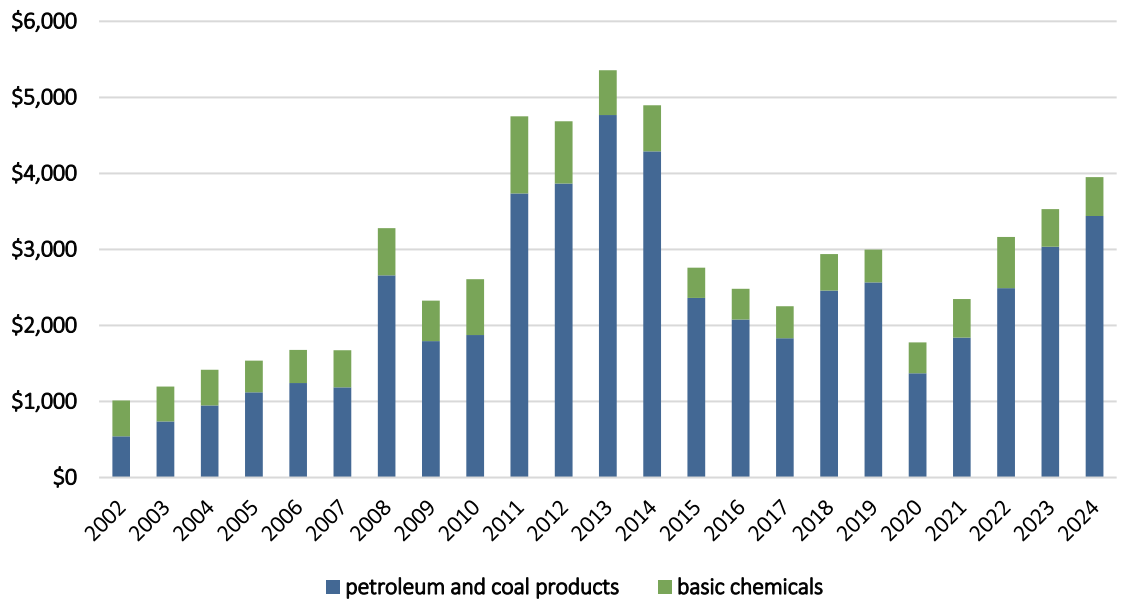

Figure 134. Washington State Petroleum and Coal Product Exports and Basic Chemical Exports (Millions $) (NAICS 3241 and 3251). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 135 and Figure 136 show data on the value over time and 2024 share of petroleum and coal product exports and basic chemical exports from the top five exporting states and Washington. From 2002 to 2024, export value remained relatively stable in most of the top states but surged in Texas and Louisiana. The vast majority of exports from the U.S. in 2024 for these two industries were from Texas and Louisiana, which accounted for around 75.7 percent of the total. Washington was the seventh largest exporter of U.S. petroleum and coal products and basic chemicals compared to other states in 2024, accounting for about two percent of the total.

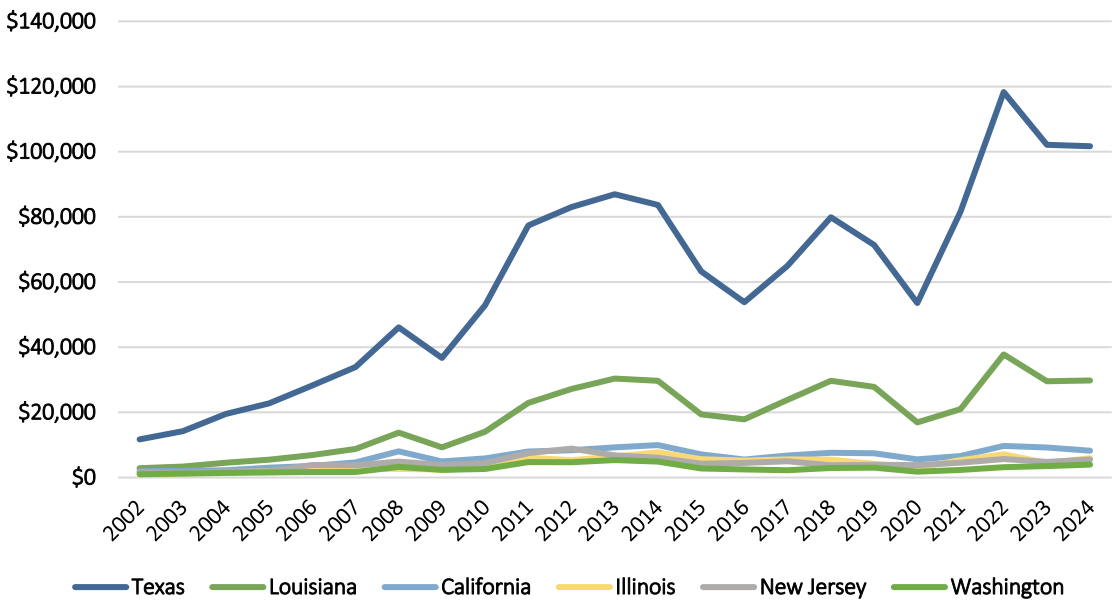

Figure 135. Petroleum and Coal Product Exports and Basic Chemical Exports, Top Five States and Washington (Millions $) (NAICS 3241 and 3251). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

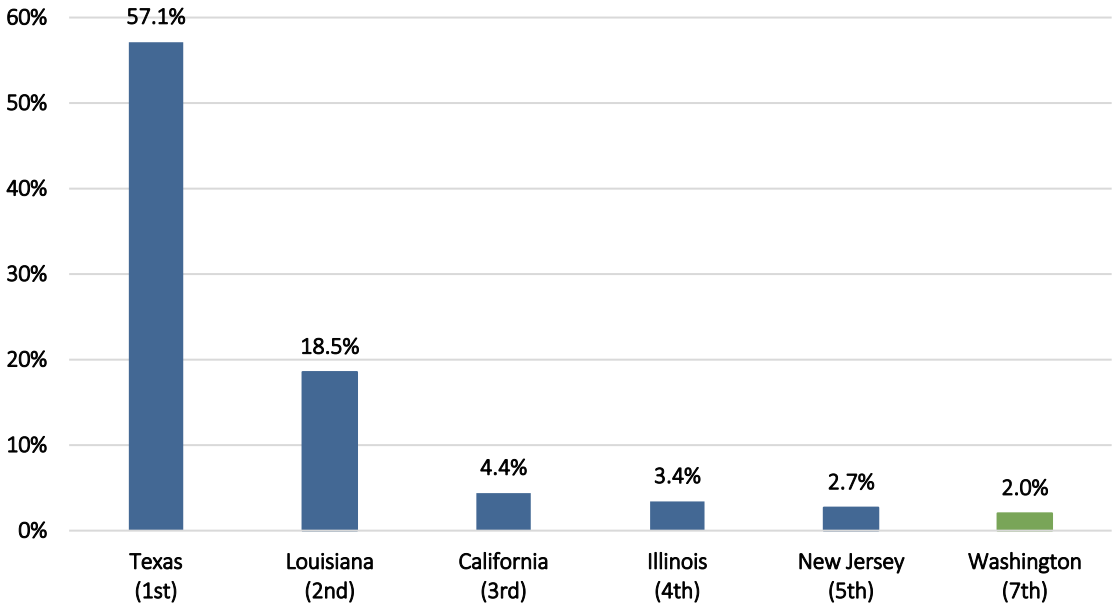

Figure 136. Share of U.S. Petroleum and Coal Product Exports and Basic Chemical Exports, Top Five States and Washington 2024 (NAICS 3241 and 3251). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 137 shows the share of global exports for refined petroleum in 2023 for the six largest exporters. The U.S. had the largest share at 11.5 percent with about $107 billion in refined petroleum exports. That was almost double the share of the second largest exporter, Singapore (6.0 percent). Figure 138 shows that the top exporters of hydrogen gas in 2023 were Belgium (34.7 percent) and Canada (28.8 percent), while the U.S. ranked fourth with 8.2 percent of global exports of hydrogen gas.

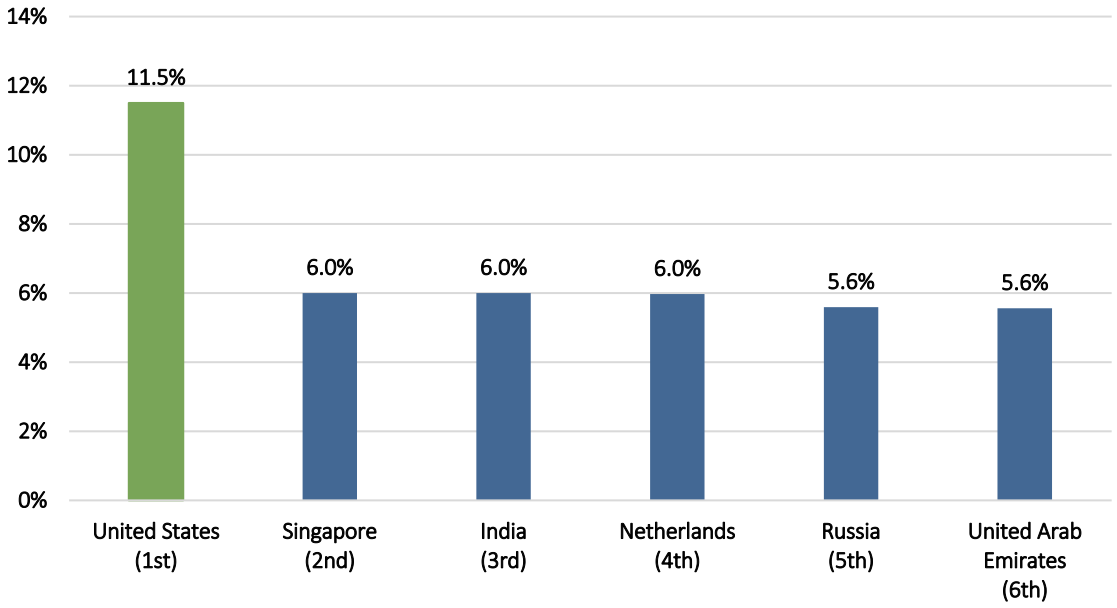

Figure 137. Share of International Refined Petroleum Exports (HS 2710), Top Six Exporters 2023. Source: Observatory of Economic Complexity

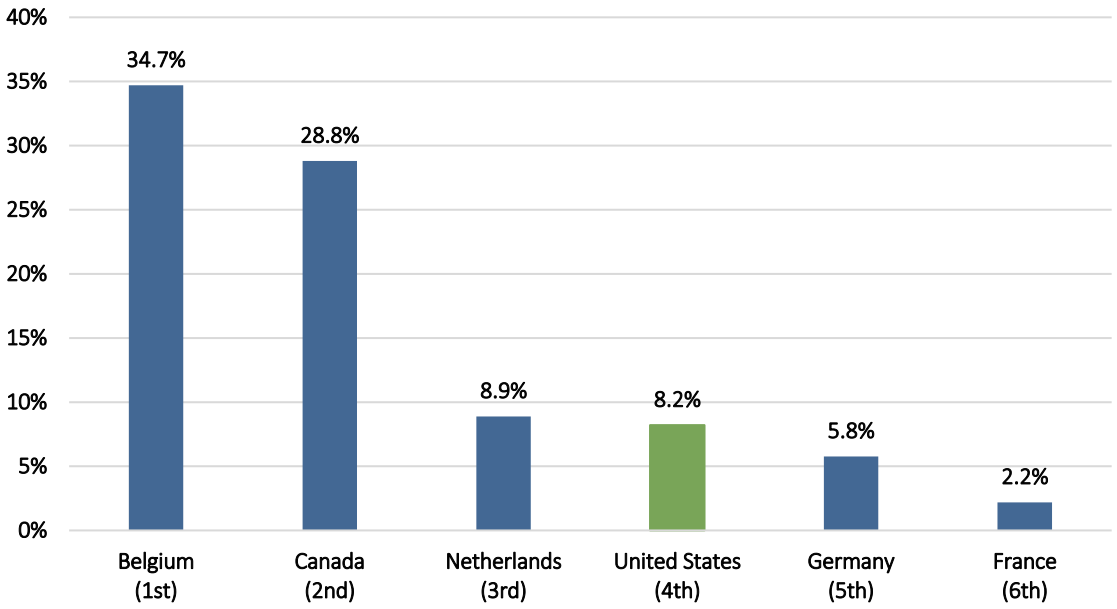

Figure 138. Share of International Hydrogen Gas Exports (HS 280410), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Of the top exporting countries for refined petroleum, only the Netherlands and Singapore have carbon pricing policies (Table 70). All of the top exporters of hydrogen gas except for the United States have carbon prices. Facilities in Europe covered by the EU ETS pay around $72.70 per MTCO2e, while European facilities covered by national policies pay between $50.08 and $74.60 depending on the country. Canada's federal carbon price is higher than the current carbon price in Washington, but the province of Quebec is exempt from the federal carbon price and instead is part of the same carbon pricing system as California. Singapore's carbon tax is relatively low, at around $19.20 per MTCO2e. The countries with carbon pricing policies in place all have carbon leakage mitigation policies for their EITEs.

Table 70. International Carbon Pricing for Top Six Exporters of Refined Petroleum and Hydrogen Gas. Sources: World Bank; International Carbon Action Partnership

Country/Region	Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
Netherlands	Both	66.50 EUR ($74.60)	Only if covered by EU ETS
European Union	Both	64.74 EUR ($72.70)	Yes
Canada	Hydrogen Gas	95.00 CAD ($68.23)	Yes
Germany	Hydrogen Gas	55.00 EUR ($61.76)	Yes
France	Hydrogen Gas	44.60 EUR ($50.08)	Yes
Quebec	Hydrogen Gas	$25.87	Yes
Singapore	Refined Petroleum	25.00 SGD ($19.20)	Yes
Belgium	Hydrogen Gas	EU ETS only	Yes
United States	**Both**	**N/A**	**N/A**
Russia	Refined Petroleum	N/A	N/A
India	Refined Petroleum	N/A	N/A
United Arab Emirates	Refined Petroleum	N/A	N/A

Outlook

Projections

Nationally, the U.S. Energy Information Administration projects that consumption of petroleum products and biofuels in the U.S. will decline by 19 percent from 2024 to 2050 in their reference case, 22 percent in a high oil price scenario, and 16 percent in a low oil price scenario (Table 71).

Table 71. Projected U.S. Consumption of Petroleum and Other Liquid Fuels, 2024-2050 (measured in quad BTUs). Source: U.S. Energy Information Administration

Scenario	2024	2030	2040	2050	% Change 2024-2050
Reference Case	37.20	36.56	31.48	30.19	-19%
High Oil Price	37.22	36.52	30.51	28.90	-22%
Low Oil Price	37.22	36.77	31.96	31.13	-16%

Note: "Other liquid fuels" includes ethanol and other biofuels.

In Washington, the decline in refined petroleum consumption will likely be steeper than the national average, given Washington's goal of reducing emissions 95 percent below 1990 levels by 2050 and the state's cap and invest program. A recent study by Western Washington University on Washington's petroleum refineries estimated that, based on projections from a California report and Washington state's policies, gasoline consumption in Washington could decline by 50 to 95 percent from 2022 to 2050. However, the study also noted that the state's refineries could potentially shift production towards renewable diesel and sustainable aviation fuel, with the increased demand for those fuels partially, though not completely, offsetting the decrease in domestic demand for traditional fuels[cviii].

Additionally, global consumption of refined petroleum is projected to increase from 2024 to 2050. As seen in Table 72, the U.S. Energy Information Administration projects that global consumption of petroleum products and biofuels will increase by 19 percent from 2024 to 2050 in their reference case, 12 percent in a high oil price scenario, and 23 percent in a low oil price scenario.

Table 72. Projected Global Consumption of Liquid Fuels, 2024-2050 (measured in quad BTUs). Source: U.S. Energy Information Administration

Scenario	2024	2030	2040	2050	% Change 2024-2050
Reference Case	195.6	202.0	214.0	231.9	19%
High Oil Price	193.5	196.9	203.9	216.5	12%
Low Oil Price	196.5	204.7	219.5	240.8	23%

Note: Liquid fuels include petroleum products as well as ethanol and other biofuels.

The U.S. market for hydrogen is expected to grow 8.7 percent per year from 2024 to 2030[cix]. Domestic hydrogen production in particular could see substantial growth over the long-term because of government investment from policies such as the Infrastructure Investment and Jobs Act[cx].

Cost Pass Through

Based on IRS tax returns data, profitability within the petroleum refining industry nationwide stands at 7.9 percent as of 2021. This suggests that Washington's petroleum refineries would only be able to absorb a small portion of the cost of carbon pricing. The relative isolation of the west coast market from the rest of the U.S. and the fact that the other major refining state in the region, California, has a carbon price could allow Washington's refineries to pass through some of the cost to consumers. However, maritime shipping of refined petroleum imports to Washington, either from abroad or from other parts of the U.S., would likely constrain how much of the cost Washington's refineries could pass through.

As noted by the Western Washington University study, Washington's refineries could potentially shift production from traditional petroleum products towards fuels such as renewable diesel and sustainable aviation fluid. The BP Cherry Point refinery for example has invested in renewable diesel production[cxi]. Increased energy efficiency could also help to marginally reduce the industry's emissions[cxii], and industry stakeholders stated that Washington's policy environment had accelerated investment in energy efficiency improvements. However, stakeholders also commented that further gains in efficiency would require much more significant capital investments, and that reductions in output from refineries would also decrease their energy efficiency.

For the basic chemical manufacturing industry (which includes industrial gas manufacturing), profitability in 2021 was 15.7 percent based on IRS tax returns data. Hydrogen gas production is relatively isolated from out of state competition because of the challenges involved in long distance shipping, but it is primarily used as an input for Washington's petroleum refineries, which are exposed to regional and international competition. Industrial hydrogen gas is traditionally produced using natural gas as a feedstock (also known as blue hydrogen)[cxiii]. Green hydrogen, which uses water and renewable energy, could provide an alternative to blue hydrogen, but green hydrogen requires large amounts of ultra-pure water, renewable energy, and capital investments. Industry stakeholders noted that investments in green hydrogen production in Washington could be constrained by the supply of renewable energy available in the state.

Key Takeaways

- Washington has the fifth largest petroleum refining capacity out of every state and is one of the top ten producers of refined petroleum in the country.
- Washington's industrial gas manufacturing industry is relatively small compared to other states in terms of employment and revenue.
- Texas and Louisiana are the largest producers and exporters of refined petroleum and industrial gases in the U.S. Globally, the U.S. is the leading exporter of refined petroleum, while Belgium and Canada are the major hydrogen gas exporters.
- The refined petroleum market of the west coast states is somewhat insulated from the rest of the U.S. due to limited pipeline connections, but ample port access means it is not completely isolated from outside competition.
- The hydrogen gas market faces limited exposure to outside competition due to the difficulty of shipping hydrogen across long distances. However, the Washington industrial gas manufacturing EITEs primarily sell to the state's refineries, which are more exposed to competition.
- Some international competitors in the refined petroleum and hydrogen gas markets have carbon prices, but most competitors have low or no carbon pricing policies in place. Jurisdictions that have carbon pricing policies in place also offer free allowances or other forms of support to their EITEs.
- Domestic demand for refined petroleum is expected to decrease in the long term, but that could be partially offset by growing global demand and increased domestic demand for alternative fuels.

- Demand for hydrogen is expected to increase over the long term, but this will be driven by increased demand and government funding for green hydrogen rather than the blue hydrogen produced currently produced by Washington's industrial gas manufacturing EITEs.

Pulp and Paper

Industry Overview

Pulp, paper, and paperboard manufacturing involves converting raw materials like wood chips and recycled paper into a variety of paper products used for printing, packaging, hygiene, and industrial applications. Washington's paper mills produce more pulp, paper, and paperboard than converted paper products, the opposite of most the rest of the U.S. The state is among the top exporters of paper products in the country, with over $1 billion in goods traveling through Washington ports.

There are sixteen pulp, paper, and paperboard facilities located in Washington, six of which are classified as EITEs. Three of the facilities are located in Cowlitz County (Nippon Dynawave, North Pacific Paper Company, and WestRock), one is located in Clark County (Georgia Pacific Consumer Operations), one is located in Jefferson County (Port Townsend Paper Corporation), and one is located in Walla Walla County (Packaging Corporation of America). Figure 139 shows the locations of the pulp, paper, and paperboard EITEs in Washington.

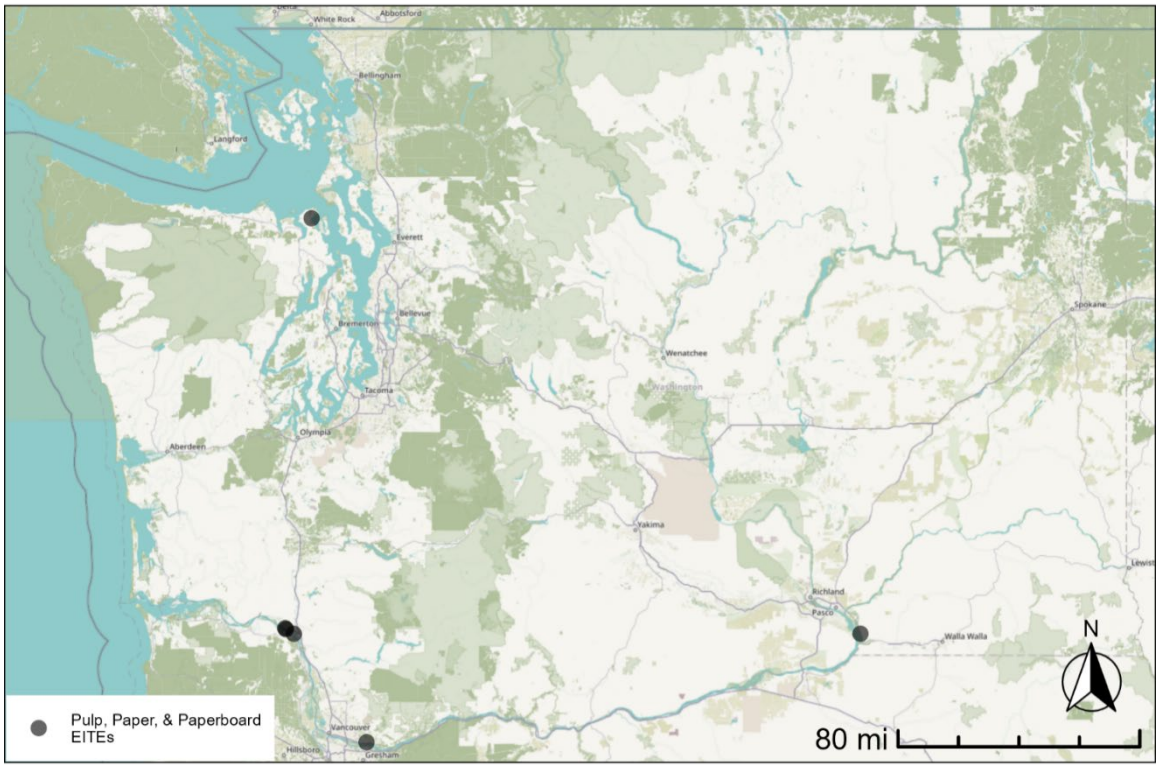

Figure 139. Map of Pulp, Paper, and Paperboard EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 140 shows that economic activity in the paper manufacturing industry in Washington has decreased in terms of real GDP over the past twenty-five years, with a 26 drop-off just since a recent peak in 2019 of $1.5 billion. The paper manufacturing industry also represents a smaller percentage of Washington's overall economy, as shown in Figure 141.

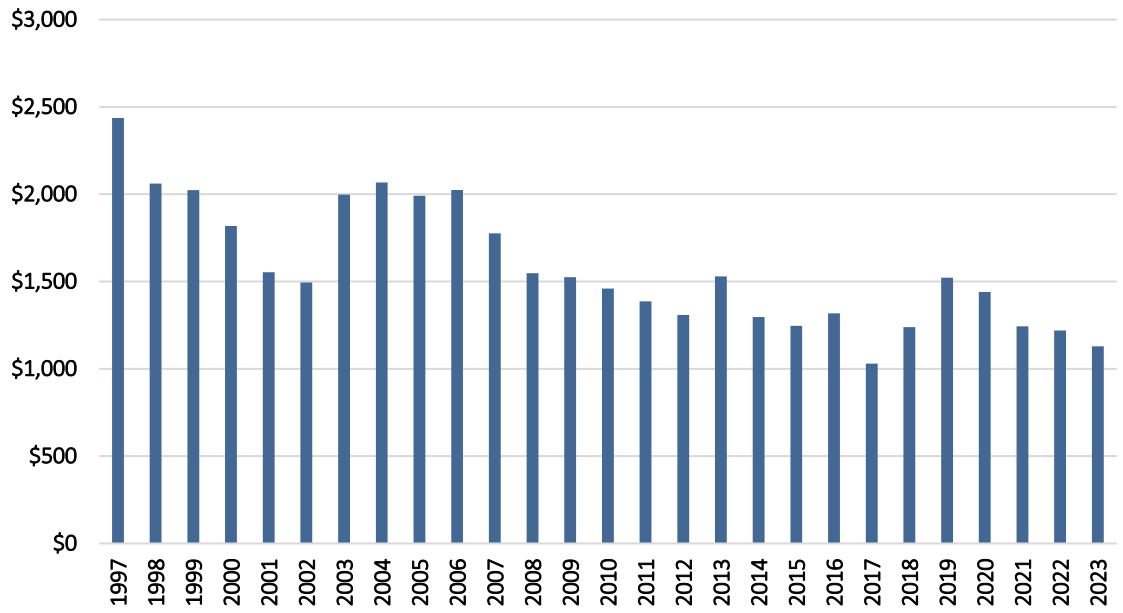

Figure 140. Washington State Paper Manufacturing Real GDP (Millions 2017 $) (NAICS 322). Source: U.S. Bureau of Economic Analysis

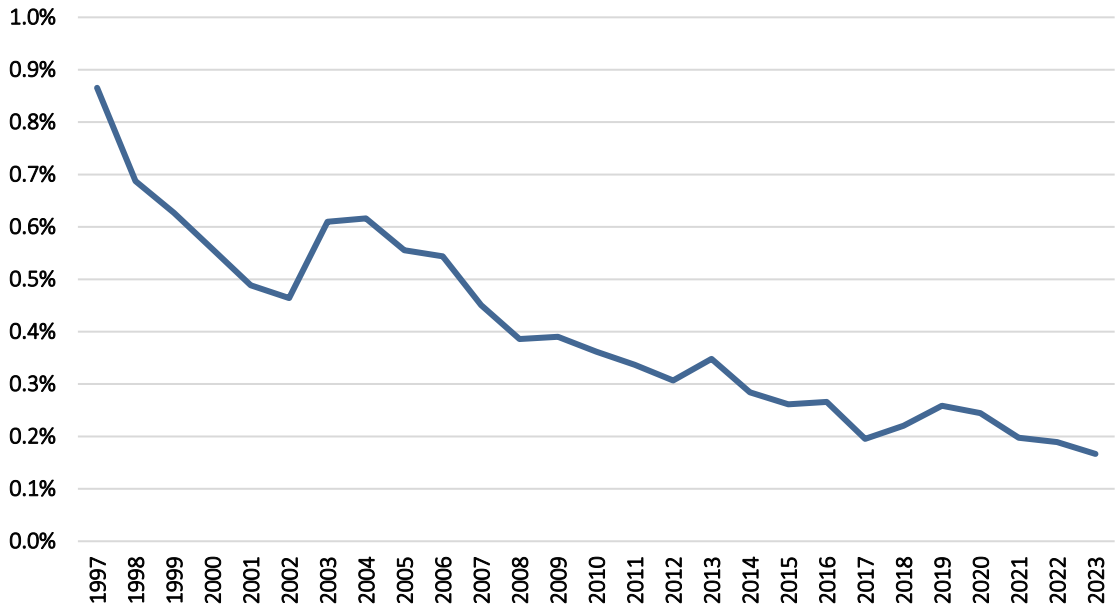

Figure 141. Share of Washington State GDP from Paper Manufacturing (NAICS 322). Source: U.S. Bureau of Economic Analysis

Employment

Employment in the paper manufacturing industry is also trending downwards in Washington, although more volatile than GDP (see Figure 142). The nearly 6 percent drop in industry employment over a decade differs from the national trend, a 1 percent increase. Figure 143 shows that Washington employed approximately 2.3 percent of all paper manufacturing employees in 2022 according to County Business Patterns data. Midwestern states have consistently employed the most people in the paper manufacturing industry, with Wisconsin, Pennsylvania, and Ohio representing the top three states by this measure.

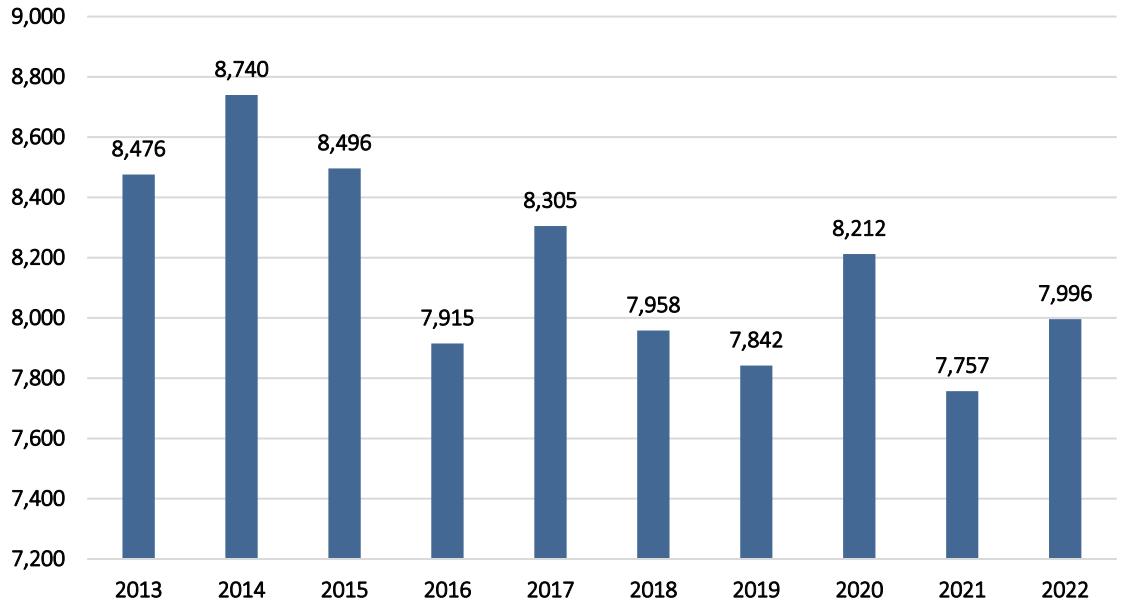

Figure 142. Total Washington State Paper Industry Employment (NAICS 322). Source: U.S. County Business Patterns

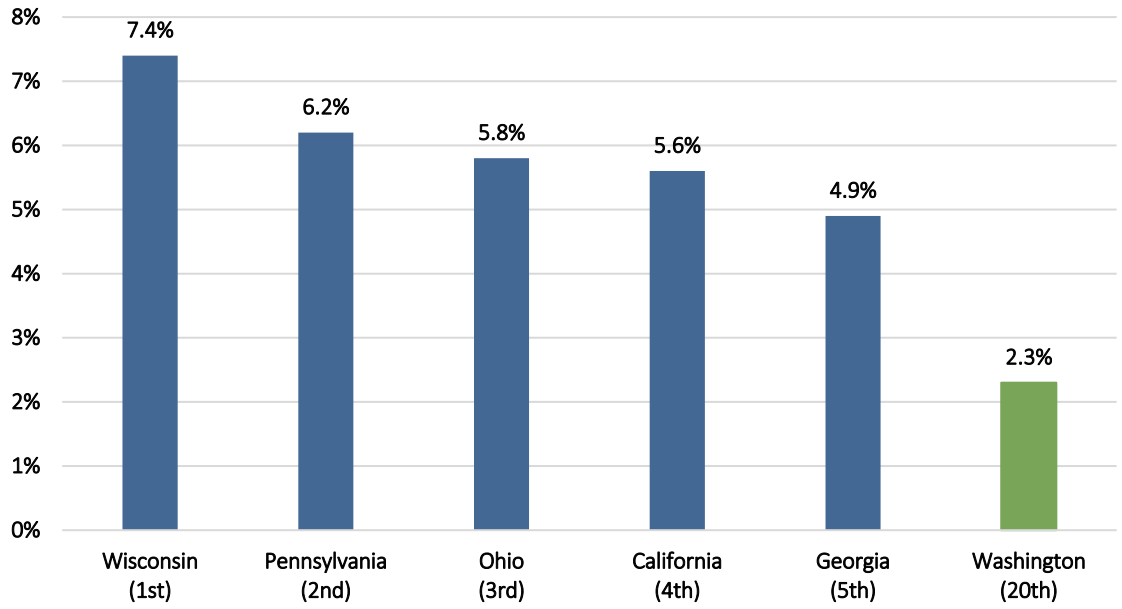

Figure 143. Share of U.S. Paper Industry Employment, Top Five States and Washington 2022 (NAICS 322). Source: U.S. County Business Patterns

Revenue

Figure 144 shows facilities in Washington generated about 2.7 percent of total U.S. revenue in the paper manufacturing industry, ranking 18th compared to all other states. As with employment, the same states comprise the top five, although in a different order. Wisconsin is still the top state based on revenue generation, but Georgia leapfrogs all others in the top five.

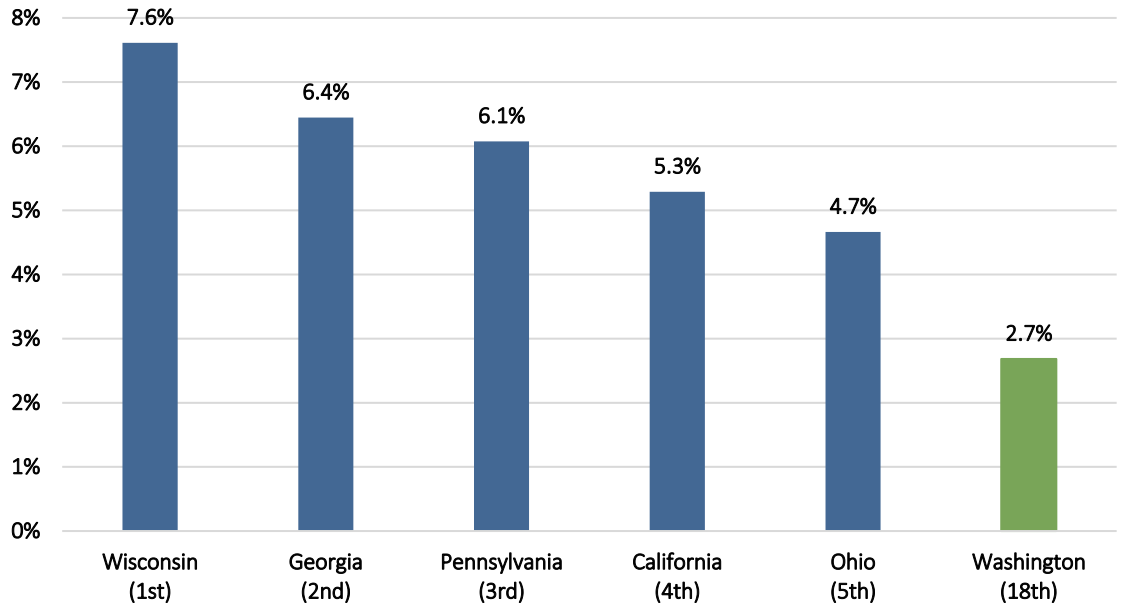

Figure 144. Share of U.S. Paper Industry Revenue, Top Five States and Washington 2021 (NAICS 322). Source: Annual Survey of Manufactures

Supply Chains

Paper manufacturing relies on forestry for wood pulp/chips and recycling plants for recycled paper to produce paper products. At least for wood chips, the industry largely needs to source this locally, as it economically infeasible to source from further distances. The industry also requires various chemicals to produce paper products, including pulping chemicals, bleaching agents, additives, and potentially coating chemicals depending on the specific product. Merchant wholesalers can often provide these input materials. Transportation and logistics companies are vital to moving products to and from manufacturing plants.

Table 73 and Table 74 show the five industries that would be most impacted by a $1 million reduction in output from paper mills and paperboard mills, respectively. These tables also include estimates for the total impact of these $1 million reductions on all industries. Both simulations show that merchant wholesalers would be the most heavily impacted industry.

Table 73. Impact of $1 Million Reduction in Output from Paper Mills, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Other Durable Goods Merchant Wholesalers	($37,495)
Sawmills	($27,885)
Management of Companies and Enterprises	($25,994)
Wholesale – Other Nondurable Goods Merchant Wholesalers	($24,522)
Warehousing and Storage	($21,568)
All Industries	**($495,696)**

Table 74. Impact of $1 Million Reduction in Output from Paperboard Mills, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Other Durable Goods Merchant Wholesalers	($83,035)
Sawmills	($44,883)
Electric Power Transmission and Distribution	($37,074)
Truck Transportation	($22,228)
Local Government Electric Utilities	($21,738)
All Industries	**($632,822)**

Domestic Competition

Market Structure

The paper manufacturing industry in Washington State operates within a somewhat localized market, as it is economically difficult to source woodchips (a primary material for paper production) from far distances. This creates a degree of regional insulation from competition elsewhere in the U.S. However, according to one stakeholder in packaging, they have sourced certain chemical inputs from Asia. Washington's ports and strong export infrastructure provide access to the Asian market in particular. As

a result, while the industry is shaped by local resource availability and regional demand, it remains exposed to global competition and market trends.

Domestic Carbon Pricing

Of the top states by revenue, only California has a carbon price in place (Table 75). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction.

Table 75. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Paper Industry. Sources: Washington State Department of Ecology; California Air Resources Board

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes
California	$25.87	Yes
Wisconsin	N/A	N/A
Georgia	N/A	N/A
Pennsylvania	N/A	N/A
Ohio	N/A	N/A

Washington Exports

Figure 145 shows paper product exports from Washington state from 2002 to 2024. Exports of paper products from Washington have generally increased over the past two decades. Total exports of paper products from Washington in 2024 were roughly $1.1 billion. While pulp and paper products still represent the great majority of exported paper products from Washington state, the value of exported converted paper products from Washington state has increased nearly 120 percent since 2002.

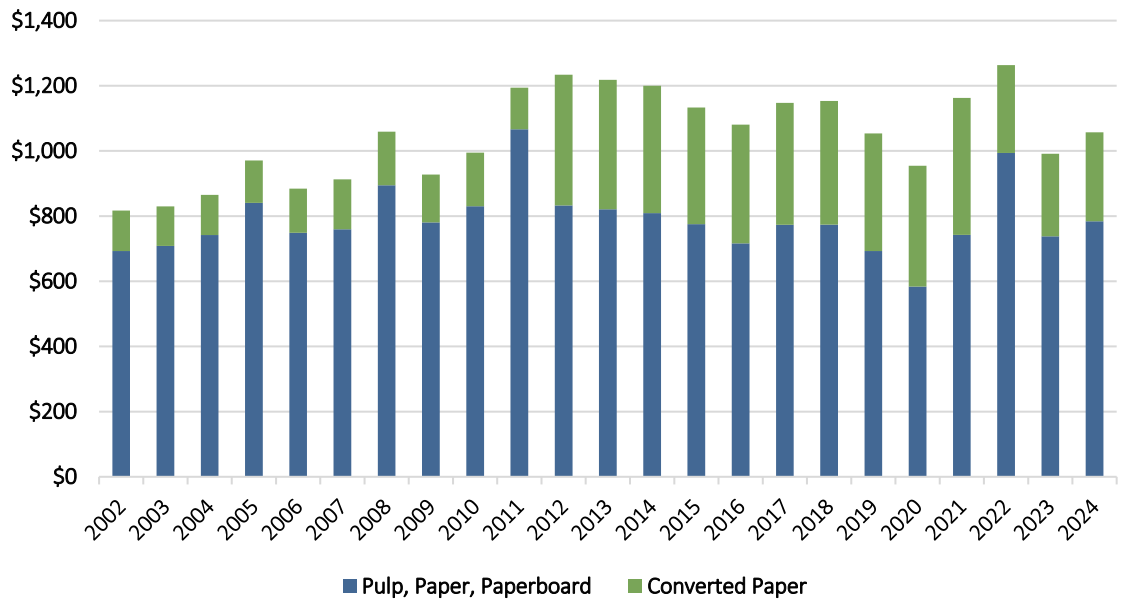

Figure 145. Washington State Paper Product Exports (Millions $) (NAICS 3221 and 3222). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 146 shows data on the value of paper product exports by year from the top five exporting states plus Washington, while Figure 147 shows the percentage of 2024 paper export value from each of these six states. From 2002 to 2024, export value remained relatively stable in most of the top states, although Georgia recognized a significant increase over that timeframe. Over 21 percent of all paper export value comes from the top two exporting states (Georgia and Texas). Washington was the ninth largest exporter of U.S. paper products in 2024, accounting for about 4.2 percent of all export value.

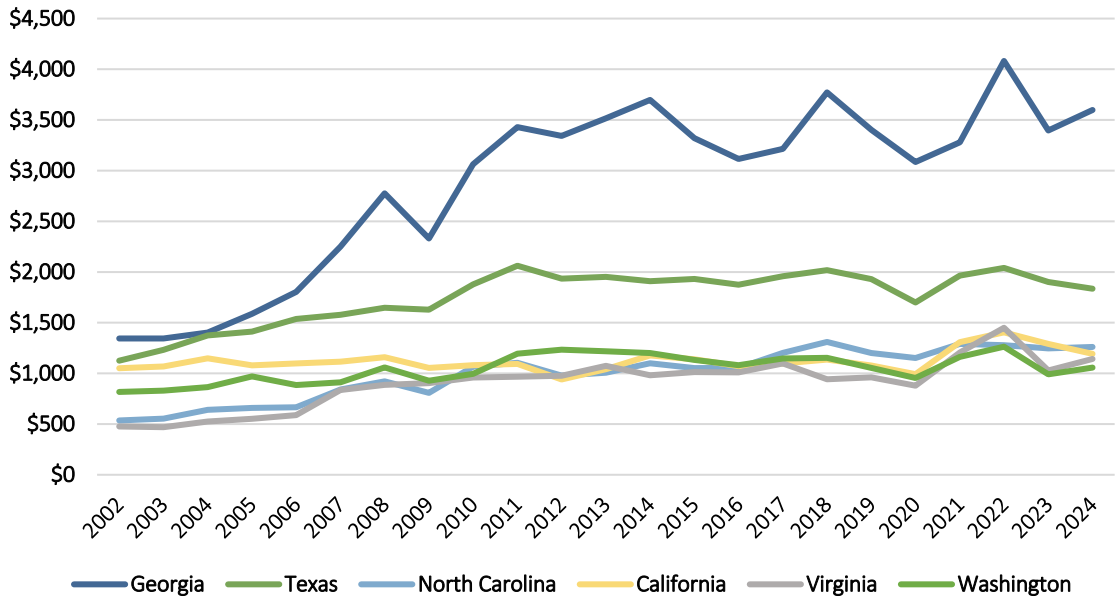

Figure 146. Paper Product Exports, Top Five States and Washington (Millions $) (NAICS 322). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

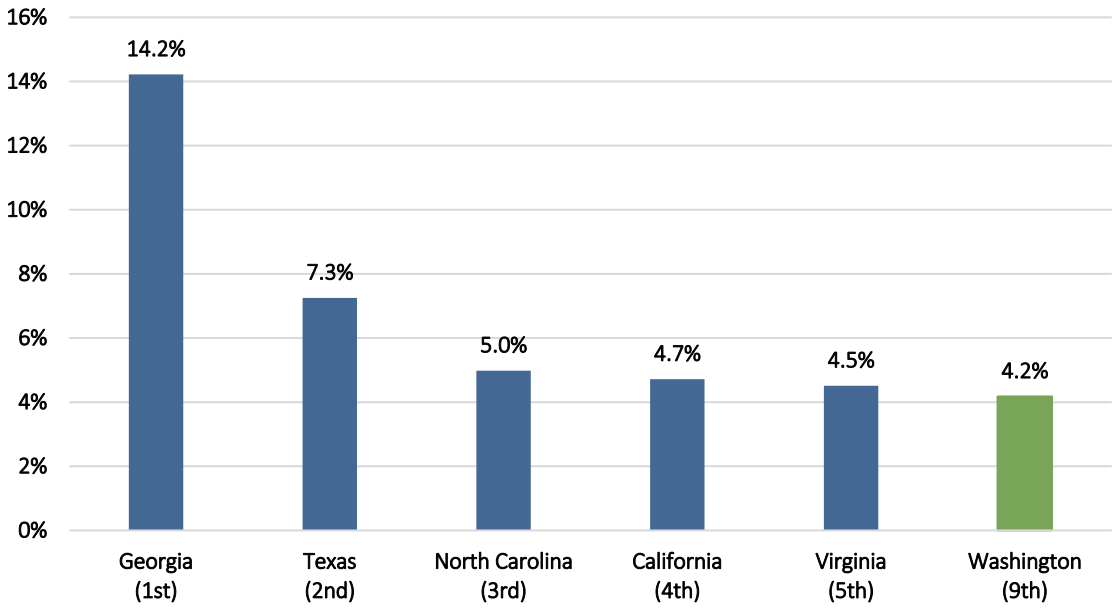

Figure 147. Share of U.S. Paper Product Exports, Top Five Exporters and Washington 2024 (NAICS 322). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 148 and Figure 149 show the share of global exports for wood, pulp, and paper scrap and paper article product, respectively, in 2023 for the six largest exporters. The U.S. represents a close second to Brazil in terms of pulp and paper scrap, with 14.0 percent of all pulp and paper scrap export value totaling $8.57 billion. In terms of paper article products, the U.S. ranks third behind China and Germany, representing just under 8 percent of total global export value.

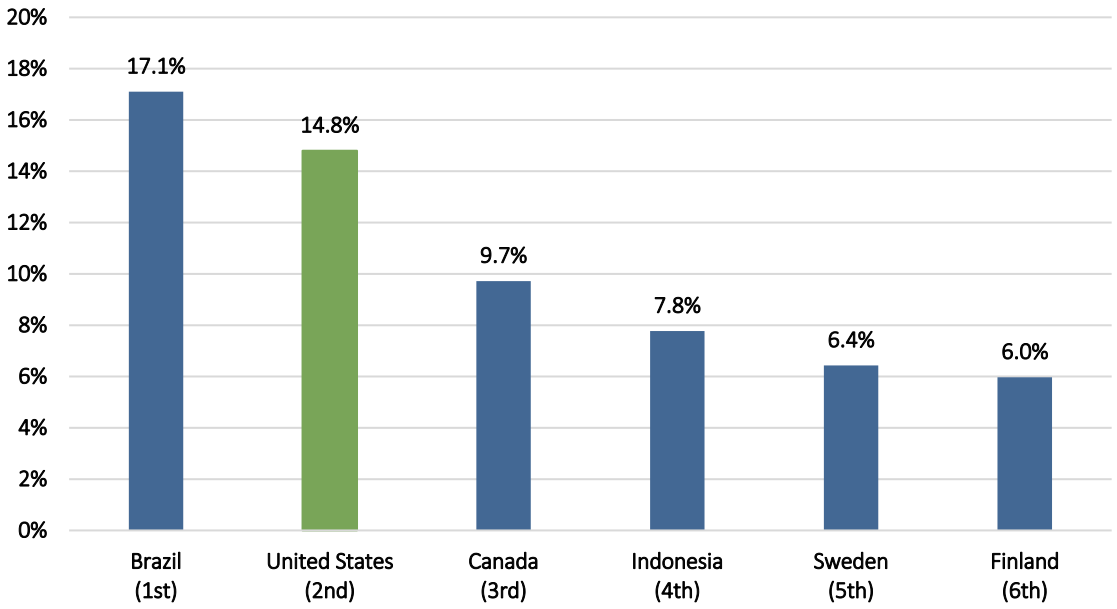

Figure 148. Share of International Wood, Pulp, and Paper Scrap Exports (HS 47), Top Six Exporters 2023. Source: Observatory of Economic Complexity

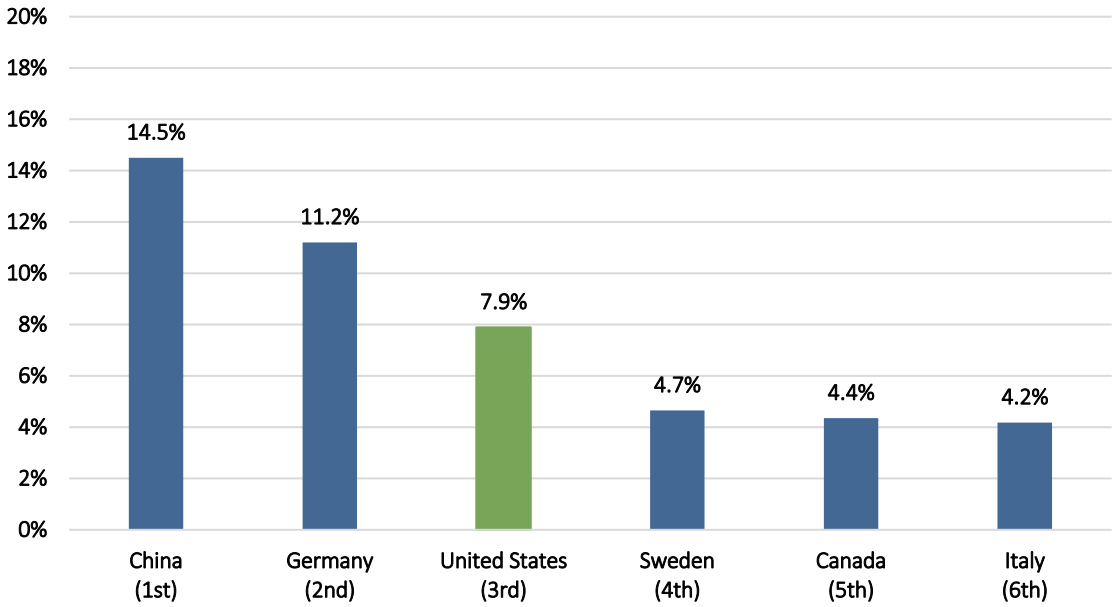

Figure 149. Share of International Paper Article Exports (HS 48), Top Six Exporters 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

Table 76 summarizes carbon pricing for each top paper-exporting country. Most of these countries have carbon pricing policies in place. Sweden has the highest price for carbon emissions at $155.22. Some of these carbon policies do not apply to paper manufacturing; specifically, China and Indonesia have

policies in place that are only applicable to a small subset of industries. Countries with carbon pricing in place also have carbon leakage mitigation policies for their EITEs.

Table 76. International Carbon Pricing for Top Exporters of Paper Products. Sources: World Bank; International Carbon Action Partnership

Country/Region	Paper Product Industry	Price per MTCO2e	EITE Leakage Mitigation Policies
Sweden	Both	1,510 SEK ($155.22)	Only if covered by EU ETS
Finland	Wood, Pulp, and Paper Scrap	93.02 EUR ($104.45)	Yes
European Union	Both	64.74 EUR ($72.70)	Yes
Canada	Both	95.00 CAD ($68.23)	Yes
Germany	Paper Articles	55.00 EUR ($61.76)	Yes
Quebec	Both	$25.87	Yes
China*	Paper Articles	95.96 CNY ($13.32)	Yes
Indonesia**	Wood, Pulp, and Paper Scrap	12,000 IDR ($0.74)	N/A
Italy	Paper Articles	EU ETS only	Yes
United States	Both	N/A	N/A
Brazil	Wood, Pulp, and Paper Scrap	N/A	N/A

* Only applies to electricity, cement, steel, and aluminum sectors

** Only applies to electricity sector

Outlook

Projections

Paper manufacturing is anticipated to decrease in the U.S., largely due to reduced demand in print and newsprint paper products as digitalization continues. Paperboard products pick up some of the slack in general paper product demand with e-commerce growth and the need for cardboard packaging. One study suggests that annual paper production in the U.S. will decrease by roughly 6 percent from 2025 to 2050 under a "business-as-usual" scenario with no changes to carbon pollution policies[cxiv]. A net-zero emissions policy alternative might represent a steeper decline in paper production through 2045, but the study models an uptick in U.S. production thereafter. This shift in forecasted production is due to increased economic incentive for negative emissions from biomass with carbon capture and storage.

Cost Pass Through

Based on IRS tax returns data, profitability within the petroleum refining industry nationwide stands at 14.0 percent as of 2021. The paper manufacturing sector in Washington is moderately exposed to carbon pricing impacts, but its risk of carbon leakage is reduced by the presence of similar carbon policies in neighboring jurisdictions such as California and Oregon. These neighboring states do have carbon prices lower than Washington's price of $58.51 per metric ton of CO_2e though. The Washington-based industry may face increased operating costs, but some of these costs may be partially passed through to customers, especially in the neighboring markets.

Key Takeaways

- Washington is among the top exporting states of paper products in the country, with over $1 billion in goods traveling through Washington state ports.

- While there is no one state that dominates paper manufacturing production, the industry is geographically oriented toward the Midwest.
- While most of the top competing nations have carbon pricing policies in place, most also offer free allowances or other forms of leakage mitigation policies for their EITEs.
- Some modeling suggests that paper production will decrease under "business-as-usual" conditions.

Semiconductors

Industry Overview

Semiconductor manufacturing involves making silicon wafers and then converting them into semiconductors through a series of chemical and physical processes. Examples of semiconductor devices include memory chips, microprocessors, transistors, diodes, and integrated circuits[cxv]. There are about twenty semiconductor and related device manufacturing facilities located in Washington, two of which are classified as EITEs. Both of the facilities are located in Clark County: Analog Devices and TSMC Washington (formerly known as WaferTech). Figure 150 shows the locations of the semiconductor manufacturing EITEs in Washington.

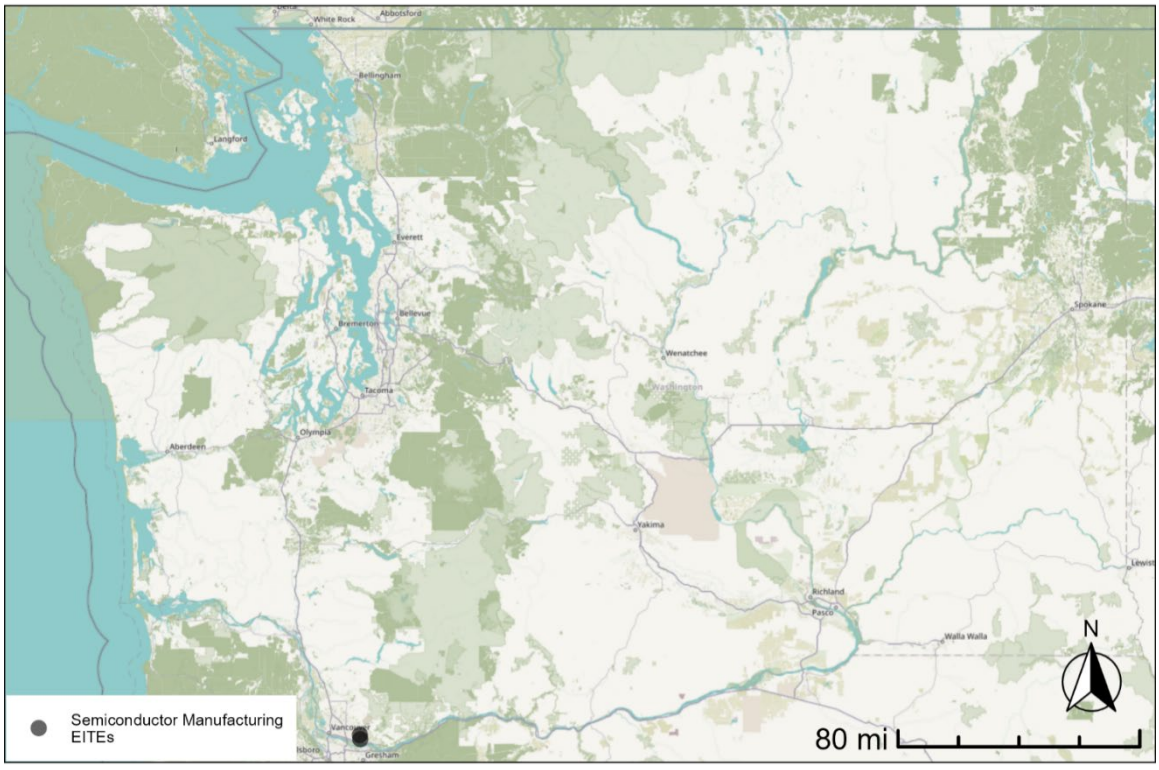

Figure 150. Map of Semiconductor Manufacturing EITEs in Washington

Washington Industry

Gross Domestic Product

Figure 151 shows that Washington's real GDP from computer and electronic product manufacturing has grown dramatically over the past twenty-five years; the roughly $4.4 billion in real GDP in 2023 is almost nineteen times what it was in 1997. The share of Washington's GDP from computer and electronic manufacturing has likewise grown substantially, increasing from 0.08 percent in 1997 to 0.64 percent in 2023 (Figure 152).

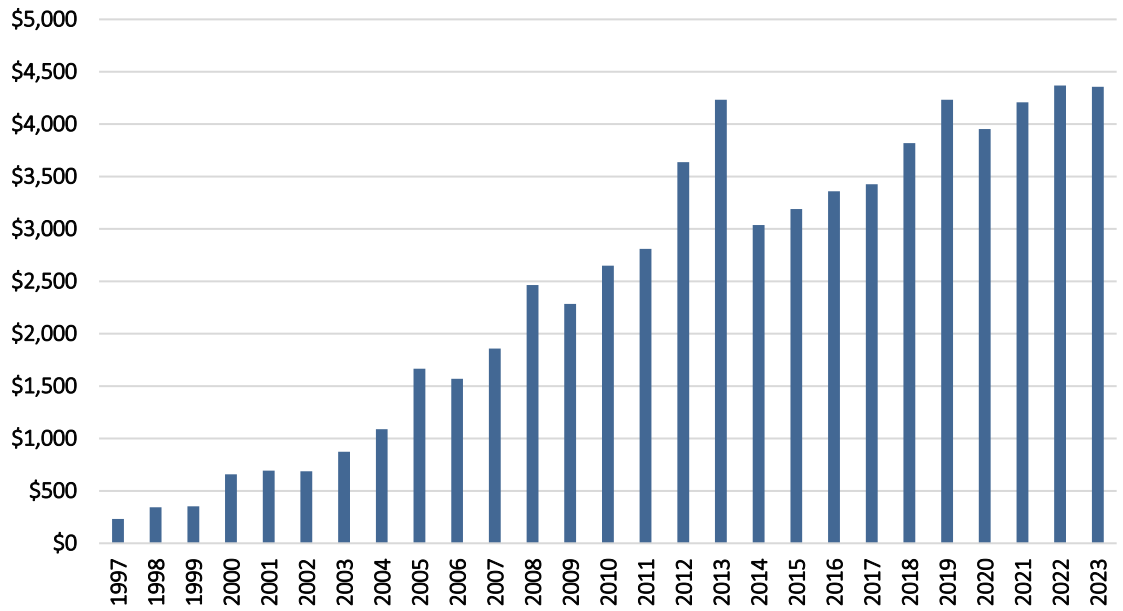

Figure 151. Washington State Computer and Electronic Product Manufacturing Real GDP (Millions 2017 $) (NAICS 334). Source: U.S. Bureau of Economic Analysis

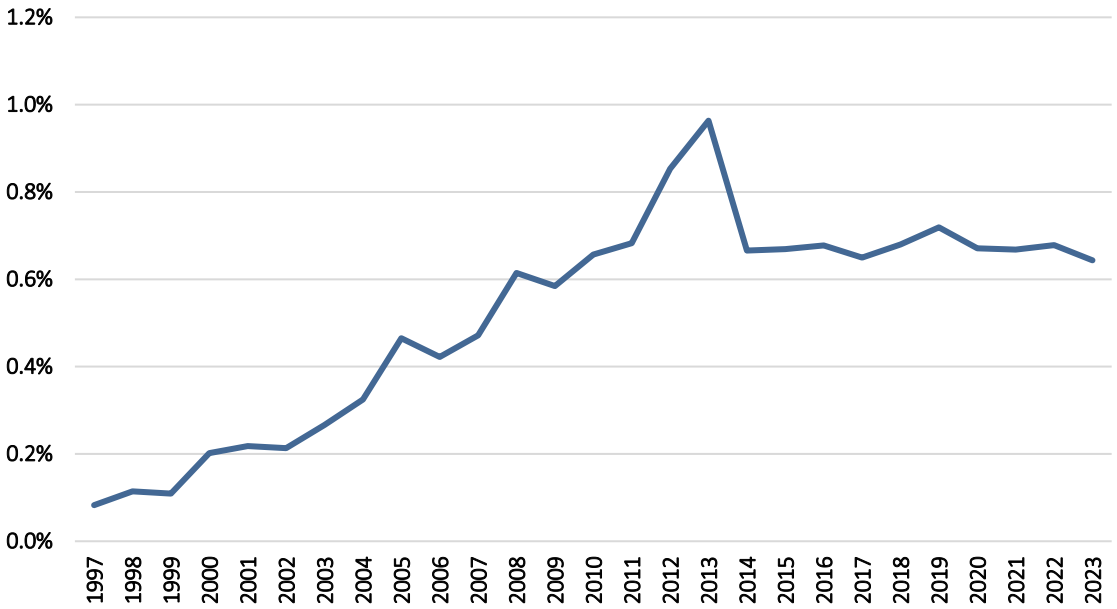

Figure 152. Share of Washington State GDP from Computer and Electronic Product Manufacturing (NAICS 334). Source: U.S. Bureau of Economic Analysis

Employment

As seen in Figure 153, employment in the semiconductor and related device manufacturing industry generally grew from 2013 to 2022, with employment in 2022 totaling around 3,300 workers. Figure 154 shows that Washington ranked ninth in employment in the industry in 2022 compared to other states, employing 3.1 percent of U.S. workers in the industry. The states with the highest share of workers in the industry were Texas, Oregon, California, and Arizona, which combined employed 59.1 percent of U.S. workers in the industry.

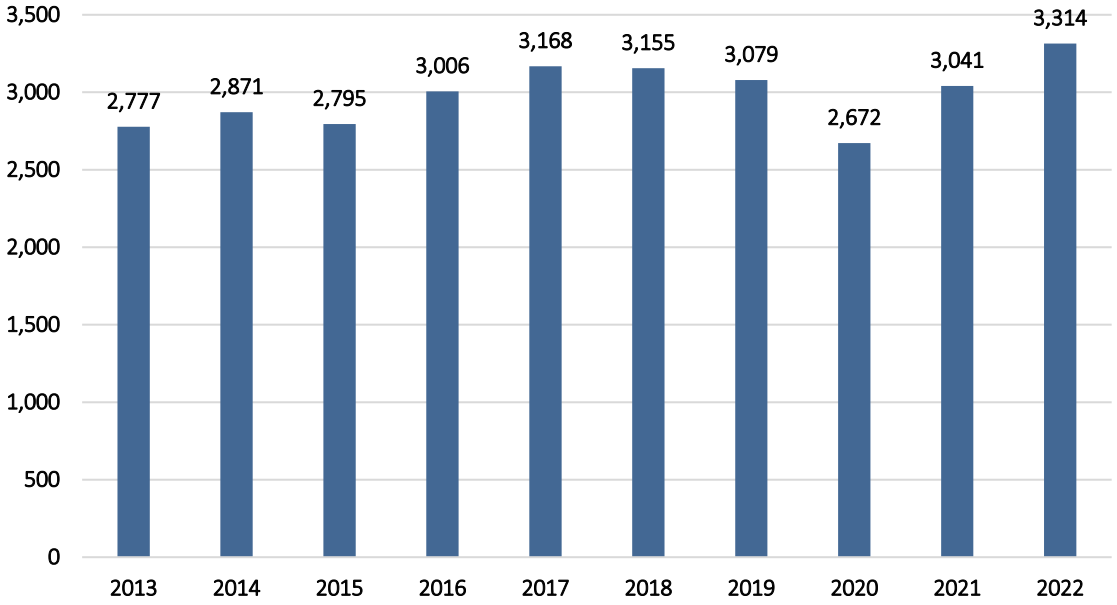

Figure 153. Total Washington State Semiconductor and Related Device Manufacturing Industry Employment (NAICS 334413). Source: U.S. County Business Patterns

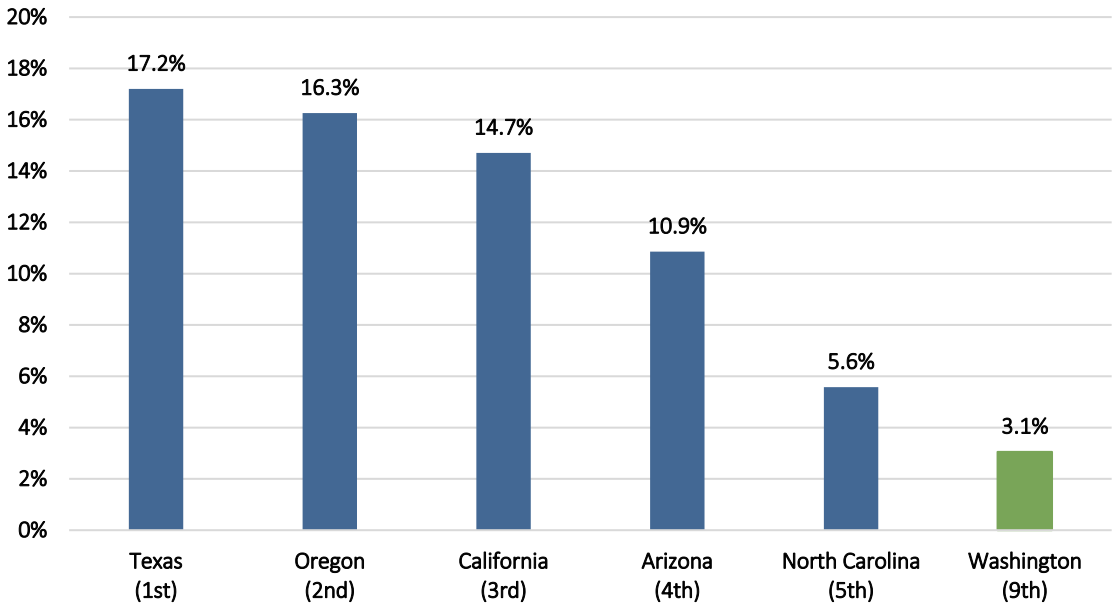

Figure 154. Share of U.S. Semiconductor and Related Device Manufacturing Industry Employment, Top Five States and Washington 2022 (NAICS 334413). Source: U.S. County Business Patterns

Revenue

Washington ranked eleventh in revenue in the semiconductor and other electronic component manufacturing industry in 2021, as shown in Figure 155, with a 2.4 percent share of total U.S. revenue in the industry. Like with employment, the top four states were California, Oregon, Texas, and Arizona, with California leading by a sizeable margin.

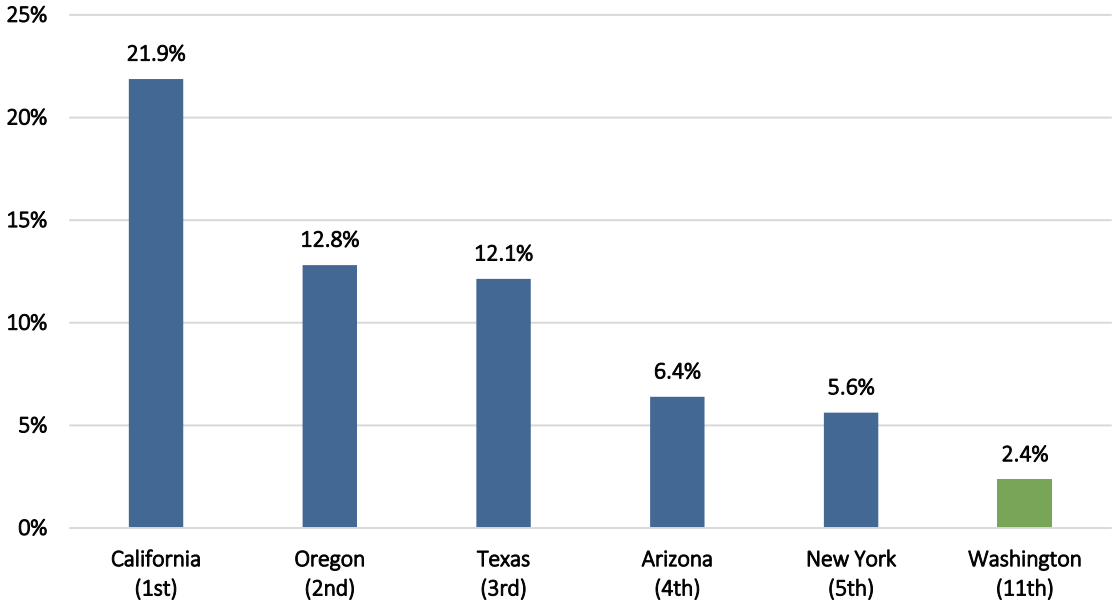

Figure 155. Share of U.S. Semiconductor and Other Electronic Component Manufacturing Industry Revenue, Top Five States and Washington 2021 (NAICS 3344). Source: Annual Survey of Manufactures

Supply Chains

Table 77 shows the five industries that would be most impacted by a $1 million reduction in output in the semiconductor and related device manufacturing industry, as well as the total impact on all industries. The industries that would be most impacted would be the wholesale of electronic and durable goods dependent on semiconductors and related devices, electric utilities, and management of companies and enterprises. The total impact on all industries would be substantial, totaling nearly $320,000.

Table 77. Impact of $1 Million Reduction in Output from Semiconductor and Related Device Manufacturing, Top Five Industries and Total. Source: IMPLAN

Industry	Indirect Impact
Wholesale – Household Appliances and Electrical and Electronic Goods	($47,604)
Management of Companies and Enterprises	($30,525)
Electric Power Transmission and Distribution	($24,592)
Local Government Electric Utilities	($14,746)
Wholesale – Other Durable Goods Merchant Wholesalers	($10,676)
All Industries	($314,252)

Domestic Competition

Market Structure

Industry stakeholders noted that there are not any significant barriers that geographically segment the market, meaning that competition in the industry can come from anywhere across the globe. Analog Devices and TSMC Washington, the two semiconductor manufacturing EITEs in Washington, are both part of global companies. Other major semiconductor manufacturing companies in the U.S., such as Intel and Micron, also operate around the globe. There are different market segments for different types of semiconductor devices, both in terms of function (e.g., memory, microprocessors) and how sophisticated the semiconductor is (i.e., more common sixteen nanometer chips compared to highly advanced five nanometer chips)[cxvi].

Domestic Carbon Pricing

Of the top states by revenue, California and New York have carbon price policies in place (Table 78). The carbon price in California's most recent auction was $25.87 per MTCO2e, which was substantially lower than the $58.51 per MTCO2e in Washington's most recent auction. New York's price of $19.63 per MTCO2e only applies to the electricity sector, so its semiconductor and related device manufacturing industry is only impacted indirectly by any pass through of the carbon price in electricity prices. Oregon is in the process of implementing its carbon pricing policy and is expecting to distribute its first allowances sometime in 2025.

Table 78. Domestic Carbon Pricing for Washington and Top Five States by Revenue, Semiconductor and Related Device Manufacturing Industry. Sources: Washington State Department of Ecology; California Air Resources Board; Regional Greenhouse Gas Initiative

State	Price per MTCO2e	EITE Leakage Mitigation Policies
Washington	$58.51	Yes

California	$25.87	Yes
New York*	$19.63	N/A
Oregon**	N/A	Yes
Texas	N/A	N/A
Arizona	N/A	N/A

* Only applies to the electricity sector

** Oregon intends to distribute the first allowances for its carbon pricing policy sometime in 2025

Washington Exports

Figure 156 shows that exports of semiconductors and other electronic components from Washington have oscillated between roughly $600 million and $900 million a year. In 2024, exports were only about $521 million, the second lowest amount since 2002.

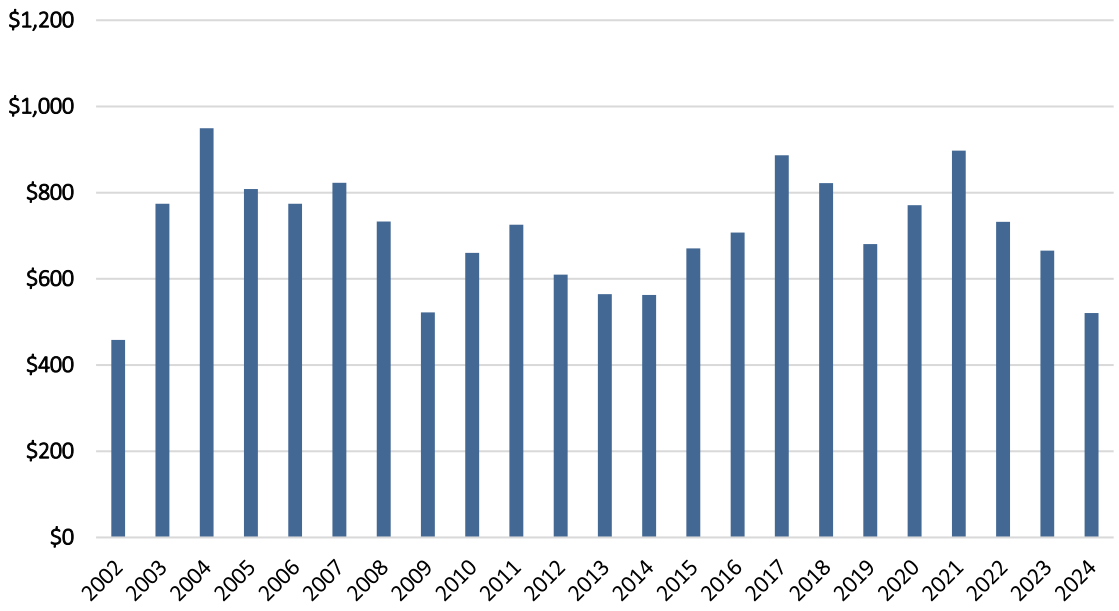

Figure 156. Washington State Semiconductor and Other Electronic Component Exports (Millions $) (NAICS 3344). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

U.S. Exports by State

Figure 157 and Figure 158 show data on the value over time and 2024 share of semiconductor and other electronic component exports from the top five states and Washington. Exports from Texas, Oregon, and New Mexico have increased since 2002, while exports from California, Arizona, and Washington have declined slightly. Texas, Oregon, and California had the largest shares of U.S. semiconductor and other electronic component exports in 2024, each well over ten percent. In contrast, Washington ranked twenty-first in its share, which was only 0.7 percent.

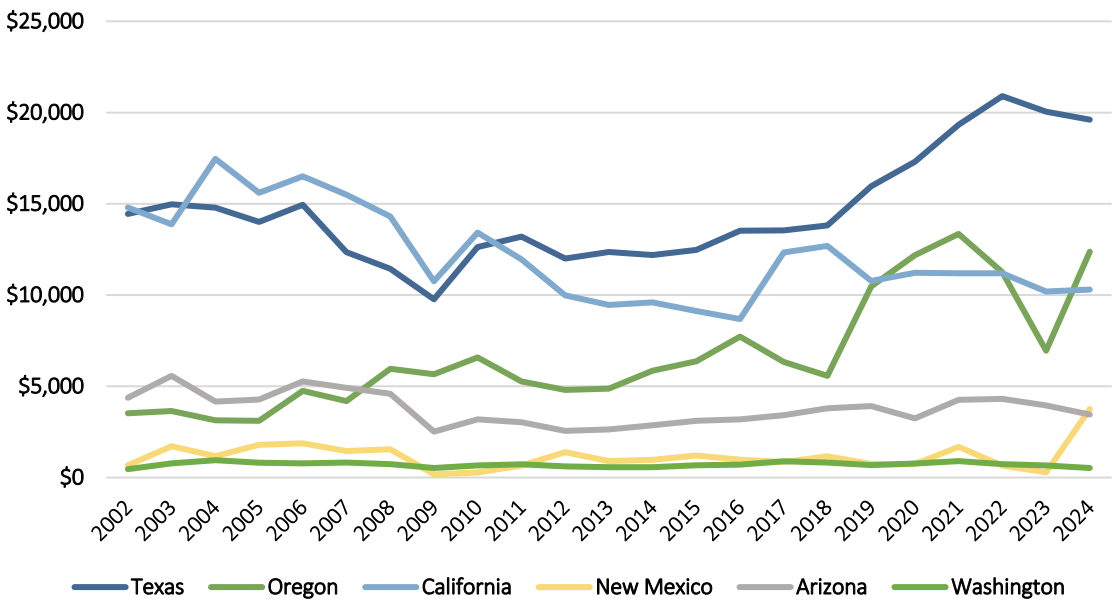

Figure 157. Semiconductor and Other Electronic Component Exports, Top Five States and Washington (Millions $) (NAICS 3344). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

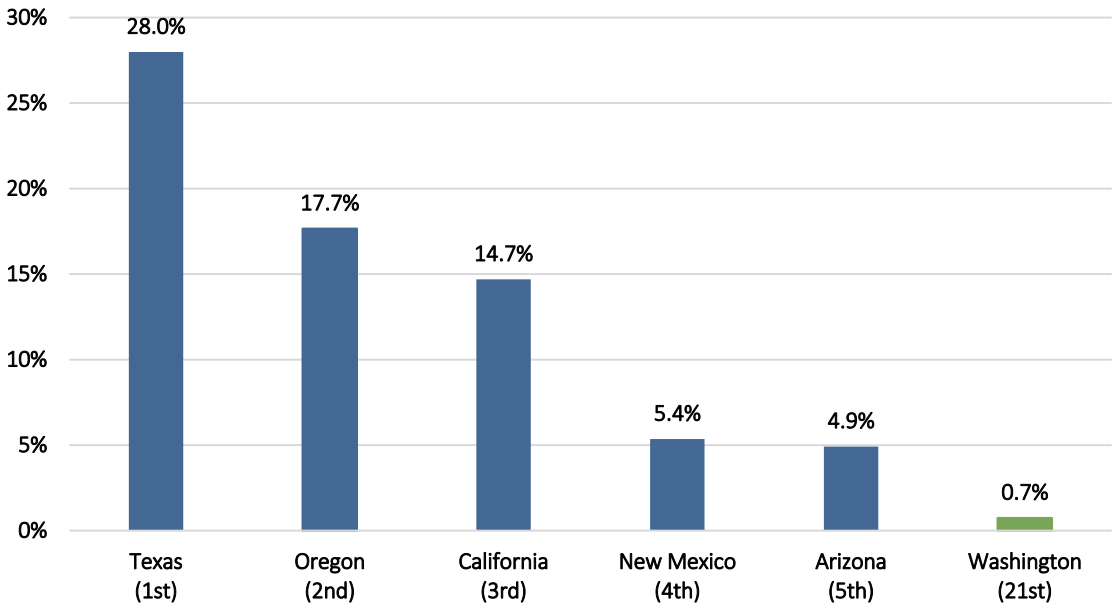

Figure 158. Share of U.S. Semiconductor and Other Electronic Component Exports, Top Five Exporters and Washington 2024 (NAICS 3344). Source: USA Trade Online

Note: Export data can include the dollar value of goods that were not produced in state but were exported from the state.

International Competition

International Exports

Figure 159 shows international exports of semiconductors and integrated circuits in 2023. Exports for the industry in 2023 largely came from East and Southeast Asian countries, particularly Taiwan (20.7 percent) and China (20.3 percent). The U.S. ranked eighth in international exports for the industry, with only 3.8 percent of global exports.

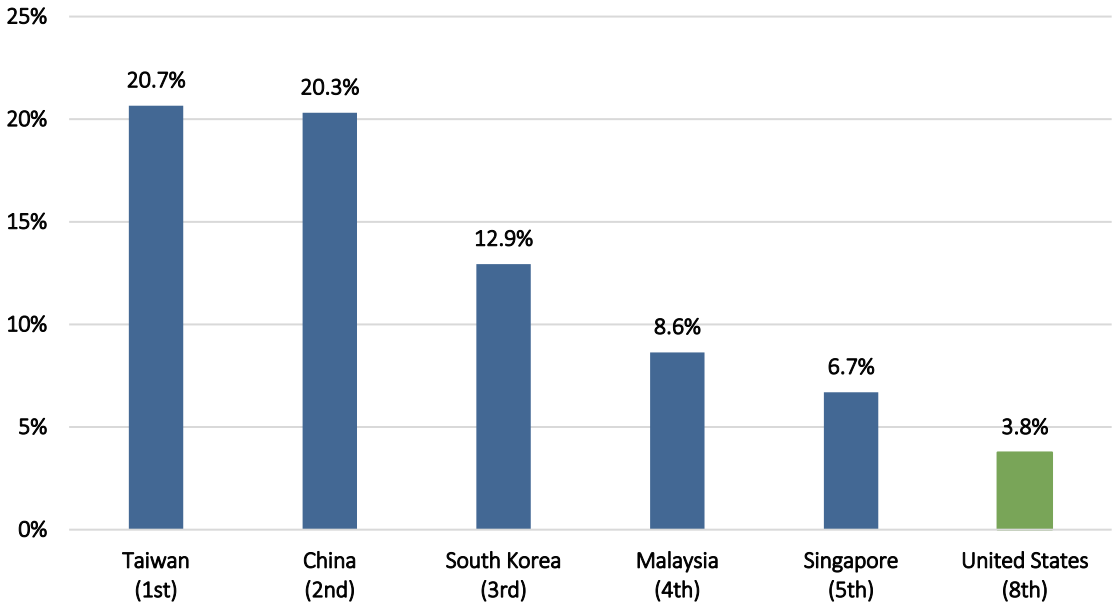

Figure 159. Share of International Semiconductor Device and Integrated Circuit Exports (HS 8541 and 8542), Top Five Exporters and U.S. 2023. Source: Observatory of Economic Complexity

International Carbon Pricing

As seen in Table 79, the top exporters of semiconductors and integrated circuits generally have low carbon prices, well below the $58.51 per MTCO2e in Washington's most recent auction. The countries with carbon pricing policies all have carbon leakage mitigation policies for their EITEs. China's carbon price only indirectly impacts its semiconductor manufacturers through electricity prices, and Malaysia has no carbon pricing policy at all.

Table 79. International Carbon Pricing for Top Exporters of Semiconductor Devices and Integrated Circuits. Sources: World Bank; International Carbon Action Partnership

Country/Region	Price per MTCO2e	EITE Leakage Mitigation Policies
Singapore	25.00 SGD ($19.20)	Yes
China*	95.96 CNY ($13.32)	Yes
South Korea	10,355 SKW ($7.37)	Yes
Taiwan	50 to 300 TWD ($1.65 to $9.88)	Yes
United States	**N/A**	**N/A**
Malaysia	N/A	N/A

* Only applies to the electricity, cement, steel, and aluminum sectors

Outlook

Projections

The semiconductor manufacturing industry is expected to grow dramatically over the next several years. A 2024 report from PwC forecasted that global revenue for the semiconductor industry could reach $1 trillion in 2030, driven by increased demand from the artificial intelligence and automotive sectors, as well as a push for regional supply chain self-sufficiency[cxvii]. This would be a 66.7 percent increase from the industry's 2024 revenue of about $600 billion. In the U.S., semiconductor manufacturing capacity in 2032 could potentially be triple what it was in 2022 due to increased demand and policy incentives such as the CHIPS and Science Act[cxviii]. In Washington specifically, Analog Devices recently signed a preliminary agreement to receive $105 million in funding from the CHIPS and Science Act, a portion of which would be used to expand the company's Camas plant[cxix]. Additionally, Washington recently created a working group focused on bringing funding from the CHIPS and Science Act into the state[cxx].

Cost Pass Through

Based on IRS tax returns data, profitability within the semiconductor and related device manufacturing industry nationwide stands at 30.9 percent as of 2021. The high profit margins suggest that the semiconductor manufacturing EITEs may be able to absorb some of the cost from carbon pricing. However, the globalized nature and high expected growth for the industry means that there is a substantial amount of competition, which would likely limit the ability of the semiconductor manufacturing EITEs to pass on costs from carbon pricing to consumers. The expected increase in U.S. semiconductor manufacturing capacity could also increase the risk of production being shifted to other states.

Industry stakeholders also voiced concerns about their ability to decarbonize. They noted that the use of fluorinated greenhouse gases, which are a substantial source of carbon emissions from the industry, is critical to the semiconductor manufacturing process. While there are ways that the industry can improve its efficiency and reduce the use of fluorinated greenhouse gases[cxxi], they currently cannot be completely eliminated.

Key Takeaways

- Washington's computer and electronic component industry has grown nearly nineteen-fold over the past twenty-five years. Nationally, its industry ranks around tenth in terms of employment and revenue.
- Texas, California, Oregon, and Arizona are the top states for the semiconductor and electronic components industry.
- Competitors either have low or no carbon prices, and those that have carbon prices offer free allowances or other forms of leakage mitigation policies for their EITEs.
- The industry is expected to grow dramatically in the U.S. over the next decade, spurred by high demand and funding from the CHIPS and Science Act.
- High profit margins in the industry could allow Washington's semiconductor manufacturing EITEs to absorb some of the cost of carbon pricing, but global competition and increasing production capacity in the U.S. raise the risk of carbon leakage.

Appendix A. Total Reported Greenhouse Gas Emissions (MTCO2e) by EITE Facility

Table A 1 presents total reported greenhouse gas emissions by EITE facility.

Table A 1. Total Reported Greenhouse Gas Emissions (MTCO2e) by EITE Facility[43]

EITE	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	63356	58995	64110	64385	60218	63454	68968	66107	61784	68887	65848	72277
Analog Devices, Inc. - Camas	23649	29137	30091	34239	39279	22525	12180	15185	13822	15173	18989	18421
Ash Grove Cement Company - Seattle	305595	355314	523850	484815	381581	355399	362741	366202	346185	359054	315155	367651
Basic American Foods - Moses Lake	28205	28312	28982	31063	28977	30576	25458	30698	33001	32323	32927	24544
Boeing Commercial Airplanes - Everett	71463	73643	73522	66276	76191	80529	72308	77572	67553	67480	69711	66124
bp Cherry Point Refinery - Blaine	1757798	2206320	2078478	1995759	2130007	2060243	1987668	2190530	2013167	2066338	2123672	2188015
Cardinal FG Company - Winlock	92356	102904	102813	105009	107246	107559	106984	93946	103025	105912	106396	107118
CertainTeed Gypsum - Seattle	35650	35465	36299	41654	47948	50452	51104	49333	49936	55216	52402	55645
Darigold - Sunnyside	22078	19266	18329	21372	31480	37986	38345	42702	40732	38759	36877	36711
Georgia-Pacific Consumer Operations LLC - Camas	720455	675348	629619	640546	583163	559482	242007	95534	67807	51241	49553	53794
Georgia-Pacific Gypsum LLC - Tacoma	42750	45053	45663	46906	48825	46857	49065	49200	38732	39502	49915	49843
Goodrich	35476	34440	41089	42844	45107	44750	43776	52018	26209	29872	42395	42340
HF Sinclair Puget Sound Refinery LLC - Anacortes	2105161	2007178	1808404	1946822	1980495	1897818	1989609	1859842	1803411	1837958	1907858	1900999
J.R. Simplot Company - Moses Lake	45202	36308	35923	34886	34811	39793	35266	34481	33788	32411	33007	30430
J.R. Simplot Company - Othello	93771	87106	87301	87686	93712	95215	99691	92473	110848	114828	112190	107817
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	108364	110966	114924	117856	122424	126365	130646	128390	106233	110563	124441	124834
Lamb Weston - Pasco	48326	49844	47241	48162	42188	50961	43648	46270	38996	40297	39066	35750
Lamb Weston - Quincy	39693	39846	38324	37922	40468	34928	32073	36584	32198	35504	35378	29971

[43] Extracted from the Washington Greenhouse Gas Reporting Program available at: https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Publication/idhm-59de.

EITE	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lamb Weston - Richland	34603	34225	34551	36252	35966	50397	84314	100713	86387	84268	92506	84081
LANXESS	61809	65708	68453	69314	70983	67725	65866	65484	64561	67316	65308	60120
Marathon Anacortes Refinery - Anacortes	1311523	1177419	1344336	1288787	1359988	1359656	1234174	1421372	1208552	1296106	1370882	1202267
Matheson - Anacortes		41885	53751	59381	55071	35843	61179	41845	47503	57526	43715	53407
McCain Foods - Othello	107911	89215	95228	77566	67668	63045	61901	63938	56865	67901	81049	68869
Nippon Dynawave - Longview	1637372	1509835	1544182	1466046	1563256	1532282	1663075	1609229	1532644	1721330	1609289	1574261
North Pacific Paper Company, LLC - Longview	43924	43125	39975	36771	37298	34365	37345	38216	39097	44358	42740	36395
Nucor Steel Seattle, Inc, - Seattle	124468	128708	166109	87036	84518	89466	98865	85248	83972	97512	84680	82396
Nutrien US LLC. - Kennewick	146926	154497	132071	155667	151151	144080	119791	145245	144928	186638	142911	13400
Owens-Brockway Glass Container Inc Plant #2 - Kalama	10090	19199	22136	22288	23284	23955	24090	22844	22983	26528	24952	21704
Packaging Corporation of America - Wallula	928399	832636	889452	853674	814165	708497	652556	870818	853083	801746	586148	318762
Phillips 66 Ferndale Refinery - Ferndale	803370	773758	770956	749019	767579	748762	798454	835061	801159	832384	718028	902436
Port Townsend Paper Corporation - Port Townsend	614401	555704	562963	572564	490011	602488	571050	583291	587700	521622	512753	553804
Solvay Chemicals, Inc. - Longview	48881	49256	49626	49098	47667	46989	55496	56448	44916	58272	62123	50068
Steelscape - Kalama	23199	23551	22435	23274	25336	25217	24156	22577	21774	22183	18422	18633
The Boeing Company - Auburn Site - Auburn	38932	38558	36691	36058	36033	38096	37028	36795	34964	34746	34665	33303
Tyson Fresh Meats, Inc. - Wallula	52155	65322	77161	74580	88889	113369	98817	132186	129863	106862	94596	100445
U.S. Oil & Refining Co. - Tacoma	169581	175417	179363	139259	146049	142341	139445	155836	163311	134326	130279	148012
WaferTech LLC - Camas	182166	177591	178962	165975	147211	107172	96815	88223	104942	103949	98160	73391
Washington Potato Company - Warden	31804	31968	29997	31553	30289	29844	29914	29176	32015	11509	25915	31872
WestRock LLC - Longview	1672199	1729898	1774975	1708008	1661899	1646438	1551719	1555080	1541833	1475085	1408874	1311764

Appendix B. CAP and HAP Emissions by EITE Facility

Table A. 2 through Table A. 8 present EITE facility emissions for each of the CAPs from 2012 to 2023.[44] Table A. 9 presents total combustion related HAP emissions by EITE facility from 2012 to 2022. Blank cells represent years where no data was provided. Values are rounded to the nearest hundredth. Unless otherwise indicated, values of 0.00 represent years were 0 tons were reported.

Table A. 2 CO Emissions by EITE Facility (tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	15.80	6.19	6.66	0.33	0.42	0.08	1.32	0.24	0.50	0.65	0.30	0.64
Analog Devices, Inc. - Camas										0.24		
Ash Grove Cement Company - Seattle	832.27	731.35	1149.35	963.70	951.59	969.12	1076.17	958.53	906.80	927.31	738.14	813.88
Basic American Foods - Moses Lake											24.30	
Boeing Commercial Airplanes - Everett	51.63	53.73	46.14	26.54	45.42	48.78	46.64	47.27	45.94	41.95	43.04	41.68
bp Cherry Point Refinery - Blaine	974.00	691.00	472.00	493.92	427.00	425.00	289.15	336.30	456.68	483.06	431.51	457.87
Cardinal FG Company - Winlock	524.32	246.51	323.67	311.30	172.01	137.12	248.81	212.31	228.21	154.72	320.82	316.43
CertainTeed Gypsum - Seattle										30.77		
Georgia-Pacific Consumer Operations LLC - Camas	526.00	485.00	470.00	480.00	492.00	496.00	393.00	221.00	171.78	135.05	141.31	148.90
Georgia-Pacific Gypsum LLC - Tacoma	88.94	95.49	92.70	90.36	93.40	97.13	96.28	91.53	24.68	23.61	25.99	23.95
Goodrich Corporation - Spokane										16.10		
HF Sinclair Puget Sound Refinery LLC - Anacortes	485.31	559.51	633.27	510.07	545.55	500.75	549.89	571.15	543.89	584.16	603.52	561.83
J.R. Simplot Company - Moses Lake											33.61	
J.R. Simplot Company - Othello											1.35	
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	97.33	99.39	97.36	109.59	116.86	122.53	116.85	115.93	94.98	100.14	114.67	113.38
Lamb Weston - Pasco											19.76	
Lamb Weston - Quincy											24.00	
Lamb Weston - Richland												24.10

[44] EPA 2024. 2022v1 Emissions Modeling Platform. Data files accessed January 2025. Internet Address: https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
LANXESS Corporation - Kalama	48.73	28.50	28.34	26.04	29.95	19.32	39.81	35.33	34.66	38.64	38.64	43.64
Marathon Anacortes Refinery - Anacortes	598.17	638.17	487.17	440.97	487.55	474.76	451.97	445.87	358.88	473.43	463.77	416.50
Matheson - Anacortes		17.21	15.95	1.39	1.35	1.31	1.61	5.19	1.36	1.40	1.39	1.72
McCain Foods - Othello											41.21	
Nippon Dynawave - Longview	1378.00	1105.20	2817.50	2745.26	2557.68	2308.92	1573.76	1701.14	1509.65	1567.94	1498.66	1605.78
North Pacific Paper Company, LLC - Longview						192.54	198.16	165.90	145.36	133.40	273.78	210.78
Nucor Steel Seattle, Inc, - Seattle	709.11	256.79	435.75	404.14	372.35	346.85	297.91	314.60	526.63	324.73	271.50	566.17
Nutrien US LLC. - Kennewick	8.90	1.10	0.66	1.70	2.16	1.50	1.96	1.50	0.90	1.10	1.70	2.40
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.08	0.08	1.81	1.83	2.13	2.22	2.25	3.44	1.81	4.23	2.26	1.80
Packaging Corporation of America - Wallula	690.00	1007.87	1261.86	819.63	477.46	428.16	459.87	630.20	452.40	539.42	630.80	190.60
Phillips 66 Ferndale Refinery - Ferndale	237.00	220.00	183.00	176.00	177.00	181.00	154.00	167.00	140.00	160.00	140.00	161.98
Port Townsend Paper Corporation - Port Townsend	784.00	821.00	848.00	622.00	756.00	722.30	595.40	796.50	672.60	595.70	625.80	719.50
Solvay Chemicals, Inc. - Longview										20.50		
Steelscape - Kalama										1.12		
The Boeing Company - Auburn Site	29.84	29.56	28.55	27.20	28.24	29.66	28.62	28.72	26.18	26.99	26.87	25.65
Tyson Fresh Meats, Inc. - Wallula											24.62	
U.S. Oil & Refining Co. - Tacoma	70.09	76.60	110.70	73.23	55.63	56.23	55.29	69.89	70.80	88.58	82.40	86.08
WaferTech LLC - Camas										1.60		
Washington Potato Company - Warden											19.28	
WestRock LLC - Longview	1095.00	2027.31	1110.97	17.86	616.07	470.69	454.85	712.49	662.59	485.71	443.41	389.44
Total EITE CO Emissions	**9244.51**	**9197.56**	**10621.3**	**8343.08**	**8407.83**	**8031.96**	**7133.56**	**7632.02**	**7077.28**	**6962.24**	**7108.41**	**6924.68**

Table A. 3 NH3 Emissions by EITE facility (tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Analog Devices, Inc. - Camas										1.24		
Ash Grove Cement Company - Seattle	0.00	0.00	0.00	0.00	4.51	4.91	12.74	1.74	4.72	3.46	3.88	3.74
Boeing Commercial Airplanes - Everett	1.90	1.93	1.91	1.68	1.81	1.85	1.66	1.65	1.61	1.44	1.47	1.43
bp Cherry Point Refinery - Blaine	2.10	4.10	7.11	4.64	6.11	5.12	0.10	0.13	0.44	0.49	6.26	6.71
Cardinal FG Company - Winlock												0.00
Georgia-Pacific Consumer Operations LLC - Camas	16.75	0.00	14.75	15.75	13.75	12.22	4.22	0.10	0.05	0.05	0.04	0.04
Goodrich Corporation - Spokane						0.05	0.05	0.06	0.27	0.27	0.27	
HF Sinclair Puget Sound Refinery LLC - Anacortes	0.00	4.55	4.18	2.10	1.29	2.48	4.29	4.58	6.66	1.50	2.16	0.91
J.R. Simplot Company - Moses Lake							4.21	8.76	12.19	8.72	9.12	
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	0.87	0.96	0.77	0.80	0.92	0.89	0.92	0.82	0.71	0.81	0.86	0.90
Lamb Weston - Pasco	1.06	0.00	2.30	2.51	2.41	0.00	0.00	2.46		2.90	3.93	
Lamb Weston - Quincy	2.68	0.00	4.51	2.55	0.00*	0.00*	3.15	2.77	0.84	0.84	0.84	
Lamb Weston - Richland												1.09
LANXESS Corporation - Kalama	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00
Marathon Anacortes Refinery - Anacortes	0.00	12.00	13.00	13.00	24.69	2.63	2.20	2.86	2.04	2.50	2.68	2.45
Matheson - Anacortes		1.19	1.44	1.55	1.50	1.31	1.51	1.41	1.50	1.49	1.38	1.47
Nippon Dynawave - Longview	81.00	78.40	70.00	68.40	71.20	69.80	78.40	51.50	47.10	54.10	48.70	45.20
North Pacific Paper Company, LLC - Longview						0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nutrien US LLC. - Kennewick	35.88	31.53	31.40	27.73	25.51	35.12	30.50	33.45	35.68	37.87	37.96	33.17
Packaging Corporation of America - Wallula	44.00	37.00	37.40	34.90	27.70	22.20	22.10	34.76	38.59	36.21	24.21	9.90
Phillips 66 Ferndale Refinery - Ferndale	6.00	4.00	3.00	4.00	4.00	4.00	5.00	9.00	4.00	4.00	5.00	5.90
Port Townsend Paper Corporation - Port Townsend	37.00	36.00	39.00	36.00	38.00	38.00	27.10	21.50	24.90	20.70	17.90	22.90
Solvay Chemicals, Inc. - Longview										0.28		
The Boeing Company - Auburn Site	0.17	0.00	0.00	0.16	0.16	0.18	0.01	*0.00**	0.00	0.00	0.00	0.00
Tyson Fresh Meats, Inc. - Wallula	20.87	0.00	8.82	6.23	6.38	14.26	5.67	3.30	5.71	5.68	8.31	

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
U.S. Oil & Refining Co. - Tacoma	42.85	40.12	43.30	38.85	48.92	48.33	46.19	44.07	38.30	23.12	23.06	22.38
WaferTech LLC - Camas	0.87	0.00	1.94	1.01	0.97	1.33	1.31	1.09	1.59	1.56	1.28	
WestRock LLC - Longview	48.00	48.00	75.25	55.78	68.32	69.71	81.27	74.33	76.07	77.05	68.56	63.22
NH3 EITE Total	**342.01**	**299.78**	**360.07**	**317.64**	**348.15**	**334.38**	**332.60**	**300.35**	**302.96**	**286.28**	**268.27**	**221.40**

**Indicates values less than 0.005 tons. All other zeroes are true zeros. Blanks represent years with no emission data.*

Table A. 4 NOX Emissions by EITE facility (tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	24.20	9.48	10.16	14.62	12.60	10.48	13.28	10.11	11.12	10.75	9.70	11.00
Analog Devices, Inc. – Camas										0.60		
Ash Grove Cement Company – Seattle	665.05	996.62	1143.99	1457.84	1343.15	1367.89	1158.99	1066.03	1120.79	1068.03	805.66	783.48
Basic American Foods – Moses Lake											11.80	
Boeing Commercial Airplanes – Everett	66.07	76.59	62.23	30.88	77.18	82.79	79.92	81.28	74.38	71.76	73.85	72.76
bp Cherry Point Refinery – Blaine	1876.00	1959.00	1893.00	1865.29	1905.00	1930.00	1819.92	1916.26	1704.00	1843.98	1928.83	1879.16
Cardinal FG Company – Winlock	657.44	774.22	791.48	807.24	807.64	809.14	809.35	694.04	768.94	797.13	804.22	798.79
CertainTeed Gypsum – Seattle										59.31		
Georgia-Pacific Consumer Operations LLC – Camas	489.00	464.00	463.00	453.00	452.00	486.00	235.00	49.00	35.10	21.12	8.85	8.77
Georgia-Pacific Gypsum LLC – Tacoma	32.80	35.54	35.84	35.57	36.51	42.16	43.43	37.35	35.76	36.84	46.66	46.78
Goodrich Corporation – Spokane										14.30		
HF Sinclair Puget Sound Refinery LLC – Anacortes	1100.59	1408.70	1229.65	1075.62	1109.00	1053.68	1146.08	1164.58	1296.47	1324.93	1316.46	1317.44
J.R. Simplot Company – Moses Lake											26.37	
J.R. Simplot Company – Othello											23.44	
Kaiser Aluminum Washington, LLC (Trentwood Works) – Spokane Valley	101.22	103.90	101.29	111.15	115.27	118.51	122.27	119.89	99.73	103.36	117.00	117.41
Lamb Weston – Pasco											23.69	
Lamb Weston – Quincy											32.07	
Lamb Weston – Richland												28.70
LANXESS Corporation – Kalama	84.75	83.63	81.44	90.30	83.82	83.68	72.89	61.87	63.68	70.03	70.03	51.93

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Marathon Anacortes Refinery – Anacortes	1882.01	1731.01	1918.01	1825.51	2019.75	1970.78	1877.81	2097.91	1586.90	1719.80	1873.17	1449.85
Matheson – Anacortes		9.60	10.67	9.53	8.67	5.60	9.51	7.40	8.39	10.04	7.52	9.40
McCain Foods – Othello											44.92	
Nippon Dynawave – Longview	2137.00	2048.00	2086.31	2023.60	1969.03	1949.43	2276.13	2270.78	2255.74	2282.77	2069.05	2161.04
North Pacific Paper Company, LLC – Longview						3.80	4.14	4.37	4.61	5.18	4.62	4.36
Nucor Steel Seattle, Inc, - Seattle	192.13	206.59	168.73	161.37	149.00	160.80	167.03	160.20	148.33	181.66	173.56	222.34
Nutrien US LLC. – Kennewick	49.20	46.20	47.79	49.15	51.09	47.01	48.19	45.73	44.52	39.62	39.52	37.52
Owens-Brockway Glass Container Inc Plant #2 – Kalama	0.12	0.12	26.08	4.17	5.98	13.28	7.27	4.94	5.72	10.31	21.29	38.05
Packaging Corporation of America – Wallula	861.00	629.12	742.07	676.36	681.22	637.27	600.10	791.80	884.80	875.91	675.00	282.30
Phillips 66 Ferndale Refinery – Ferndale	788.00	784.00	723.00	726.00	769.00	674.00	691.00	711.00	601.00	703.00	581.00	681.02
Port Townsend Paper Corporation – Port Townsend	493.00	482.00	494.00	488.00	489.00	475.00	490.00	499.00	555.00	532.00	449.00	456.00
Solvay Chemicals, Inc. – Longview										10.61		
Steelscape – Kalama										28.29		
The Boeing Company – Auburn Site	78.46	68.89	66.65	67.28	69.26	77.07	77.31	64.26	69.01	85.02	74.91	52.91
Tyson Fresh Meats, Inc. – Wallula											23.87	
U.S. Oil & Refining Co. – Tacoma	127.31	134.89	132.85	119.96	63.18	115.42	116.22	142.06	139.27	158.13	154.18	163.56
WaferTech LLC – Camas										11.57		
Washington Potato Company – Warden											11.48	
WestRock LLC – Longview	1372.00	1498.16	1215.31	103.14	1044.05	1040.95	1091.55	1109.52	1067.51	1002.10	981.73	812.79
Total EITE NOX Emissions	**13077.36**	**13550.27**	**13443.54**	**12195.59**	**13261.40**	**13154.74**	**12957.41**	**13109.38**	**12580.79**	**13078.16**	**12483.45**	**11487.36**

Table A. 5 PM2.5 Emissions by EITE Facility (Tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	3.21	1.28	1.37	1.39	1.20	1.39	1.39	1.31	1.24	1.44	1.36	1.56
Analog Devices, Inc. - Camas										0.14		
Ash Grove Cement Company - Seattle	23.89	28.27	33.53	27.04	22.87	21.92	10.01	10.18	8.86	9.49	8.43	9.87

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Boeing Commercial Airplanes - Everett	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
bp Cherry Point Refinery - Blaine	93.00	98.00	83.00	100.13	111.00	77.00	129.95	134.24	125.72	129.75	137.08	129.08
Cardinal FG Company - Winlock	5.48	9.48	9.19	8.75	7.84	13.27	12.84	22.16	8.11	12.24	13.60	19.56
CertainTeed Gypsum - Seattle										22.72		
Georgia-Pacific Consumer Operations LLC - Camas	169.00	154.00	147.00	158.00	129.00	139.00	76.00	30.10	24.15	19.63	19.72	20.68
Georgia-Pacific Gypsum LLC - Tacoma	30.24	33.48	35.17	33.47	36.28	32.82	29.31	31.94	45.78	39.40	28.82	32.10
HF Sinclair Puget Sound Refinery LLC - Anacortes	0.00	189.67	181.71	204.87	177.27	182.02	191.34	176.39	180.34	186.50	209.75	207.82
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	49.95	50.19	45.89	44.70	48.26	43.58	43.07	43.09	36.45	38.59	33.66	45.07
Lamb Weston - Richland												7.20
LANXESS Corporation - Kalama	14.49	16.85	11.97	14.03	21.25	18.07	12.58	14.52	10.41	12.29	12.29	10.65
Marathon Anacortes Refinery - Anacortes	144.11	118.11	128.11	124.14	138.28	141.04	132.41	146.21	120.90	143.90	146.58	121.47
Matheson - Anacortes		1.23	1.45	1.32	1.21	0.78	1.32	1.03	1.09	1.31	0.98	1.23
Nippon Dynawave - Longview	67.00	115.74	123.39	127.98	123.23	118.68	133.77	130.41	139.48	145.70	106.81	112.47
North Pacific Paper Company, LLC - Longview						3.25	5.61	7.80	9.22	9.73	8.25	2.85
Nucor Steel Seattle, Inc, - Seattle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nutrien US LLC. - Kennewick	0.80	0.10	0.05	1.24	1.28	1.29	1.28	1.13	1.18	1.20	1.28	1.36
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.00	0.00	6.15	5.58	5.75	6.05	4.03	5.33	5.35	5.47	8.44	7.31
Packaging Corporation of America - Wallula	128.00	118.49	114.19	106.19	119.49	129.26	101.80	147.32	109.72	82.91	89.19	45.33
Phillips 66 Ferndale Refinery - Ferndale	53.00	65.00	58.00	53.00	48.00	54.00	53.00	21.00	40.00	37.00	65.00	25.46
Port Townsend Paper Corporation - Port Townsend	198.00	224.00	210.00	182.00	154.00	127.00	128.82	5.28	149.03	131.74	153.95	158.38
Solvay Chemicals, Inc. - Longview										1.44		
Steelscape - Kalama										3.62		
The Boeing Company - Auburn Site	0.00	0.00	0.00	4.39	3.64	3.46	5.47	0.00	0.00	0.00	0.00	0.00
U.S. Oil & Refining Co. - Tacoma	0.00	0.00	0.00	10.88	0.00	0.00	0.00	11.62	0.00	0.00	0.00	0.00
WaferTech LLC - Camas										1.45		
WestRock LLC - Longview	81.00	308.03	199.91	48.25	193.77	191.86	210.97	135.33	170.78	176.20	146.25	134.78

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
PM2.5 EITE Total	1061.16	1531.91	1390.08	1257.35	1343.62	1305.74	1284.96	1076.39	1187.81	1213.86	1191.43	1094.24

Table A. 6 PM10 Emissions by EITE Facility (Tons)

Row Labels	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	3.21	1.28	1.37	1.39	1.20	1.39	1.39	1.31	1.24	1.44	1.36	1.56
Analog Devices, Inc. - Camas										0.14		
Ash Grove Cement Company - Seattle	29.90	35.71	42.64	35.14	30.35	29.15	16.16	16.46	14.31	15.33	13.62	15.96
Basic American Foods - Moses Lake											33.30	
Boeing Commercial Airplanes - Everett	0.00	0.00	0.00	0.00	0.00	0.00	5.23	0.00	0.00	0.00	0.00	0.00
bp Cherry Point Refinery - Blaine	128.00	98.00	83.00	107.08	118.00	84.00	129.95	134.44	125.82	129.92	137.28	129.23
Cardinal FG Company - Winlock	8.18	12.16	11.64	12.41	10.77	16.47	15.87	25.11	10.84	13.15	17.04	23.20
CertainTeed Gypsum - Seattle										45.45		
Georgia-Pacific Consumer Operations LLC - Camas	193.00	178.00	173.00	181.00	151.00	163.00	95.00	33.20	26.21	20.88	21.24	22.10
Georgia-Pacific Gypsum LLC - Tacoma	31.37	34.71	36.41	34.60	36.28	32.82	29.31	31.94	47.77	41.16	30.29	33.72
HF Sinclair Puget Sound Refinery LLC - Anacortes	235.75	192.57	182.86	206.97	177.27	182.02	191.34	176.39	180.34	186.50	209.75	208.84
J.R. Simplot Company - Moses Lake											14.34	
J.R. Simplot Company - Othello											3.24	
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	60.56	60.77	55.56	53.31	58.00	52.11	51.60	51.46	43.27	46.03	40.00	53.90
Lamb Weston - Pasco											17.10	
Lamb Weston - Quincy											17.73	
Lamb Weston - Richland												7.20
LANXESS Corporation - Kalama	15.02	17.22	11.97	14.12	21.51	18.07	12.58	14.52	10.41	12.29	12.29	10.92
Marathon Anacortes Refinery - Anacortes	154.11	143.11	157.11	152.38	139.97	142.73	135.01	148.81	123.80	146.90	149.35	124.58
Matheson - Anacortes		1.23	1.57	1.45	1.34	0.89	1.45	1.15	1.22	1.44	1.10	1.35
McCain Foods - Othello											42.28	
Nippon Dynawave - Longview	76.00	120.74	129.45	133.29	128.63	124.30	144.25	135.67	147.84	153.78	116.66	120.49

Row Labels	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
North Pacific Paper Company, LLC - Longview						3.25	5.61	7.80	9.22	9.73	8.25	2.85
Nucor Steel Seattle, Inc, - Seattle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nutrien US LLC. - Kennewick	2.90	2.10	2.35	2.56	2.38	2.38	2.41	2.29	3.19	2.54	2.53	2.50
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.00	0.00	6.20	5.62	5.80	6.09	4.05	5.38	5.39	5.52	8.48	7.34
Packaging Corporation of America - Wallula	128.00	122.79	119.89	112.99	122.49	133.56	105.60	154.82	116.52	89.67	94.19	48.33
Phillips 66 Ferndale Refinery - Ferndale	59.00	65.00	64.00	59.00	54.00	60.00	59.00	27.00	46.00	43.00	71.00	31.46
Port Townsend Paper Corporation - Port Townsend	264.00	291.00	275.00	247.00	220.00	193.00	181.41	46.10	202.76	183.79	207.62	211.57
Solvay Chemicals, Inc. - Longview										1.44		
Steelscape - Kalama										3.91		
The Boeing Company - Auburn Site	0.00	0.00	0.00	7.79	6.14	5.51	7.91	0.00	0.00	0.00	0.00	0.00
Tyson Fresh Meats, Inc. - Wallula											19.78	
U.S. Oil & Refining Co. - Tacoma	11.74	11.97	12.11	11.39	11.36	11.96	11.56	12.08	11.87	14.87	14.82	17.16
WaferTech LLC - Camas										4.42		
Washington Potato Company - Warden											0.00	
WestRock LLC - Longview	81.00	332.58	218.87	56.60	214.14	210.33	232.02	151.77	191.90	202.71	162.94	148.81
PM10 EITE Total	**1481.72**	**1720.94**	**1585.00**	**1436.09**	**1510.63**	**1473.03**	**1438.71**	**1177.70**	**1319.93**	**1376.00**	**1467.60**	**1223.08**

Table A. 7 SO2 Emissions by EITE Facility (Tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	1.43	0.22	0.21	0.12	0.08	0.10	0.07	0.01	0.01	0.01	0.01	0.13
Analog Devices, Inc. - Camas										0.01		
Ash Grove Cement Company - Seattle	37.29	42.20	57.00	77.05	68.17	69.42	67.47	77.67	64.79	76.55	46.19	54.72
Boeing Commercial Airplanes - Everett	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00
bp Cherry Point Refinery - Blaine	930.00	879.00	917.00	906.88	781.00	828.00	726.36	608.10	645.68	698.08	847.62	664.63
Cardinal FG Company - Winlock	46.64	54.26	56.71	58.60	58.66	56.22	54.55	49.27	55.28	57.62	54.86	55.20
Georgia-Pacific Consumer Operations LLC - Camas	20.00	19.00	17.00	16.00	30.00	40.00	21.00	4.00	3.00	2.70	2.41	2.81
Georgia-Pacific Gypsum LLC - Tacoma		0.00	0.00	0.00	0.00							
Goodrich Corporation - Spokane										0.20		
HF Sinclair Puget Sound Refinery LLC - Anacortes	359.02	459.08	346.74	229.66	235.61	225.24	227.41	214.10	224.16	230.17	213.01	232.25
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	0.60	0.64	0.61	0.67	0.69	0.71	0.73	0.75	0.62	0.65	0.72	0.71
Lamb Weston - Richland												0.17
LANXESS Corporation - Kalama	5.10	5.09	3.24	3.16	3.24	3.17	4.32	4.14	1.51	1.99	1.99	0.36
Marathon Anacortes Refinery - Anacortes	315.02	237.02	191.12	130.05	124.86	79.72	79.62	73.82	56.90	118.20	80.75	67.94
Matheson - Anacortes		0.00*	0.00*	0.77	0.70	0.45	0.76	0.56	0.58	0.68	0.51	0.62
Nippon Dynawave - Longview	582.00	378.00	440.25	351.23	376.00	390.21	327.69	391.88	456.05	481.72	432.60	341.53
North Pacific Paper Company, LLC - Longview						0.19	0.21	0.21	0.22	0.25	0.22	0.20
Nucor Steel Seattle, Inc, - Seattle	77.85	74.91	76.29	65.83	70.08	51.85	67.23	60.75	0.00	0.00	0.00	33.02
Nutrien US LLC. - Kennewick	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.00	0.00	15.48	14.36	14.18	9.28	9.27	0.45	3.87	17.22	16.29	13.15
Packaging Corporation of America - Wallula	793.00	534.30	186.35	67.73	691.66	885.41	392.97	363.44	1093.67	1278.55	628.43	137.90
Phillips 66 Ferndale Refinery - Ferndale	108.00	46.00	49.00	44.00	45.00	38.00	43.00	36.00	33.00	47.00	44.00	27.74
Port Townsend Paper Corporation - Port Townsend	187.00	198.00	79.00	51.40	44.00	46.00	68.00	75.60	80.90	77.50	83.00	113.90
Solvay Chemicals, Inc. - Longview										0.10		
Steelscape - Kalama										0.16		

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
The Boeing Company - Auburn Site	0.00	0.00	0.00	0.28	0.32	0.35	0.27	0.00	0.00	0.00	0.00	0.00
U.S. Oil & Refining Co. - Tacoma	4.35	3.67	4.21	5.25	6.66	6.41	6.51	3.76	2.85	3.78	3.51	5.05
WaferTech LLC - Camas										0.11		
Washington Potato Company - Warden											0.14	
WestRock LLC - Longview	202.00	132.50	141.11	9.10	125.53	197.98	258.24	180.17	250.05	259.27	201.12	182.63
SO2 EITE Total	**3669.30**	**3063.89**	**2581.31**	**2032.15**	**2676.44**	**2928.73**	**2356.15**	**2144.68**	**2973.15**	**3352.52**	**2657.38**	**1934.66**

**Indicates values less than 0.005 tons. All other zeroes are true zeros. Blanks represent years with no emission data.*

Table A. 8 VOC Emissions by EITE Facility (Tons)

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Air Liquide Hydrogen Plant - Anacortes	1.67	1.60	1.60	1.62	1.51	1.61	1.64	1.62	1.63	1.64	1.62	1.65
Analog Devices, Inc. - Camas										26.52		
Ash Grove Cement Company - Seattle	3.54	0.00	12.35	4.57	5.03	6.26	2.67	2.91	2.36	6.32	4.07	5.08
Basic American Foods - Moses Lake											1.70	
Boeing Commercial Airplanes - Everett	503.51	527.64	542.00	67.93	565.91	487.89	410.26	418.60	298.11	229.23	254.74	265.32
bp Cherry Point Refinery - Blaine	473.00	517.00	368.00	480.39	362.25	431.00	417.01	484.37	397.14	387.87	406.47	352.96
Cardinal FG Company - Winlock	16.61	13.87	13.13	12.27	9.41	12.90	9.52	9.24	9.76	13.94	14.46	14.32
Georgia-Pacific Consumer Operations LLC - Camas	143.00	122.00	122.00	123.00	106.00	102.00	76.00	42.20	31.93	28.38	29.11	11.52
Georgia-Pacific Gypsum LLC - Tacoma		0.00	0.00	0.00	25.78	24.90	0.00	0.00	0.00	0.00	0.00	0.00
Goodrich Corporation - Spokane										1.80		
HF Sinclair Puget Sound Refinery LLC - Anacortes	401.09	574.66	446.57	462.71	473.40	429.13	461.55	474.83	429.77	443.20	476.99	433.15
J.R. Simplot Company - Moses Lake											9.73	
J.R. Simplot Company - Othello											22.14	
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	265.19	220.01	201.18	184.19	188.29	218.92	249.96	221.04	138.55	182.51	173.31	233.44
Lamb Weston - Pasco											14.46	
Lamb Weston - Quincy											23.88	
Lamb Weston - Richland												10.20

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
LANXESS Corporation - Kalama	32.25	19.55	22.22	20.73	17.25	25.91	37.65	25.64	24.17	201.66	201.66	97.28
Marathon Anacortes Refinery - Anacortes	696.00	764.00	1003.00	923.70	953.97	859.69	848.60	895.90	662.52	794.15	803.51	887.21
Matheson - Anacortes		2.21	2.67	2.73	2.57	2.03	2.71	2.31	2.48	2.68	2.35	2.63
McCain Foods - Othello											55.35	
Nippon Dynawave - Longview	422.00	481.91	491.72	473.15	467.17	129.98	131.66	147.55	145.40	150.59	150.51	152.29
North Pacific Paper Company, LLC - Longview						249.40	262.11	234.74	230.49	233.95	318.85	248.49
Nucor Steel Seattle, Inc, - Seattle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nutrien US LLC. - Kennewick	0.50	0.10	0.04	0.30	0.31	0.31	0.31	0.20	0.10	0.10	0.11	0.20
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.03	0.03	11.33	15.66	12.58	12.30	10.92	13.45	12.52	13.97	14.18	13.02
Packaging Corporation of America - Wallula	1781.00	1577.77	1547.73	852.64	1274.80	171.81	165.14	220.06	233.36	247.34	226.19	99.35
Phillips 66 Ferndale Refinery - Ferndale	860.00	869.00	1006.00	939.00	854.00	972.00	862.00	891.00	784.00	815.00	735.00	603.07
Port Townsend Paper Corporation - Port Townsend	49.00	49.00	52.00	48.00	45.00	45.03	75.05	79.06	80.08	67.08	61.10	67.07
Solvay Chemicals, Inc. - Longview										19.09		
Steelscape - Kalama										11.35		
The Boeing Company - Auburn Site	115.83	152.24	133.94	14.78	113.63	106.06	121.14	117.96	64.58	63.15	73.79	87.87
Tyson Fresh Meats, Inc. - Wallula											3.96	
U.S. Oil & Refining Co. - Tacoma	127.12	182.51	268.90	176.67	158.32	175.91	178.37	205.07	239.03	213.90	205.67	208.44
WaferTech LLC - Camas										18.04		
Washington Potato Company - Warden											1.26	
WestRock LLC - Longview	219.00	245.52	191.83	146.36	187.53	182.32	246.40	217.74	216.20	234.53	207.71	179.30
VOC EITE Total	**6110.34**	**6320.62**	**6438.22**	**4950.40**	**5824.71**	**4647.37**	**4570.67**	**4705.48**	**4004.18**	**4407.99**	**4493.89**	**3973.85**

Table A. 9 Combustion Related HAP Emissions by EITE Facility (Tons)[45, 46]

EITE Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

[45] EPA 2024. 2022v1 Emissions Modeling Platform. Data files accessed January 2025. Internet Address: https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform

[46] Combustion related HAP emissions identified using external and internal combustion-related source classification codes.

Boeing Commercial Airplanes - Everett	1.66	1.66	1.65	26.69	0.00	1.61	1.61	1.44	1.40	1.26	1.29
bp Cherry Point Refinery - Blaine	4.27	2.94	2.62	2.65	2.33	3.74	2.50	3.11	5.36	2.55	3.93
Cardinal FG Company - Winlock	2.42E-07	2.42E-07				3.44E-06	1.05E-05	1.05E-05	3.42E-06	3.42E-06	1.35E-05
Georgia-Pacific Consumer Operations LLC - Camas	0.66	0.66	0.67	0.67	0.67	1.00	0.69	1.00	3.35	3.07	3.29
HF Sinclair Puget Sound Refinery LLC - Anacortes	3.55	1.55	3.71	3.85	3.00	2.58	2.77	2.67	2.41	2.49	2.50
Kaiser Aluminum Washington, LLC (Trentwood Works) - Spokane Valley	0.28	0.28	0.26	0.25	0.26	0.21	0.18	0.22	0.20	0.21	0.22
LANXESS Corporation - Kalama	0.98	0.98	1.56	1.14	0.05	0.05	1.11	0.96	0.10	0.11	0.05
Marathon Anacortes Refinery - Anacortes	4.37	4.56	3.82	7.37	9.25	2.66	3.86	5.74	3.35	3.73	3.95
Matheson - Anacortes		0.03	0.06	0.48	0.44	0.28	0.48	0.34	0.40	0.48	0.36
Nippon Dynawave - Longview	75.99	3.10	144.07	196.56	161.28	198.41	209.69	197.85	195.00	198.40	43.78
Nutrien US LLC. - Kennewick	0.17	0.17	0.01	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00
Owens-Brockway Glass Container Inc Plant #2 - Kalama	0.00	0.00				1.32E-04	4.14E-04	3.10E-04	1.32E-04	1.32E-04	1.33E-04
Packaging Corporation of America - Wallula	7.77	7.77	8.70	8.84	7.93	4.55	6.02	3.21	3.20	1.74	1.92
Phillips 66 Ferndale Refinery - Ferndale	1.48	1.26	1.36	1.41	1.42	1.24	1.24	1.32	1.27	1.34	1.30
Port Townsend Paper Corporation - Port Townsend	11.64	11.64	14.40	11.76	11.07	13.35	14.23	16.86	20.22	22.68	20.42
The Boeing Company - Auburn Site	1.67	1.67	0.59	14.99	0.00	0.67	0.67	0.85	0.78	0.80	0.80
U.S. Oil & Refining Co. - Tacoma	0.11	0.11	1.17	3.60		0.34	0.34	0.62	0.63	0.77	0.59
WestRock LLC - Longview	1.26	0.31	1.37	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01
HAP EITE Total	115.86	38.69	186.00	280.29	197.72	230.73	245.44	236.24	237.68	239.63	84.42

Appendix C. Health Impact Data

The following tables provide additional information, as detailed in the Health Impacts section.

ERG tailored the BenMAP data to align with the Washington State Office of Financial Management (OFM) data. The OFM data includes 2034 total Washington estimates for each age, shown in the second column in Table A. 10. ERG adjusted the BenMAP data, shown in the third column, with the calculated proportions shown in the last column of Table A. 10.

Table A. 10 Population Projects by Age for Calculating Proportions

Age	Total 2034 (OFM Data)	2030 BenMAP Data	Proportion (OFM/ BenMAP)
0	88,513	110,590	0.80
1	88,427	110,465	0.80
2	88,791	110,465	0.80
3	89,174	110,465	0.81
4	89,572	110,465	0.81
5	89,967	110,838	0.81
6	90,327	110,838	0.81
7	90,646	110,838	0.82
8	90,913	110,838	0.82
9	91,149	110,838	0.82
10	90,631	109,206	0.83
11	92,545	109,206	0.85
12	95,528	109,206	0.87
13	94,000	109,206	0.86
14	99,393	109,206	0.91
15	99,577	99,104	1.00
16	99,897	99,104	1.01
17	100,649	99,104	1.02
18	101,993	99,104	1.03
19	104,282	99,104	1.05
20	106,463	101,072	1.05
21	108,631	101,072	1.07
22	110,534	101,072	1.09
23	112,205	101,072	1.11
24	113,843	101,072	1.13
25	115,151	107,813	1.07
26	116,040	107,813	1.08
27	116,335	107,813	1.08
28	116,094	107,813	1.08
29	115,284	107,813	1.07
30	114,468	112,880	1.01

Age	Total 2034 (OFM Data)	2030 BenMAP Data	Proportion (OFM/ BenMAP)
31	113,660	112,880	1.01
32	116,405	112,880	1.03
33	121,203	112,880	1.07
34	120,747	112,880	1.07
35	119,053	119,016	1.00
36	117,626	119,016	0.99
37	116,752	119,016	0.98
38	117,293	119,016	0.99
39	121,332	119,016	1.02
40	124,401	118,875	1.05
41	126,585	118,875	1.06
42	127,840	118,875	1.08
43	128,089	118,875	1.08
44	127,196	118,875	1.07
45	125,772	110,484	1.14
46	124,527	110,484	1.13
47	123,351	110,484	1.12
48	122,467	110,484	1.11
49	121,759	110,484	1.10
50	119,937	97,321	1.23
51	117,480	97,321	1.21
52	114,343	97,321	1.17
53	110,517	97,321	1.14
54	106,151	97,321	1.09
55	102,462	89,294	1.15
56	99,667	89,294	1.12
57	97,631	89,294	1.09
58	96,336	89,294	1.08
59	95,598	89,294	1.07
60	87,794	87,798	1.00
61	87,485	87,798	1.00
62	90,786	87,798	1.03
63	95,406	87,798	1.09
64	98,571	87,798	1.12
65	89,763	88,756	1.01
66	85,425	88,756	0.96
67	84,012	88,756	0.95
68	84,861	88,756	0.96
69	90,473	88,756	1.02
70	89,565	84,144	1.06
71	88,564	84,144	1.05

Age	Total 2034 (OFM Data)	2030 BenMAP Data	Proportion (OFM/ BenMAP)
72	87,499	84,144	1.04
73	86,309	84,144	1.03
74	85,055	84,144	1.01
75	83,369	71,831	1.16
76	81,170	71,831	1.13
77	78,241	71,831	1.09
78	74,700	71,831	1.04
79	70,804	71,831	0.99
80	66,804	51,969	1.29
81	62,633	51,969	1.21
82	58,348	51,969	1.12
83	53,984	51,969	1.04
84	49,574	51,969	0.95
85	17,127	13,486	1.27
86	17,127	13,486	1.27
87	17,127	13,486	1.27
88	17,127	13,486	1.27
89	17,127	13,486	1.27
90	17,127	13,486	1.27
91	17,127	13,486	1.27
92	17,127	13,486	1.27
93	17,127	13,486	1.27
94	17,127	13,486	1.27
95	17,127	13,486	1.27
96	17,127	13,486	1.27
97	17,127	13,486	1.27
98	17,127	13,486	1.27
99	17,127	13,486	1.27
Total	**8,765,295**	**8,556,738**	**1.02**

Table A. 11 presents the adjusted 2034 populaition data Erg input into COBRA by county.

Table A. 11 2034 Tailored Population Projection Inputs into COBRA, by Washington County

County	Total 2034 Population	% Total WA Population
Adams	20,815	0.24%
Asotin	26,550	0.30%
Benton	247,577	2.82%
Chelan	89,940	1.03%
Clallam	90,773	1.04%
Clark	649,246	7.41%
Columbia	3,962	0.05%

County	Total 2034 Population	% Total WA Population
Cowlitz	117,182	1.34%
Douglas	49,288	0.56%
Ferry	8,591	0.10%
Franklin	112,651	1.29%
Garfield	2,183	0.02%
Grant	116,787	1.33%
Grays Harbor	78,357	0.89%
Island	92,716	1.06%
Jefferson	35,652	0.41%
King	2,613,457	29.82%
Kitsap	312,506	3.57%
Kittitas	50,079	0.57%
Klickitat	25,586	0.29%
Lewis	87,029	0.99%
Lincoln	10,963	0.13%
Mason	73,600	0.84%
Okanogan	46,326	0.53%
Pacific	23,405	0.27%
Pend Oreille	15,523	0.18%
Pierce	1,024,393	11.69%
San Juan	20,679	0.24%
Skagit	149,256	1.70%
Skamania	13,181	0.15%
Snohomish	935,921	10.68%
Spokane	571,422	6.52%
Stevens	51,492	0.59%
Thurston	336,245	3.84%
Wahkiakum	4,533	0.05%
Walla Walla	67,795	0.77%
Whatcom	262,464	2.99%
Whitman	52,970	0.60%
Yakima	274,203	3.13%
Washington Total	**8,765,295**	**100%**

Table A. 12 outlines each EITEs county, sector, and changes in emissions that ERG input into COBRA. In COBRA, the selected county and sector dictate the emissions baseline. Given that some baseline emissions were less than the reduction amount, ERG input the change in emissions as an increase and then used the absolute value of the results. When emissons were not provided by Ecology, “N/A” is presented.

Table A. 12 Inputs into COBRA- County, Sector, and Pollutant Changes

EITE	County	Sector	6% of $PM_{2.5}$	6% of SO_2	6% of NO_x	6% of VOC
Air Liquide	Skagit	Chemical & Allied Product Manufacturing	0.09	0.01	0.66	0.10
Analog Devices, Inc.	Clark	Other Industrial Processes	0.01	0.00	0.04	1.59
Ash Grove Cement Company	King	Other Industrial Processes	0.59	3.28	47.01	0.30
Basic American Foods - Moses Lake	Grant	Other Industrial Processes	N/A	N/A	0.71	0.10
Boeing Commercial Airplane Auburn	King	Other Industrial Processes	0.00	0.00	3.17	5.27
Boeing Commercial Airplane Group - Everett	Snohomish	Other Industrial Processes	0.00	0.00	4.37	15.92
BP CHERRY POINT REFINERY	Whatcom	Petroleum & Related Industries	7.74	39.88	112.75	21.18
Cardinal FG Company Winlock	Lewis	Other Industrial Processes	1.17	3.31	47.93	0.86
CertainTeed Gypsum Manufacturing Inc	King	Other Industrial Processes	1.36	N/A	3.56	N/A
COLLINS AEROSPACE	Spokane	Other Industrial Processes	N/A	0.01	0.86	0.11
Darigold, Inc	Yakima	Other Industrial Processes	N/A	0.01	1.81	0.11
Georgia-Pacific - Consumer Operations	Clark	Other Industrial Processes	1.24	0.17	0.53	0.69
Georgia-Pacific Gypsum LLC	Pierce	Other Industrial Processes	1.93	N/A	2.81	0.00
HF SINCLAIR PUGET SOUND REFINERY	Skagit	Petroleum & Related Industries	12.47	13.94	79.05	25.99
JR SIMPLOT - MOSES LAKE FACILITY	Grant	Other Industrial Processes	N/A	N/A	1.58	0.58
JR SIMPLOT - OTHELLO	Adams	Other Industrial Processes	N/A	N/A	1.41	1.33
Kaiser Trentwood	Spokane	Metals Processing	2.70	0.04	7.04	14.01
LAMB WESTON INC - PASCO	Franklin	Other Industrial Processes	N/A	N/A	1.42	0.87
LAMB WESTON INC - QUINCY	Grant	Other Industrial Processes	N/A	N/A	1.92	1.43
Lamb Weston, Inc.	Benton	Other Industrial Processes	0.43	0.01	1.72	0.61
LANXESS Corporation	Cowlitz	Chemical & Allied Product Manufacturing	0.64	0.02	3.12	5.84
Marathon Anacortes Refinery	Skagit	Petroleum & Related Industries	7.29	4.08	86.99	53.23
Matheson Gas Anacortes	Skagit	Petroleum & Related Industries	0.07	0.04	0.56	0.16

EITE	County	Sector	6% of $PM_{2.5}$	6% of SO_2	6% of NO_x	6% of VOC
MCCAIN FOODS USA - OTHELLO	Adams	Other Industrial Processes	N/A	N/A	2.70	3.32
Nippon Dynawave Packaging Co.	Cowlitz	Other Industrial Processes	6.75	20.49	129.66	9.14
North Pacific Paper Corp. (NORPAC)	Cowlitz	Other Industrial Processes	0.17	0.01	0.26	14.91
Nucor Steel Seattle Inc	King	Metals Processing	0.00	1.98	13.34	0.00
Nutrien US LLC	Benton	Chemical & Allied Product Manufacturing	0.08	0.00	2.25	0.01
Owens-Brockway Glass Container, Inc. - Plant 2	Cowlitz	Other Industrial Processes	0.44	0.79	2.28	0.78
Packaging Corporation of America	Walla Walla	Other Industrial Processes	2.72	8.27	16.94	5.96
PHILLIPS 66 Ferndale Refinery	Whatcom	Petroleum & Related Industries	1.53	1.66	40.86	36.18
Pt Townsend Paper	Jefferson	Other Industrial Processes	9.50	6.83	27.36	4.02
Solvay Chemicals, Inc.	Cowlitz	Chemical & Allied Product Manufacturing	0.09	0.01	0.64	1.15
Steelscape, Inc.	Cowlitz	Metals Processing	0.22	0.01	1.70	0.68
TYSON FRESH MEATS INC	Walla Walla	Other Industrial Processes	N/A	N/A	1.43	0.24
US Oil & Refining Co	Pierce	Petroleum & Related Industries	0.00	0.30	9.81	12.51
WaferTech LLC	Clark	Other Industrial Processes	0.09	0.01	0.69	1.08
Washington Potato Company	Grant	Other Industrial Processes	N/A	0.01	0.69	0.08
WestRock Longview, LLC	Cowlitz	Other Industrial Processes	8.09	10.96	48.77	10.76

References

[i] https://gis.ecology.wa.gov/portal/home/item.html?id=454c5efc20334dc4909405310b2dbfcb
[ii] https://apps.ecology.wa.gov/publications/UIPages/documents/2302115.pdf
[iii] https://hub.arcgis.com/datasets/waecy::tribal-lands/about
[iv] N. Roy, et al., 2025, *Considerations for Washington's Linkage Negotiations with California and Quebec*, Resources for the Future, Report 25-05, https://media.rff.org/documents/Report_25-05_Bu5rhlh.pdf.
[v] Washington State Department of Ecology, n.d., *National air quality standards*, https://ecology.wa.gov/air-climate/air-quality/air-quality-targets/air-quality-standards
[vi] Washington State Department of Ecology, n.d., *Cap-and-Invest emissions reporting*, https://ecology.wa.gov/Air-Climate/Climate-Commitment-Act/Cap-and-invest/Emissions-reporting
[vii] Washington State Department of Ecology, n.d., *Mandatory greenhouse gas reports*, https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/tracking-greenhouse-gases/mandatory-greenhouse-gas-reports.
[viii] Washington State Department of Ecology, n.d., *Washington Emissions Inventory Reporting System (WEIRS)*, https://ecology.wa.gov/regulations-permits/reporting-requirements/air-quality-emissions-reporting/emissions-inventory-reporting
[ix] U.S. Environmental Protection Agency, 2024, *Interactive Map of Air Quality Monitors*, https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

[x] fU.S. Environmental Protection Agency, 2024, *Ambient Monitoring Archive for HAPs.* https://www.epa.gov/amtic/amtic-ambient-monitoring-archive-haps

[xi] American Lung Association, 2025, *State of the Air Key Findings - Populations at Risk*, https://www.lung.org/research/sota/key-findings/people-at-risk
[xii] Washington State Department of Health, n.d., *Asthma Data*, https://doh.wa.gov/data-and-statistical-reports/diseases-and-chronic-conditions/asthma-data
[xiii] Washington State Department of Health, n.d., *Asthma Data*, https://doh.wa.gov/data-and-statistical-reports/diseases-and-chronic-conditions/asthma-data
[xiv] Asthma and Allergy Foundation of America, 2025, *Cost of Asthma on Society*, https://aafa.org/advocacy/key-issues/access-to-health-care/cost-of-asthma-on-society/
[xv] Erika Garcia et al., 2019, *Association of Changes in Air Quality With Incident Asthma in Children in California, 1993-2014*, https://doi.org/10.1001/jama.2019.5357
[xvi] U.S. Environmental Protection Agency, 2025, *CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)*, https://www.epa.gov/cobra
[xvii] U.S. Environmental Protection Agency, 2025, *COBRA Questions and Answers*, https://www.epa.gov/cobra/cobra-questions-and-answers
[xviii] U.S. Environmental Protection Agency, 2025, *COBRA Questions and Answers*, https://www.epa.gov/cobra/cobra-questions-and-answers
[xix] U.S. Environmental Protection Agency, 2025, *User's Manual for the CO - Benefits Risk Assessment (COBRA) Screening Model*, https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model
[xx] U.S. Environmental Protection Agency, 2025, *What Is COBRA?,* https://www.epa.gov/cobra/what-cobra
[xxi] U.S. Environmental Protection Agency, 2025, *COBRA Future Input Files*, https://www.epa.gov/cobra/cobra-future-input-files
[xxii] Washington State Office of Financial Management, 2025, *November 2024 Forecast: Forecast of the State Population*, https://ofm.wa.gov/sites/default/files/public/dataresearch/pop/stfc/stfc_2024.pdf
[xxiii] Washington State Office of Financial Management, 2025, *November 2024 Forecast: Forecast of the State Population*, https://ofm.wa.gov/sites/default/files/public/dataresearch/pop/stfc/stfc_2024.pdf

[xxiv] U.S. Environmental Protection Agency, 2025, *COBRA Questions and Answers*, https://www.epa.gov/cobra/cobra-questions-and-answers#19
[xxv] U.S. Environmental Protection Agency, 2025, *COBRA Questions and Answers*, https://www.epa.gov/cobra/cobra-questions-and-answers#19
[xxvi] World Population Review, 2025, *Health Care Costs by State 2025*, https://worldpopulationreview.com/state-rankings/health-care-costs-by-state
[xxvii] Centers for Medicare and Medicaid Services, n.d., *Health Care Expenditures per Capita by State of Residence*, https://www.akleg.gov/basis/get_documents.asp?session=33&docid=1083
[xxviii] Centers for Medicare and Medicaid Services, 2025, *NHE Fact Sheet*, https://www.cms.gov/data-research/statistics-trends-and-reports/national-health-expenditure-data/nhe-fact-sheet
[xxix] U.S. Census Bureau, n.d., *QuickFacts: Washington*, https://www.census.gov/quickfacts/fact/table/WA/INC110223
[xxx] X. Wu et al., 2020, *Evaluating the Impact of Long-Term Exposure to Fine Particulate Matter on Mortality among the Elderly*, https://doi.org/10.1126/sciadv.aba5692
[xxxi] C. Arden Pope et al., 2019, *Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults*, https://doi.org/10.1289/EHP4438
[xxxii] U.S. Environmental Protection Agency, 2025, *COBRA Questions and Answers*, https://www.epa.gov/cobra/cobra-questions-and-answers
[xxxiii] U.S. Environmental Protection Agency, 2023, *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advance*, https://www.epa.gov/environmental-economics/scghg
[xxxiv] Also see Resources for the Future's Social Cost of Carbon Explorer: https://www.rff.org/publications/data-tools/scc-explorer/.
[xxxv] Dun & Bradstreet, n.d., *Dun & Bradstreet*, https://www.dnb.com/en-us/
[xxxvi] Washington State Department of Ecology, n.d., Industrial facility permits and regulations, https://ecology.wa.gov/regulations-permits/permits-certifications/industrial-facilities-permits
[xxxvii] U.S. Census Bureau, 2024, *County Business Patterns*, https://www.census.gov/programs-surveys/cbp.html
[xxxviii] https://catalog.data.gov/dataset/stateio-v0-4-0-two-region-economic-input-output-models-for-50-u-s-states-2012-2023
[xxxix] https://www.census.gov/programs-surveys/acs.html
[xl] Washington State Department of Ecology, 2023, *Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution*, https://apps.ecology.wa.gov/publications/UIPages/documents/2302115.pdf
[xli] https://gis.ecology.wa.gov/portal/home/item.html?id=454c5efc20334dc4909405310b2dbfcb
[xlii] Washington State Department of Ecology, 2023, *Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution*, https://apps.ecology.wa.gov/publications/UIPages/documents/2302115.pdf
[xliii] Washington State Department of Ecology, 2025, *Tribal Lands*, https://hub.arcgis.com/datasets/waecy::tribal-lands/about
[xliv] Federal Register, 2022, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*, https://www.federalregister.gov/documents/2022/10/06/2022-19612/national-emission-standards-for-hazardous-air-pollutants-for-major-sources-industrial-commercial-and
[xlv] Federal Register, 2024, *New Source Performance Standards for Greenhouse Gas Emissions From New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions From Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule*, https://www.federalregister.gov/documents/2024/05/09/2024-09233/new-source-performance-standards-for-greenhouse-gas-emissions-from-new-modified-and-reconstructed
[xlvi] Federal Register, 2024, *Review of New Source Performance Standards for Stationary Combustion Turbines and Stationary Gas Turbines* https://www.federalregister.gov/documents/2024/12/13/2024-27872/review-of-new-source-performance-standards-for-stationary-combustion-turbines-and-stationary-gas
[xlvii] U.S. Census Bureau, n.d., *Cowlitz County, Washington—Census Bureau Profile*, https://data.census.gov/profile/Cowlitz_County,_Washington?g=050XX00US53015
[xlviii] U.S. Census Bureau, n.d., *Washington—Census Bureau Profile*, https://data.census.gov/profile/Washington?g=040XX00US53
[xlix] Federal Register, 2022, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*,

https://www.federalregister.gov/documents/2022/10/06/2022-19612/national-emission-standards-for-hazardous-air-pollutants-for-major-sources-industrial-commercial-and

[l] U.S. Census Bureau, n.d., *King County, Washington—Census Bureau Profile*, https://data.census.gov/profile/King_County,_Washington?g=050XX00US53033

[li] U.S. Census Bureau, n.d., *Washington—Census Bureau Profile*, https://data.census.gov/profile/Washington?g=040XX00US53

[lii] Federal Register, 2024, *New Source Performance Standards Review for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels)*, https://www.govinfo.gov/content/pkg/FR-2024-10-15/pdf/2024-22823.pdf

[liii] Federal Register, 2024, *Review of New Source Performance Standards for Stationary Combustion Turbines and Stationary Gas Turbines*, https://www.federalregister.gov/documents/2024/12/13/2024-27872/review-of-new-source-performance-standards-for-stationary-combustion-turbines-and-stationary-gas

[liv] Federal Register, 2024, *New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry*, https://www.federalregister.gov/documents/2024/05/16/2024-07002/new-source-performance-standards-for-the-synthetic-organic-chemical-manufacturing-industry-and

[lv] Federal Register, 2024, *National Emission Standards for Hazardous Air Pollutants: Gasoline Distribution Technology Reviews and New Source Performance Standards Review for Bulk Gasoline Terminals*, https://www.federalregister.gov/documents/2024/05/08/2024-04629/national-emission-standards-for-hazardous-air-pollutants-gasoline-distribution-technology-reviews

[lvi] Federal Register, 2022, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*, https://www.federalregister.gov/documents/2022/10/06/2022-19612/national-emission-standards-for-hazardous-air-pollutants-for-major-sources-industrial-commercial-and

[lvii] Federal Register, 2024, *New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry*, https://www.federalregister.gov/documents/2024/05/16/2024-07002/new-source-performance-standards-for-the-synthetic-organic-chemical-manufacturing-industry-and

[lviii] Federal Register, 2022, *National Emission Standards for Hazardous Air Pollutants: Site Remediation*, https://www.federalregister.gov/documents/2022/12/22/2022-27523/national-emission-standards-for-hazardous-air-pollutants-site-remediation

[lix] U.S. Census Bureau, n.d., *Skagit County, Washington—Census Bureau Profile*, https://data.census.gov/profile/Skagit_County,_Washington?g=050XX00US53057

[lx] U.S. Census Bureau, n.d., *Washington—Census Bureau Profile*, https://data.census.gov/profile/Washington?g=040XX00US53

[lxi] International Transport Workers Federation, n.d., *Aeronautical Supply Chains*, https://www.itfglobal.org/sites/default/files/resources-files/scalop_aeronautical_supply_chains_english.pdf

[lxii] Grand View Research, n.d., *U.S. Aerospace Parts Manufacturing Market Size, Share & Trends Analysis Report By Product (Engines, Aircraft Manufacturing, Cabin Interiors, Equipment, System, Others), By Aircraft, And Segment Forecasts, 2024 - 2030*, https://www.grandviewresearch.com/industry-analysis/us-aerospace-parts-manufacturing-market-report.

[lxiii] American Cement Association, n.d., *How Cement is Made*, https://www.cement.org/cement-concrete/how-cement-is-made/

[lxiv] Gypsum Association, n.d., *Making Gypsum Board*, https://gypsum.org/making-gypsum-board/

[lxv] Anita Raj, 2024, *Cement Logistics: How Supply Chain Intelligence Can Accelerate Material & Cash Flow in 2025*, https://throughput.world/blog/how-throughput-accelerates-the-bottom-line-despite-logistics-challenges-in-the-cement-industry/

[lxvi] Concrete Financial Insights, n.d., *U.S. Cement Industry Data*, https://concretefinancialinsights.com/us-cement-industry-data

[lxvii] Fortune Business Insights, 2025, *Cement Market Size, Share & Industry Analysis, By Type (Portland, Blended, and Others), By Application (Residential and Non-Residential), and Regional Forecast, 2024-2032*, https://www.fortunebusinessinsights.com/industry-reports/cement-market-101825

[lxviii] Prescient & Strategic Intelligence, n.d., *U.S. Cement Market Size & Share Analysis - Trends, Drivers, Competitive Landscape, and Forecasts (2025 - 2032)*, https://www.psmarketresearch.com/market-analysis/us-cement-market
[lxix] American Cement Association, n.d., *Forecasts & Economic Analysis*, https://www.cement.org/intelligence-resources/market-intelligence/forecasts-and-economic-analysis/
[lxx] Vrushali Bothare, n.d., *Gypsum Board Market Size, Share & Trends Analysis Report By Product (Wallboard, Ceiling Board, Pre-decorated Board, Others), By Application (Pre-engineered Metal Buildings, Residential, Industrial, Commercial, Institutional) and By Region(North America, Europe, APAC, Middle East and Africa, LATAM) Forecasts, 2025-2033*, https://straitsresearch.com/report/gypsum-board-market
[lxxi] Grand View Research, n.d., *U.S. Gypsum Board Market Size, Share & Trends Analysis Report By Product (Wallboard, Ceiling Board, Pre-decorated), By Application (Pre-engineered Metal Building, Residential, Industrial), And Segment Forecasts, 2024 – 2030*, https://www.grandviewresearch.com/industry-analysis/us-gypsum-board-market-report
[lxxii] Janelle Conaway, 2024, *Industrial Decarbonization: Confronting the Hard Challenges of Cement*, https://www.library.hbs.edu/working-knowledge/industrial-decarbonization-confronting-the-hard-challenges-of-cement
[lxxiii] Carbon Smart Materials Palette, n.d., *Gypsum Board*, https://www.materialspalette.org/gypsum-board/
[lxxiv] Jullian Guirguis, 2025, *Chemical Product Manufacturing in the US - Market Research Report (2015-2030)*, https://www.ibisworld.com/united-states/industry/chemical-product-manufacturing/503/#RelatedIndustries
[lxxv] Bart Fischer et al., 2024, *Concentration and Competition in the U.S. Fertilizer Industry*, https://afpc.tamu.edu/research/publications/files/725/BP-24-1_AFPC-Fertilizer-Markets-May-2024.pdf
[lxxvi] Solvay Chemicals, n.d., *Hydrogen Peroxide Safety & Handling Technical Data Sheet*, https://www.solvay.com/sites/g/files/srpend616/files/2019-10/H2O2%20Safety%20and%20Handling%20of%20Hydrogen%20Peroxide.pdf
[lxxvii] Chantel Lorbeer et al., 2024, *The state of the chemicals industry: Time for bold action and innovation*, https://www.mckinsey.com/industries/chemicals/our-insights/the-state-of-the-chemicals-industry-time-for-bold-action-and-innovation
[lxxviii] Grand View Research, n.d., *U.S. Hydrogen Peroxide Market Size & Outlook, 2024-2030*, https://www.grandviewresearch.com/horizon/outlook/hydrogen-peroxide-market/united-states
[lxxix] Globe Newswire, 2025, *Nitrogenous Fertilizer Market Valued at USD 63.55 Billion in 2023, Anticipated at USD 105.36 Billion by 2032 with 5.78% CAGR Driven by Sustainability and Digital Innovation | SNS Insider*, https://www.globenewswire.com/news-release/2025/04/10/3059373/0/en/Nitrogenous-Fertilizer-Market-Valued-at-USD-63-55-Billion-in-2023-Anticipated-at-USD-105-36-Billion-by-2032-with-5-78-CAGR-Driven-by-Sustainability-and-Digital-Innovation-SNS-Insid.html
[lxxx] Australia's Nuclear Science and Technology Organisation, 2020, *Producing less costly, greener hydrogen peroxide*, https://www.ansto.gov.au/news/producing-less-costly-greener-hydrogen-peroxide
[lxxxi] U.S. Department of Energy, 2024, *Chemicals Value Chain Decarbonization: Integrated Solutions for a Complex Challenge*, https://www.energy.gov/eere/iedo/articles/chemicals-value-chain-decarbonization-integrated-solutions-complex-challenge
[lxxxii] Bart Fischer et al., 2024, *Concentration and Competition in the U.S. Fertilizer Industry*, https://afpc.tamu.edu/research/publications/files/725/BP-24-1_AFPC-Fertilizer-Markets-May-2024.pdf
[lxxxiii] Fertilizers Europe, n.d., *Decarbonising Fertilizers by 2050*, https://www.fertilizerseurope.com/decarbonising-fertilizers-by-2050/
[lxxxiv] Brielle Jaekel, 2021, *The Difference in Transporting Fresh vs. Frozen Foods*, https://www.foodlogistics.com/transportation/3pl-4pl/article/21283034/the-difference-in-transporting-fresh-vs-frozen-foods
[lxxxv] Jim Damicis and Angela Hallowell, 2024, *Growth, Change Creates Opportunities in Food Manufacturing and Processing*, https://camoinassociates.com/resources/growth-change-in-food-manufacturinging-creates-opportunities/
[lxxxvi] European Commission, n.d., *Climate-friendly alternatives to HFCs*, https://climate.ec.europa.eu/eu-action/fluorinated-greenhouse-gases/climate-friendly-alternatives-hfcs_en
[lxxxvii] U.S. Environmental Protection Agency, 2025, *Fluorinated Gas Emissions*, https://www.epa.gov/ghgemissions/fluorinated-gas-emissions
[lxxxviii] Saint-Gobain, n.d., *Glass Manufacturing Process*, https://in.saint-gobain-glass.com/knowledge-center/glass-manufacturing-process

[lxxxix] Grand View Research, n.d., *Glass Manufacturing Market Size, Share & Trends Analysis Report By Material (Container Glass, Flat Glass, Fiber Glass), By Application (Packaging, Construction, Transportation), By Region, And Segment Forecasts, 2025 – 2030*, https://www.grandviewresearch.com/industry-analysis/glass-manufacturing-market#

[xc] American Iron and Steel Institute, n.d., *Steel Production*, https://www.steel.org/steel-technology/steel-production/

[xci] The Aluminum Association, n.d., *Primary Production 101*, https://www.aluminum.org/primary-production-101

[xcii] The Aluminum Association, n.d., *Secondary Production 101*, https://www.aluminum.org/secondary-production-101

[xciii] The Aluminum Association, n.d., *Meet Aluminum: The Miracle Metal*, https://www.aluminum.org/aluminum-miracle-metal

[xciv] Fortune Business Insights, 2025, *Aluminium Market Size, Share & Industry Analysis, By Product (Sheet, Plate, Cast Products, Extrusion, and Others), By Alloy Type (Cast Alloy and Wrought Alloy), By End-use (Construction, Transportation {Aerospace, Automotive, and Marine}, Packaging {Food & Beverages, Cosmetics, and Others}, Electrical, Consumer Durables, Machinery & Equipment, and Others), and Regional Forecast, 2024-2032*, https://www.fortunebusinessinsights.com/industry-reports/segmentation/aluminium-market-100233

[xcv] International Carbon Action Partnership, 2023, *UPDATE: Pennsylvania Court rules against RGGI link; government appeals*, https://icapcarbonaction.com/en/news/update-pennsylvania-court-rules-against-rggi-link-government-appeals

[xcvi] Grand View Research, n.d., *Steel Market Size, Share & Trends Analysis Report By Product (Flat Steel, Long Steel), By Application (Building & Construction, Automotive & Transportation, Heavy Industries), By Region, And Segment Forecasts, 2025 – 2030*, https://www.grandviewresearch.com/industry-analysis/steel-market

[xcvii] Alliance for Innovation and Infrastructure, 2024, *America's Backbone: The importance of steel and its evolving demand,* https://www.aii.org/wp-content/uploads/2024/09/Americas-Backbone_The-importance-of-steel-and-its-evolving-demand.pdf

[xcviii] Nucor, 2024, *Nucor Board of Directors Approves Funding for New Pacific Northwest Rebar Micro Mill*, https://investors.nucor.com/news/news-details/2024/Nucor-Board-of-Directors-Approves-Funding-for-New-Pacific-Northwest-Rebar-Micro-Mill/default.aspx

[xcix] Jelena Aleksić and Daniel Vargas, 2023, *Aluminium demand will rise 40% by 2030. Here's how to make it sustainable*, https://www.weforum.org/stories/2023/11/aluminium-demand-how-to-make-it-sustainable/

[c] John Cooney and Marwa Abdelghani, 2025, *The Aluminum Rush: Forecast Demand for a Critical Metal*, https://cdn.sanity.io/files/xdjws328/production/fbc5872b29586743d49989ae9da1c00a18163558.pdf

[ci] Western Washington University, 2025, *Washington State Refinery Economic Impact Study*, https://www.cleanenergytransition.org/post/washington-state-refinery-economic-impact-study

[cii] U.S. Energy Information Administration, 2025, *Washington – State Profile and Energy Estimates: Profile Overview*, https://www.eia.gov/state/?sid=WA

[ciii] U.S. Energy Information Administration, 2025, *Washington – State Profile and Energy Estimates: Profile Analysis*, https://www.eia.gov/state/analysis.php?sid=WA

[civ] U.S. Energy Information Administration, 2015, *Net petroleum product exports continue to increase*, https://www.eia.gov/todayinenergy/detail.php?id=21972

[cv] U.S. Energy Information Administration, 2025, *Petroleum & Other Liquids – PAD District Imports by Country of Origin*, https://www.eia.gov/dnav/pet/pet_move_impcp_d_r50_z00_mbbl_a.htm

[cvi] Roots Analysis, n.d., *Industrial Gases Market*, https://www.rootsanalysis.com/industrial-gases-market

[cvii] Paul Martin, 2024, *Hydrogen trade: Can shipping deliver a global hydrogen market?*, https://h2sciencecoalition.com/blog/hydrogen-trade-can-shipping-deliver-a-global-hydrogen-market/

[cviii] Western Washington University, 2025, *Washington State Refinery Economic Impact Study*, https://www.cleanenergytransition.org/post/washington-state-refinery-economic-impact-study

[cix] Grand View Research, n.d., *U.S. Hydrogen Generation Market Size, Share & Trends Analysis Report By Systems, By Technology (Steam Methane Reforming, Coal Gasification), By Application, By Source, And Segment Forecasts, 2024 - 2030*, https://www.grandviewresearch.com/industry-analysis/us-hydrogen-generation-market-report

[cx] U.S. Department of Energy, n.d., *U.S. National Hydrogen Strategy and Roadmap*, https://www.hydrogen.energy.gov/library/roadmaps-vision/clean-hydrogen-strategy-roadmap

[cxi] BP, 2024, *bp's Cherry Point refinery turns feedstock into renewable diesel fuel. Here's how*, https://www.bp.com/en_us/united-states/home/news/features-and-highlights/bps-cherry-point-refinery-turns-feedstock-into-renewable-diesel-fuel-heres-how.html
[cxii] U.S. Department of Energy, 2015, *Bandwidth Study U.S. Petroleum Refining*, https://www.energy.gov/eere/iedo/articles/bandwidth-study-us-petroleum-refining?nrg_redirect=427901
[cxiii] U.S. Energy Information Administration, 2016, *Hydrogen for refineries is increasingly provided by industrial suppliers*, https://www.eia.gov/todayinenergy/detail.php?id=24612
[cxiv] Molly Charles et al., 2024, *The role of the pulp and paper industry in achieving net zero U.S. CO2 emissions in 2050*, https://www.sciencedirect.com/science/article/pii/S2666278724000369
[cxv] Semiconductor Industry Association, n.d., *Frequently Asked Questions*, https://www.semiconductors.org/semiconductors-101/frequently-asked-questions/
[cxvi] Roots Analysis, n.d., Semiconductor Market, https://www.rootsanalysis.com/semiconductor-market
[cxvii] PwC, 2024, *State of the semiconductor industry*, https://www.pwc.com/gx/en/industries/technology/state-of-the-semicon-industry.html
[cxviii] Semiconductor Industry Association, 2024, *America Projected to Triple Semiconductor Manufacturing Capacity by 2032, the Largest Rate of Growth in the World*, https://www.semiconductors.org/america-projected-to-triple-semiconductor-manufacturing-capacity-by-2032-the-largest-rate-of-growth-in-the-world/
[cxix] National Institute of Standards and Technology, 2025, *Analog Devices Inc. (Washington)*, https://www.nist.gov/chips/analog-devices-inc-washington-camas
[cxx] Washington State Department of Commerce, 2024, *Working group named targeting billions in CHIPS and Science Act funding for Washington state*, https://www.commerce.wa.gov/working-group-named-targeting-billions-in-chips-and-science-act-funding-for-washington-state/
[cxxi] U.S. Environmental Protection Agency, 2025, *Semiconductor Industry*, https://www.epa.gov/eps-partnership/semiconductor-industry