2024 Community Greenhouse Gas Emissions Inventory Report

City of Seattle

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Letter from OSE Director Lylianna Allala

Dear friends and partners,

As I reflect on the findings of Seattle's 2024 greenhouse gas inventory, I see both meaningful progress and a clear call to deepen our work.

Seattle's core emissions are approximately 18% below 2008 levels, even as our population has grown by a third and our region's economy has nearly doubled. **These results show what sustained policy, collective action, and cleaner infrastructure can accomplish.**

The findings also show how much further we have to go. Transportation remains our largest source of climate pollution, and fossil gas continues to produce most emissions from buildings. Seattle has committed to reducing emissions 58% below 2008 levels by 2030 — nearly halving them in six years. **The progress documented here should strengthen our resolve to accelerate the work ahead.**

That bold action is grounded in a principle that guides our office's work: caring for the environment begins with caring for one another. Reducing emissions must also mean cleaner air, safer and healthier homes, accessible ways to travel, protection from extreme heat and flooding, and pathways to family-wage careers.

Seattle is showing our commitment to bold and just climate action through proven, data-informed strategies that deliver results. Seattle's Building Emissions Performance Standard (BEPS) and Clean Heat Program, which help Seattle residents and commercial building owners to transition off fossil fuels, are projected to reduce building emissions by a combined 35% by 2050. Seattle is also making progress toward cutting emissions from all City-owned buildings by 2042.

Programs like the Building Decarbonization Grant provide funding to help building owners comply with BEPS while prioritizing support for affordable and senior housing, nonprofit-owned or occupied buildings, and buildings in or serving communities disproportionately affected by the impacts of climate change.

Investments that grow the clean energy workforce and that support community-led climate and environmental justice solutions enable cross-sectoral participation in bold and unified climate action across the city.

Across City government, **Seattle City Light** provides low-carbon electricity while strengthening the grid that makes it possible to electrify transportation and buildings. The **Department of Transportation** is implementing voter-approved investments and expanding safe, reliable, low-pollution travel options. **Seattle Public Utilities** is

strengthening waste prevention, supporting reuse and salvage of building materials, and funding projects that help communities prepare for flooding. Our partners across housing, planning, economic development, parks, public health, and emergency management are essential to making **climate-friendly choices practical, affordable, and accessible for everyone.**

The inventory reminds us that emissions numbers alone cannot show who breathes the most polluted air, who can afford efficient heating and cooling, or whether investments reach neighborhoods with the greatest need. **As we finalize Seattle's Climate Action Plan update, we will connect climate goals to action by identifying bold strategies with cross-cutting benefits.**

Cities across the country face a difficult challenge: increasingly experiencing the impacts of climate change amidst the pace of real-world change. That shared challenge should push us to move with greater urgency to work across sectors, to scale the approaches that are working, and make the transformational decisions this moment requires. I look forward to doing that with you.

In partnership,

Lylianna Allala
Director
Seattle Office of Sustainability and Environment

Executive Summary

Seattle conducts a greenhouse gas emissions inventory every two years to better understand the scope and scale of our local climate footprint. This inventory covers emissions in three key areas: road transportation, buildings, and waste. The City publishes inventory results usually two years after the data year due to the complexity, availability of data, and collaboration required to compile an inventory.

Seattle's greenhouse gas emissions declined between 2022 and 2024, continuing a long-term trend of reducing climate pollution while the city has grown.

In 2024, Seattle's core emissions from road transportation, building energy use, and waste management declined 6% since 2022 and 18% since the 2008 baseline year. Over the same period, Seattle's population grew 32%, from about 594,000 residents in 2008 to 781,000 in 2024. Seattle's regional economy grew 94%. As a result, core emissions per resident have fallen by 37% since 2008.

These findings demonstrate that the city can grow while concurrently reducing local greenhouse gas emissions. At the same time, they show that Seattle's progress is short of what is required to meet the City's climate goals to reduce emissions 58% below 2008 levels by 2030 and 87% by 2050. Data from 2024 shows that emissions need to decline by 49% by 2030, requiring reductions at roughly nine times the current annual pace.

Transportation remains Seattle's largest emissions source

Road transportation accounts for more than half of Seattle's inventory. Transportation emissions were less than 1% higher than in 2022 and 22% below 2008. Seattle residents are driving substantially less than they did in the baseline year. Estimated vehicle miles traveled per resident declined 28%, and the share of electric vehicles is on the rise. However, improvements in passenger travel were offset by emissions from increased freight activity.

Building emissions declined from their 2022 peak

Residential and commercial buildings accounted for around 41% of emissions in 2024. Building emissions were 14% below 2022, largely as a result of a spike in fossil-gas consumption in 2022. Building emissions were 10% below 2008, and 32% lower per resident than in 2008. Fossil gas continues to produce a majority of Seattle's building emissions, despite electricity having supplied more than half of total building energy use in 2024.

Waste emissions remain below the baseline but increased since 2022

Waste management made up just under 3% of Seattle's emissions in 2024. This was 7% higher than in 2022, but 26% below 2008. The recent increase was driven primarily by higher amounts of commercial waste, while residential and self-haul waste emissions remained comparatively stable.

What comes next

Seattle has established policies and investments that can support deeper future reductions. In buildings, the Building Emissions Performance Standard (BEPS) is projected to reduce annual building emissions by 12% of Seattle's 2024 core emissions. In transportation, the voter-approved $1.55 billion Transportation Levy is expanding walking, biking, transit, and safety infrastructure, alongside Low-Pollution Neighborhood planning and continued vehicle electrification. Waste-related work includes expanding and improving waste prevention, deconstruction, salvage and reuse of building materials, and access to reused lumber and other materials.

The scale of the remaining gap to our targets means that Seattle will need to build on these efforts and identify additional actions. These 2024 findings will inform **Seattle's Climate Action Plan update**, which will lay out actions required to move Seattle closer to its emissions targets while also improving resilience, health, affordability, and economic opportunity. The updated plan will also address some of the limitations of the inventory data by strengthening how the City measures climate progress, expanding emissions tracking to also track implementation, intended results, benefits to overburdened communities, climate change progression, and economic equity.

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Introduction and Context

The Role of a Greenhouse Gas Inventory in Equity-Centered Climate Action

Tracking greenhouse gas (GHG) emissions and Seattle's major emissions sources helps the City develop effective programs and policies designed to reduce climate impacts. This inventory reports on the sources and magnitude of Seattle's GHG emissions and provides short- and long-term trends so the City and its residents can better understand where emissions are changing and where future action can have the greatest impact.

Seattle conducts a community GHG emissions inventory every two years. The core inventory tracks emissions from three key areas: road transportation, buildings, and waste, while the expanded inventory includes additional sources such as air travel, industry, and wastewater. Inventory results are typically published about two years after the data year because of the time required for data to become available and for the City and its partners to compile, review, and quality-check the inventory.

Seattle's climate work has helped emissions remain below 2008 levels even as the city has grown. At the same time, the 2024 inventory continues to show that the pace of reductions is not yet aligned with the scale of the climate crisis. The report therefore uses the inventory both as an accountability tool and as a prompt to improve how Seattle measures and communicates climate impacts beyond this traditional emissions accounting frame.

Centering Climate Justice

Climate change is a racial justice issue at its core. A citywide emissions inventory is useful for showing broad trends, but it is not detailed enough on its own to show how climate pollution, energy burden, air quality, heat, and climate risk are distributed across Seattle communities.

For that reason, the results of this report should be considered alongside Seattle's broader approach to climate justice, such as investing in community organizations and entities on the frontlines of climate justice work or collaborating with workers and regional partners to build an inclusive climate workforce. These efforts support community-led climate solutions, investments in communities most affected by climate pollution and climate impacts, and a broader accountability framework than a citywide emissions inventory can provide on its own.

The Climate Action Plan update is also part of this shift toward a more holistic approach to climate work and progress tracking. The update is intended to develop a modernized

Climate Action Plan focused on climate resilience and adaptation, building a green economy, protecting public health, and near-term actions to reduce transportation emissions. This broader approach requires tracking implementation progress, resilience, public health, affordability, and equity outcomes alongside emissions reductions.

ICLEI and Scope of Emissions

ICLEI – Local Governments for Sustainability is a network of local and regional governments committed to sustainable development. This inventory follows ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, supporting consistent community-scale GHG accounting and comparisons with prior Seattle inventories.

The emission sources covered in the core emissions inventory correspond to ICLEI's local government significant influence framework. The expanded emissions inventory corresponds to ICLEI's community-wide activities framework and includes additional GHG emissions released within community boundaries or associated with community activities, such as energy consumption, travel, freight, industrial processes, and waste disposal. This core/expanded framing is related to, but not identical with, Scope 1 and Scope 2 accounting; this report uses core and expanded terminology because those categories are the basis of Seattle's historical inventory framework.

Core Emissions Sources

Core emissions include the transportation, buildings, and waste sectors as well as GHG offsets. Core emissions sources are those the City can most directly and significantly influence. Most of the City's climate policies and programs are aimed at reducing core emissions.

Buildings

- **Residential:** Heating oil, Puget Sound Energy fossil gas, and Seattle City Light electricity
- **Commercial:** CenTrio steam, heating oil, Puget Sound Energy fossil gas, Seattle City Light electricity, and University of Washington steam

Transportation

- **Passenger road travel:** Buses, cars, and light-duty trucks
- **Freight road travel:** Medium- and heavy-duty trucks

Waste

- Residential, commercial, and self-haul waste: All disposed waste materials

Offsets

- Seattle City Light offsets associated with residential and commercial activity

Expanded Emissions Sources

Expanded emissions include all core emission sectors as well as additional sectors, subsectors, and categories.

Buildings

- Residential yard equipment
- Commercial equipment

Industry

- **Energy use:** Industrial equipment, heating oil, Puget Sound Energy fossil gas, Seattle City Light electricity, and King County Wastewater Treatment
- **Fugitive gases:** Gas infrastructure leaks and SF_6 from electrical switchgear
- **Industrial processes:** Cement, glass, and steel production

Transportation

- **Air travel:** King County International Airport and Seattle-Tacoma International Airport
- **Marine:** Hotelling, pleasure craft, Washington State Ferries, and other vessel traffic
- **Rail:** Freight and passenger rail

Waste

- Construction and demolition waste
- Wastewater fugitive emissions

Sequestration

- Carbon stored in high-carbon-content waste materials from residential, commercial, and self-haul waste

Offsets

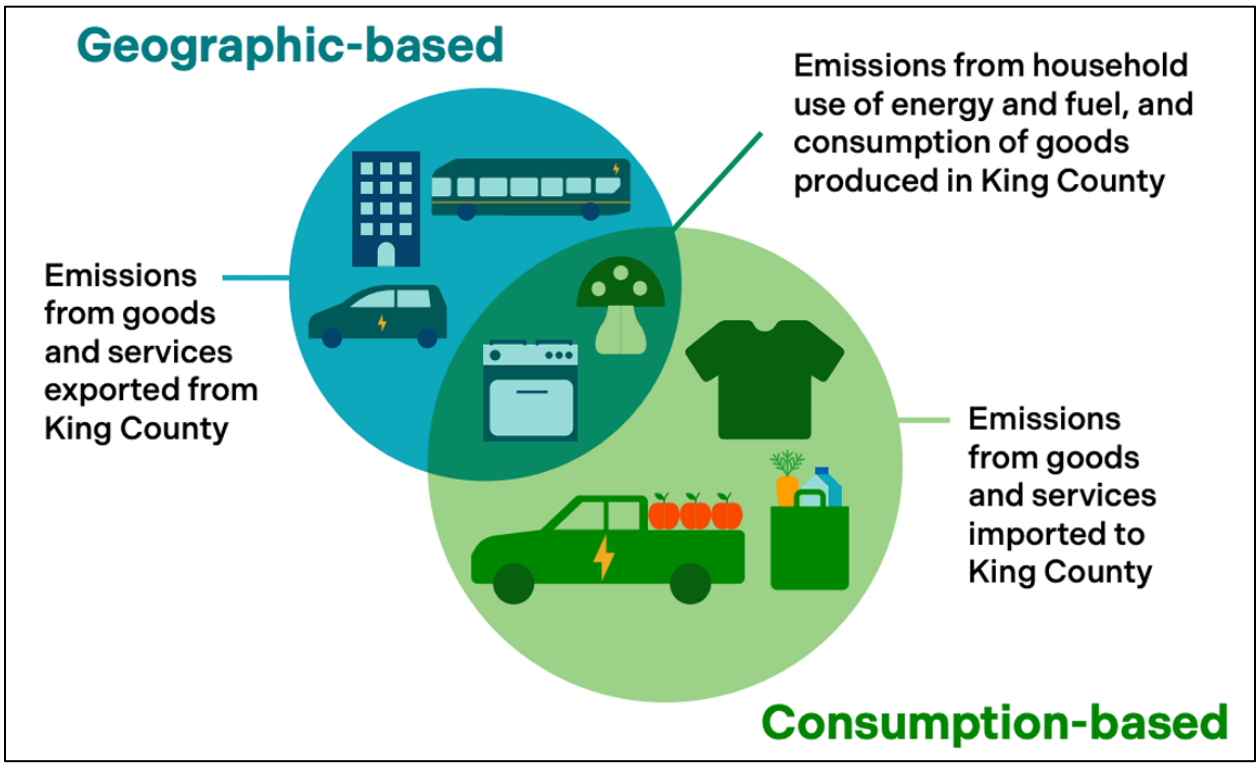
- Seattle City Light offsets associated with industrial activity
- King County Wastewater Treatment Division offsets

Consumption-based Emissions

Consumption-based inventories account for the emissions associated with the goods and services consumed within the community, no matter where they are produced. This includes embodied emissions associated with production, transportation, use, and disposal of goods, food, travel, and services consumed by Seattle households and businesses.

For example, while the core and expanded inventories capture the emissions generated by a car while it is being driven in Seattle, they do not capture the emissions generated elsewhere in sourcing the raw materials or assembling the vehicle in a factory. Those emissions likely occurred outside Seattle, but they are still associated with the consumption choices and economic activity that support life in the city. Figure 1 illustrates the difference in scale and boundary between sector-based and consumption-based accounting.

Figure 1: Comparison graphic showing the scale and boundary differences between sector-based emissions and consumption-based emissions from King County's 2023 Consumption-based Emissions Inventory Report.



As shown in Figure 1, consumption-based inventories use a broader boundary than the core and expanded inventories in this report. They help show how household consumption, supply chains, food systems, construction materials, and other goods and services contribute to climate pollution beyond Seattle's geographic boundaries.

King County's 2023 consumption-based GHG inventory report found that the average household's emissions decreased compared with 2007 and that King County's per-household emissions were lower than the Washington state average. This regional consumption-based frame complements Seattle's sector-based inventory by showing that upstream emissions from goods, services, materials, food, and travel remain important even when they occur outside city boundaries.

To advance Seattle's vision of zero waste, Seattle increasingly focuses on waste prevention strategies that reduce the upstream emissions associated with producing, transporting, using, and disposing of goods. This includes food waste prevention and rescue, building deconstruction and salvage, and promotion of reuse and repair.

Data Source Considerations

The City's greenhouse gas inventory is built from a wide range of underlying datasets that vary significantly in accuracy, granularity, methodology, and certainty. Some emissions sources, such as building energy use, rely primarily on measured utility consumption data and therefore provide a relatively direct estimate of emissions. Other sectors, such as roadway transportation, rely more heavily on modeled data inputs and assumptions.

For example, roadway transportation emissions depend on regional travel demand modeling, vehicle miles traveled (VMT) estimates, and associated emissions factors. These datasets often require interpolation, forecasting, and allocation assumptions to estimate emissions for non-model years. As a result, modeled outputs may change over time as methodologies, assumptions, and source datasets evolve.

Methodologies and data sources can change between inventory cycles, sometimes resulting in revisions to historical emissions values. In the 2024 inventory, two issues from the published 2022 inventory were corrected through quality assurance review: a PSE query issue that had previously understated 2022 fossil gas consumption by 18%, and a transportation unit conversion error in the inventory's use of PSRC-modeled data that over-reported 2018-2022 road emissions by roughly 10%. These revisions improve the accuracy and consistency of the inventory before publication, while also underscoring that older published inventory values should not be directly compared with newer reports. The most recent inventory version should generally be treated as the best available historical dataset because it incorporates updated methodologies, revised datasets, and improved calculations.

As the City evaluates emissions trends and develops future climate policies, it is important to consider both the strengths and limitations of individual data sources and to recognize varying levels of certainty across sectors. In addition, a traditional emissions inventory is primarily designed to measure citywide emissions outcomes and is less effective at evaluating adaptation and resilience outcomes, programmatic effectiveness, equity impacts, implementation progress, or neighborhood-scale climate conditions.

Core Emissions: Data Profiles

Buildings: Electricity and Fossil Gas

Data source: Measured utility energy use from Seattle City Light and Puget Sound Energy

Certainty: High. based on measured or billed utility consumption; calculated emissions also depend on utility emissions factors.

Granularity: High. annual data by sector or customer class, with Census tract detail where available.

Buildings: Heating Oil

Data source: EIA and Census data

Certainty: Low. estimates based on regional and national data, and not actual consumption data.

Granularity: Low. annual data, not seasonal or spatial.

Transportation: Cars and Trucks

Data source: PSRC SoundCast 2023 VMT and emissions estimates, scaled to inventory years

Certainty: Low/Medium. VMT and emissions are modeled; non-model years are estimated using regional VMT trends.

Granularity: High. Census tract-level VMT by passenger and medium- and heavy-duty truck categories.

Waste

Data source: SPU waste tonnage reports and waste composition studies by sector

Certainty: Medium/High. disposal tonnage is reported, while emissions depend on sampled composition data and modeled landfill factors.

Granularity: High. detailed material and stream categories, but limited spatial or seasonal detail.

Expanded Emissions: Data Profiles

Industry: Steel, cement, and glass production

Data source: Washington State greenhouse gas reporting data for cement; EPA FLIGHT facility reports for steel and glass (latest available year)

Certainty: Medium. facility-reported emissions, but reporting methods and use of prior-year data for steel and glass add uncertainty.

Granularity: Medium/High. annual data by large emitting facility, but no seasonal detail.

Industry: Electricity and Fossil Gas

Data source: Measured utility energy use from Seattle City Light and Puget Sound Energy

Certainty: High. based on measured or billed utility consumption; calculated emissions also depend on utility emissions factors.

Granularity: High. annual data by industrial customer class; geographic detail varies by utility dataset.

Industry: Non-road equipment

Data source: King County MOVES5 modeled estimates scaled to Seattle; legacy NONROAD estimates through 2014

Certainty: Low/Medium. current EPA-modeled estimates, but not measured local activity; Seattle values are proportionally scaled from King County.

Granularity: Medium. annual estimates by equipment sector and fuel type, but no seasonal or Seattle-specific activity detail.

Transportation: Air

Data source: Reported airport fuel consumption; Sea-Tac allocation using King County passenger activity and Seattle's share of King County population; full attribution of King County International Airport fuel to Seattle

Certainty: Low. Reported airport fuel volumes, but estimated Sea-Tac allocation and geographic attribution of King County International Airport fuel

Granularity: Low. annual fuel volumes by airport and fuel type; limited trip-purpose, origin-and-destination, cargo, and route-distance detail.

Transportation: Marine

Data source: Puget Sound Maritime Air Emissions Inventory, ferry fuel data, and King County MOVES5 pleasure-craft estimates; legacy NONROAD estimates through 2014

Certainty: Low/Medium. ferry estimates use reported fuel consumption; other-vessel and pleasure-craft emissions are modeled or geographically allocated.

Granularity: Medium. annual estimates by marine activity type, but limited spatial and temporal detail.

Transportation: Rail

Data source: Fuel use and ridership or service data from Amtrak and Sound Transit

Certainty: Medium. Sound Transit fuel use is reported directly; Amtrak emissions require estimation or allocation.

Granularity: Medium. annual data by operator or mode, but limited trip-level or seasonal detail.

Buildings: Non-road equipment

Data source: King County MOVES5 modeled estimates scaled to Seattle; legacy NONROAD estimates through 2014

Certainty: Low/Medium. current EPA-modeled estimates, but not measured local activity; Seattle values are proportionally scaled from King County.

Granularity: Medium. annual estimates by equipment sector and fuel type, but no seasonal or Seattle-specific activity detail.

Seattle's Climate Goals

Seattle remains committed to the emissions reduction targets established through a 2011 Council resolution, including a 58% reduction in core emissions by 2030 and net-zero carbon emissions by 2050. Seattle's 2013 Climate Action Plan and 2018 Climate Action Strategy identified focused actions in the transportation and building sectors, and the current Climate Action Plan update is intended to guide the next phase of implementation.

The 2024 inventory shows continued progress relative to 2008, but also shows that reductions are not yet moving fast enough. Using the before-offset accounting basis applied in this report, core emissions would need to fall to about 1.4 million mtCO2e by

2030 to hit the 2030 interim target. From the 2024 level, that means a further reduction of about 49% by 2030, or roughly 8% per year on a straight-line basis.

Interpreting Post-Pandemic Trends

Because 2020 and 2022 were shaped by pandemic-related disruption and recovery, this report uses 2018 selectively as a pre-pandemic reference point. The 2008 baseline remains the primary measure of long-term progress, while 2022 provides the comparison with the prior inventory.

At a high level, 2024 reflects a lower post-pandemic emissions pattern than 2018, but the change is not uniform across sectors. The sections that follow distinguish this broad citywide result from the sector-specific trends that produced it.

2024 Inventory: Key Findings

Summary

Seattle's three core emissions sectors produced around 2.8 million mtCO2e before offsets in 2024 – about 18% below the 2008 baseline and about 6% lower than 2022. Over the same period, Seattle's population grew about 32% and regional Gross Domestic Product (GDP) grew about 94%, widening the gap between emissions and population and economic growth.

Between 2008 and 2018 – the last inventory year before the pandemic – core emissions declined by about 7% while population grew by about 26%. From 2018 to 2024, core emissions fell by a further 11%, even as population grew by about 5% and regional GDP grew by about 7%. The more recent decline was driven largely by road transportation: road transportation emissions fell about 7% between 2008 and 2018, then another 16% between 2018 and 2024. Building emissions declined about 6% from 2008 to 2018 and about 4% from 2018 to 2024, while waste emissions fell substantially before 2018 but were roughly unchanged between 2018 and 2024.

These figures show that Seattle's emissions remained below pre-pandemic levels and declined more quickly after 2018, but progress has been uneven across sectors. Substantial emissions remain, and reductions are not yet deep or broad enough across all major sectors. Using the before-offset accounting basis applied in this report, core emissions would need to fall a further 49% from 2024 levels by 2030 to reach the interim target of a 58% reduction – roughly 8% per year on a straight-line basis.

Transportation Sector

Road transportation emissions were around 1.6 million mtCO2e in 2024, essentially flat compared with 2022, 16% lower than 2018, and about 22% lower than 2008. Transportation remains the largest core emissions sector, and the 2024 inventory also corrects a unit-conversion error that lowers previously reported 2018-2022 road emissions by roughly 10%.

Passenger travel declined between 2022 and 2024, placing downward pressure on emissions. However, freight truck activity and freight emissions intensity both increased, offsetting reductions from passenger vehicles and leaving overall road transportation emissions relatively flat. Vehicle electrification also continued to expand and likely moderated emissions growth.

Buildings Sector

Building emissions were around 1.1 million mtCO2e in 2024, about 14% lower than 2022, 4% lower than 2018, and about 10% lower than 2008. Fossil gas remains the dominant source of building emissions, while electricity represents a much smaller share because of Seattle City Light's low-carbon electricity supply.

Building energy use and fossil gas consumption were highest in 2022 before declining again by 2024, suggesting that 2022 likely reflects a post-pandemic rebound period rather than a stable long-term trend. Colder weather contributed to higher fossil gas use in 2022, but the magnitude of the increase was larger than would be expected from the change in heating degree days alone. By 2024, total fossil gas use had returned close to 2020 levels, and benchmarking data for larger buildings show a similar pattern: reported building emissions were elevated in 2022 and declined by 2024, even as building floor area continued to grow and emissions intensity improved.

Waste Sector

Waste management emissions were around 75 thousand mtCO2e in 2024, about 7% higher than 2022 but still about 26% lower than 2008. Waste remains a small share of Seattle's core emissions, but waste prevention, diversion, and material composition affect both local landfill emissions and the broader consumption-based climate impacts that this report cannot fully capture.

The recent increase in waste emissions was driven primarily by the commercial sector, while residential and self-haul emissions increased slightly. The same commercial waste composition study and emissions factors were applied in 2022 and 2024, so the increase primarily reflects changes in tonnage and stream mix rather than an emissions-factor change.

Emissions Overview

Core GHG Emissions

Figure 2 shows the relative contribution of Seattle's core emissions sectors in 2024. Together, road transportation, buildings, and waste management emitted around 2.8 million mtCO2e before offsets in 2024. Transportation remains the largest core sector, followed by buildings and then waste.

Unless otherwise noted, core emissions comparisons in the report narrative are presented before offsets, and expanded emissions comparisons are presented before offsets and sequestration, to emphasize changes in direct emissions. Net totals are shown separately in Tables 1 and 2 for accounting completeness. Table 1 summarizes core GHG emissions for 2008, 2018, 2022, and 2024. Values in the body of this report are rounded for readability; percentage changes in Table 1 are calculated from the unrounded core emissions export.

Figure 2: Seattle's core GHG emissions by sector in 2024.

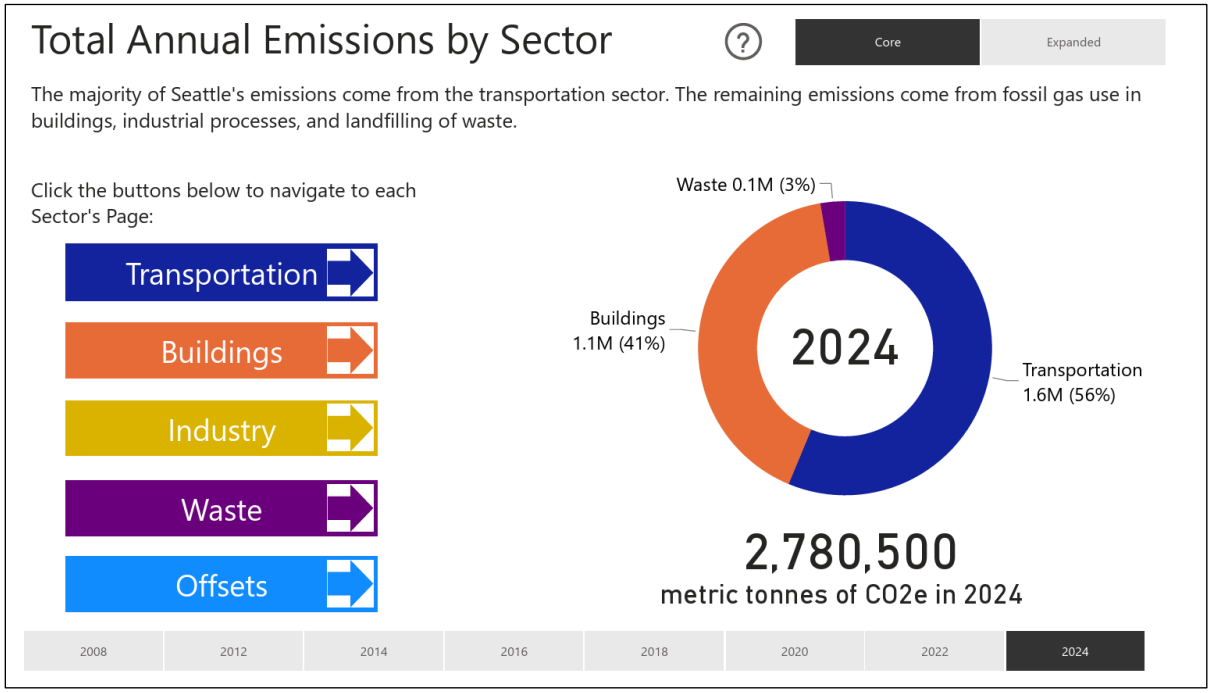


Table 1 includes 2018 to show how each core sector contributed to the overall change between the last pre-pandemic inventory year and 2024.

Road transportation accounted for roughly 86% of the overall decline over that period, while building emissions accounted for roughly 14%. Waste emissions were roughly unchanged.

Table 1: Seattle's core emissions by category in 2024, the prior inventory year (2022), the last pre-pandemic year (2018), and baseline year (2008).

Category (mtCO2e)	2008	2018	2022	2024	% change from 2008	% change from 2018	% change from 2022
Buildings	**1,274,000**	**1,192,000**	**1,329,000**	**1,142,000**	**-10.4%**	**-4.2%**	**-14.1%**
Commercial	**685,000**	**684,000**	**748,000**	**672,000**	**-2.0%**	**-1.8%**	**-10.2%**
CenTrio Steam	92,000	69,000	69,000	65,000	-28.9%	-5.2%	-5.8%
Heating Oil	8,300	200	700	500	-94.1%	164.6%	-26.9%
PSE	413,000	460,000	569,000	469,000	13.5%	1.9%	-17.6%
Seattle City Light	87,000	68,000	24,000	61,000	-30.2%	-11.2%	155.8%
UW Steam	85,000	87,000	86,000	76,000	-10.2%	-11.9%	-11.0%
Residential	**589,000**	**508,000**	**581,000**	**470,000**	**-20.2%**	**-7.4%**	**-19.1%**
Heating Oil	109,000	48,000	39,000	32,000	-70.5%	-33.2%	-17.9%
PSE	432,000	422,000	527,000	400,000	-7.4%	-5.3%	-24.1%
Seattle City Light	49,000	37,000	15,000	38,000	-21.9%	1.6%	155.7%
Offsets	**(135,000)**	**(106,000)**	**(39,000)**	**(99,000)**	**-27.2%**	**-6.6%**	**155.8%**
Transportation	**2,003,000**	**1,869,000**	**1,560,000**	**1,565,000**	**-21.8%**	**-16.2%**	**0.4%**
Road: Passenger	**1,734,000**	**1,599,000**	**1,329,000**	**1,282,000**	**-26.1%**	**-19.8%**	**-3.5%**
Buses	61,000	66,000	45,000	49,000	-20.0%	-26.2%	7.0%
Cars & Light Duty Trucks	1,673,000	1,533,000	1,284,000	1,233,000	-26.3%	-19.5%	-3.9%
Road: Trucks	**269,000**	**270,000**	**231,000**	**284,000**	**5.3%**	**5.0%**	**22.8%**
Medium & Heavy Duty	269,000	270,000	231,000	284,000	5.3%	5.0%	22.8%
Waste	**101,000**	**74,000**	**70,000**	**75,000**	**-26.4%**	**0.1%**	**7.1%**
Commercial	**53,000**	**35,000**	**28,000**	**32,000**	**-39.3%**	**-9.1%**	**14.5%**
Residential	**39,000**	**32,000**	**32,000**	**32,000**	**-16.5%**	**1.8%**	**2.3%**
Self-haul	9,900	7,600	10,000	10,000	4.2%	35.7%	2.0%
Total before offsets	**3,378,000**	**3,135,000**	**2,958,000**	**2,782,000**	**-17.7%**	**-11.3%**	**-6.0%**
Net total after offsets	**3,243,000**	**3,029,000**	**2,920,000**	**2,683,000**	**-17.3%**	**-11.4%**	**-8.1%**

Note: Report narrative uses total core emissions before offsets to emphasize changes in direct sector emissions. The net total is shown separately for accounting completeness. Displayed emissions values and totals are rounded independently from exact inventory values, so a displayed total may differ slightly from the sum of displayed components. Percentage changes are calculated from exact values prior to rounding.

Expanded GHG Emissions

Figure 3 shows the relative contribution of Seattle's expanded emissions sectors in 2024. Expanded positive emissions from transportation, buildings, industry, and waste totaled around 5.8 million mtCO2e before offsets and sequestration in 2024, roughly flat compared with 2022 and about 10% lower than 2008.

Transportation is the largest expanded emissions sector, followed by buildings and industry. Industry emitted around 889 thousand mtCO2e in 2024, while expanded waste emissions were around 100 thousand mtCO2e. Table 2 summarizes expanded GHG emissions for 2008, 2022, and 2024 and separately reports the net total after offsets and sequestration. Expanded values were rounded to the nearest 100, 500, or 1,000 mtCO2e.

Figure 3: Seattle's expanded GHG emissions by sector in 2024.

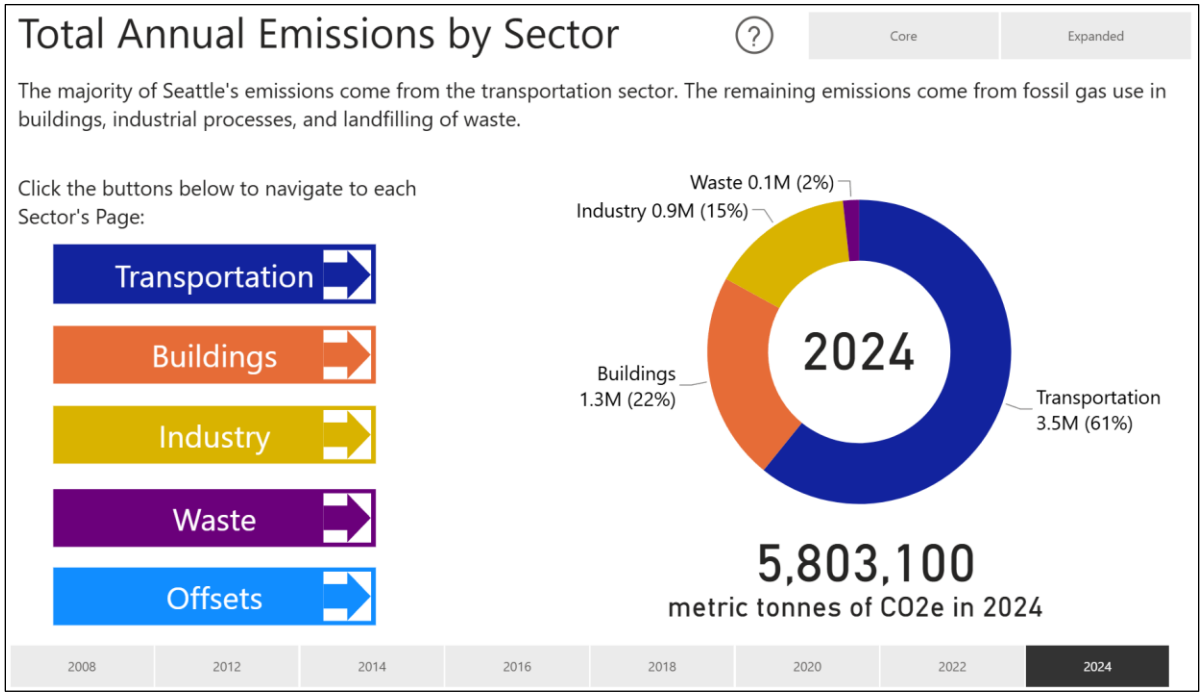


Table 2: Seattle's expanded emissions by category in 2024, the prior inventory year (2022), and baseline year (2008).

Category (mtCO2e)	2008	2022	2024	% change from 2008	% change from 2022
Buildings	**1,432,000**	**1,476,000**	**1,287,000**	**-10.1%**	**-12.8%**
Commercial	**825,000**	**811,000**	**734,000**	**-11.0%**	**-9.5%**
CenTrio Steam	92,000	69,000	65,000	-28.9%	-5.8%
Equipment	140,000	63,000	63,000	-55.1%	-0.2%
Heating Oil	8,000	1,000	0	-94.1%	-26.9%
PSE	413,000	569,000	469,000	13.5%	-17.6%
Seattle City Light	87,000	24,000	61,000	-30.2%	155.8%
UW Steam	85,000	86,000	76,000	-10.2%	-11.0%
Residential	**607,000**	**665,000**	**553,000**	**-8.9%**	**-16.8%**
Heating Oil	109,000	39,000	32,000	-70.5%	-17.9%
PSE	432,000	527,000	400,000	-7.4%	-24.1%
Seattle City Light	49,000	15,000	38,000	-21.9%	155.7%
Yard Equipment	17,000	84,000	83,000	376.6%	-1.3%
Industry	**1,357,000**	**929,000**	**889,000**	**-34.5%**	**-4.4%**
Energy Use	**511,000**	**530,000**	**441,000**	**-13.8%**	**-16.8%**
Equipment	214,000	195,000	195,000	-8.9%	-0.2%
Heating Oil	36,000	11,000	7,000	-80.5%	-35.3%
PSE	246,000	319,000	230,000	-6.5%	-28.0%
Seattle City Light	15,000	4,000	9,000	-41.0%	112.9%
Fugitive Gases	**24,000**	**30,000**	**5,000**	**-76.9%**	**-81.5%**
Process	**822,000**	**370,000**	**442,000**	**-46.2%**	**19.5%**

Category (mtCO2e)	2008	2022	2024	% change from 2008	% change from 2022
Offsets	**(164,000)**	**(57,000)**	**(124,000)**	**-24.3%**	**118.9%**
Sequestration	**(187,000)**	**(169,000)**	**(162,000)**	**-13.3%**	**-4.0%**
Transportation	**3,532,000**	**3,298,000**	**3,529,000**	**-0.1%**	**7.0%**
Air	1,302,000	1,535,000	1,756,000	34.9%	14.4%
Marine	179,000	175,000	175,000	-2.4%	0.0%
Rail	48,000	29,000	33,000	-31.8%	12.4%
Road: Passenger	1,734,000	1,329,000	1,282,000	-26.1%	-3.5%
Road: Trucks	269,000	231,000	284,000	5.3%	22.8%
Waste	**128,900**	**95,600**	**100,100**	**-22.3%**	**4.6%**
Commercial	**52,600**	**27,900**	**31,900**	**-39.3%**	**14.5%**
Construction & Demolition	12,900	7,900	6,300	-51.6%	-20.3%
Residential	**38,700**	**31,600**	**32,300**	**-16.5%**	**2.3%**
Self-haul	9,900	10,100	10,300	4.2%	2.0%
Wastewater	14,700	18,200	19,300	30.8%	5.8%
Total positive emissions	**6,449,900**	**5,798,600**	**5,805,100**	**-10.0%**	**0.1%**
Net total after offsets and sequestration	**6,098,900**	**5,572,600**	**5,519,100**	**-9.5%**	**-1.0%**

Note: Report narrative uses total positive expanded emissions before offsets and sequestration. The net total is shown separately for accounting completeness. Displayed emissions follow the rounding conventions in the source summary workbook. Because some values are rounded at different levels of the inventory hierarchy, displayed subtotals and totals may differ slightly from totals calculated from unrounded values or from the sum of displayed components. Percentage changes are calculated from exact values prior to rounding.

GDP, Population, and Emissions

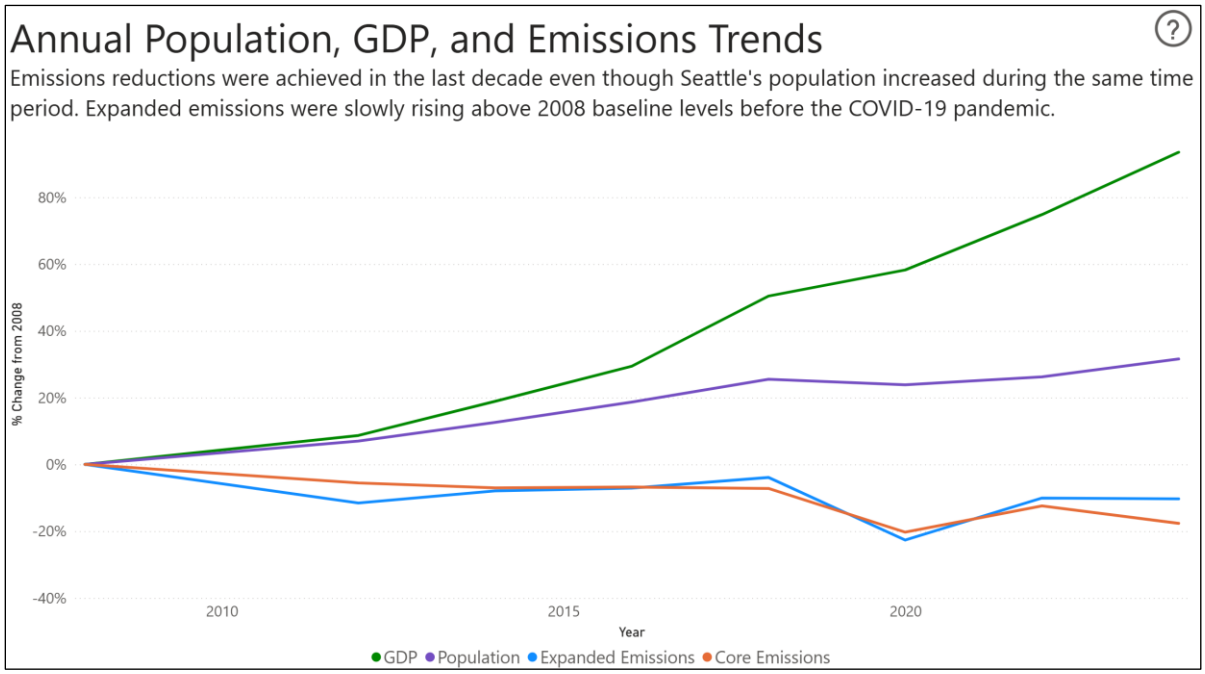
Since 2008, Seattle's population and the region's GDP have grown substantially while emissions have remained below the 2008 baseline. Population grew about 32% between 2008 and 2024, and the region's GDP grew about 94%. Over the same period, core emissions before offsets fell about 18% and expanded positive emissions before offsets and sequestration fell about 10%.

As shown in Figure 4, the gap between population and economic growth and emissions has continued to widen. Several trends provide context for this pattern. Road travel remained below pre-pandemic levels, and remote and hybrid work continued to affect how often and when people commute. Seattle's 2024 Commute Survey found that fully remote work declined from 2022, as more employees returned to their workplaces, but hybrid schedules remained common – particularly remote work on Mondays and Fridays and in-person work from Tuesday through Thursday.[1] Regional data also show that 36% of employees worked from home at least one day per week in 2024, compared with 23% in 2019.[2]

[1] https://www.commuteseattle.com/2024survey/
[2] https://www.psrc.org/about-us/media-hub/third-regions-workers-telework-least-weekly

The composition of Seattle's economy also matters. Growth in sectors that generate substantial economic value does not necessarily produce an equivalent increase in the transportation, building, waste, and industrial emissions measured by the inventory. The inventory does not quantify how much each factor contributed to the overall decline, but these trends help explain why emissions and economic growth can move in different directions.

Figure 4: Percent difference from 2008 Seattle's population, emissions and regional GDP from 2008 to 2024.



Detailed Emissions

Transportation Emissions

In the transportation sector, core road emissions decreased by around 22% since 2008 – from about 2.0 million mtCO2e in 2008 to around 1.6 million mtCO2e in 2024. As shown in Figure 5, road transportation has been Seattle's largest core emissions source since the City began tracking emissions in 1990. Emissions increased through 2008 and have generally declined since then as vehicle fuel economy improved and VMT changed. As noted in the overview, road transportation accounts for most of the overall reduction in core emissions between 2018 and 2024.

VMT fell sharply in 2020, rebounded by 2022, and then declined again by 2024. Total VMT was around 3.9 billion miles in 2024, below both 2022 and 2008 levels, while VMT per resident fell from about 6,900 miles in 2008 to about 5,000 in 2024. Figure 6 shows that passenger VMT declined between 2022 and 2024, while freight truck VMT increased. Freight truck emissions intensity also increased, offsetting reductions from passenger vehicles and helping explain why overall road transportation emissions remained relatively flat. Passenger vehicle emissions per mile remain below 2008 levels, and continued vehicle electrification likely moderated emissions growth.

Figure 5: Core transportation emissions by subsector and commodity.

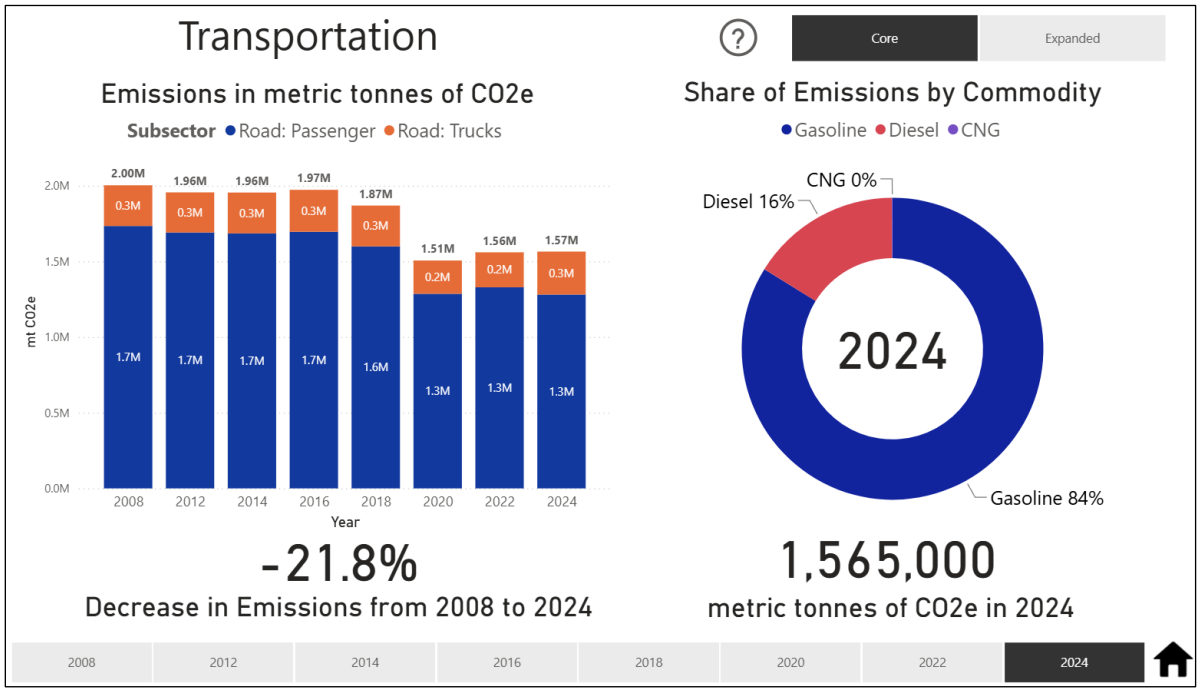
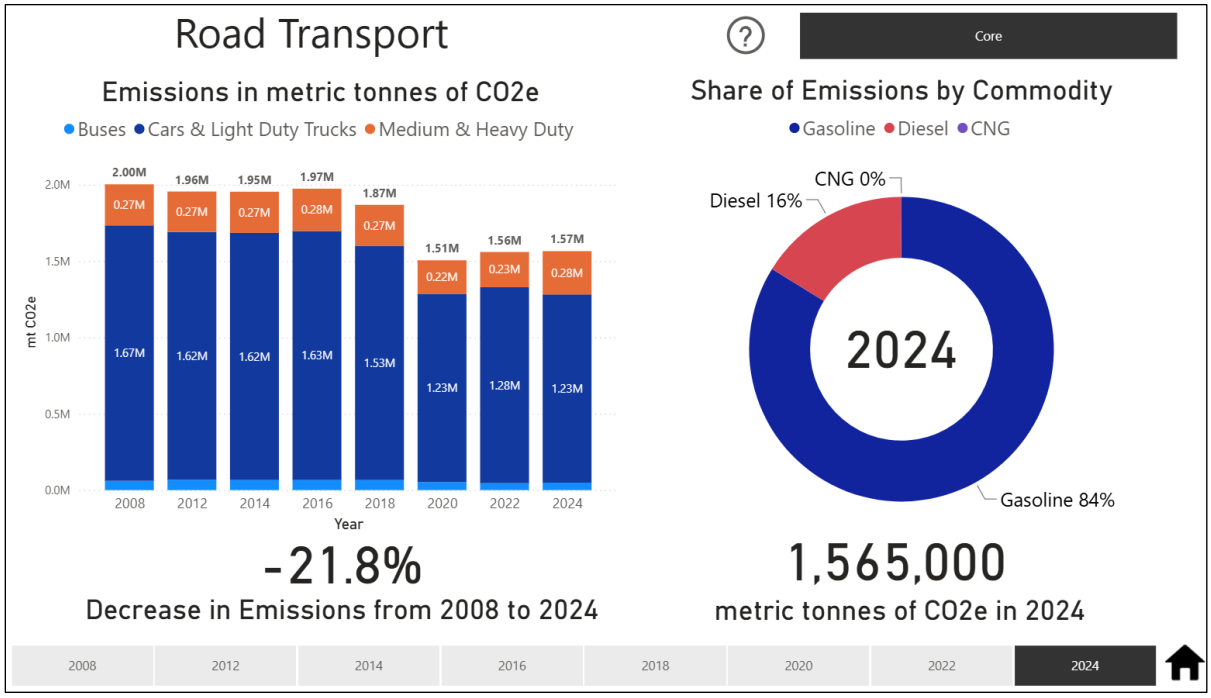


Figure 6: Core road transportation emissions by category and commodity.



Road transportation emissions are calculated from modeled data, which carries a higher level of uncertainty than emissions sources based on measured energy consumption. See Appendix D1: Road Transportation for additional methodology details.

The 2024 inventory also corrects a unit-conversion error in the use of PSRC-modeled data that caused transportation emissions between 2018 and 2022 to be over-reported in prior inventories. Corrected transportation emissions for those years are roughly 10% lower than previously reported.

As shown in Figure 7, expanded transportation emissions were around 3.5 million mtCO2e in 2024, roughly in line with 2008 and higher than 2022. The largest increase from 2022 came from air travel, which rose to about 1.8 million mtCO2e in 2024. This is the first inventory year in which air-travel emissions returned above pre-pandemic levels. Figure 8 provides the airport-level breakdown of those emissions.

Figure 7: Expanded transportation emissions by category and commodity.

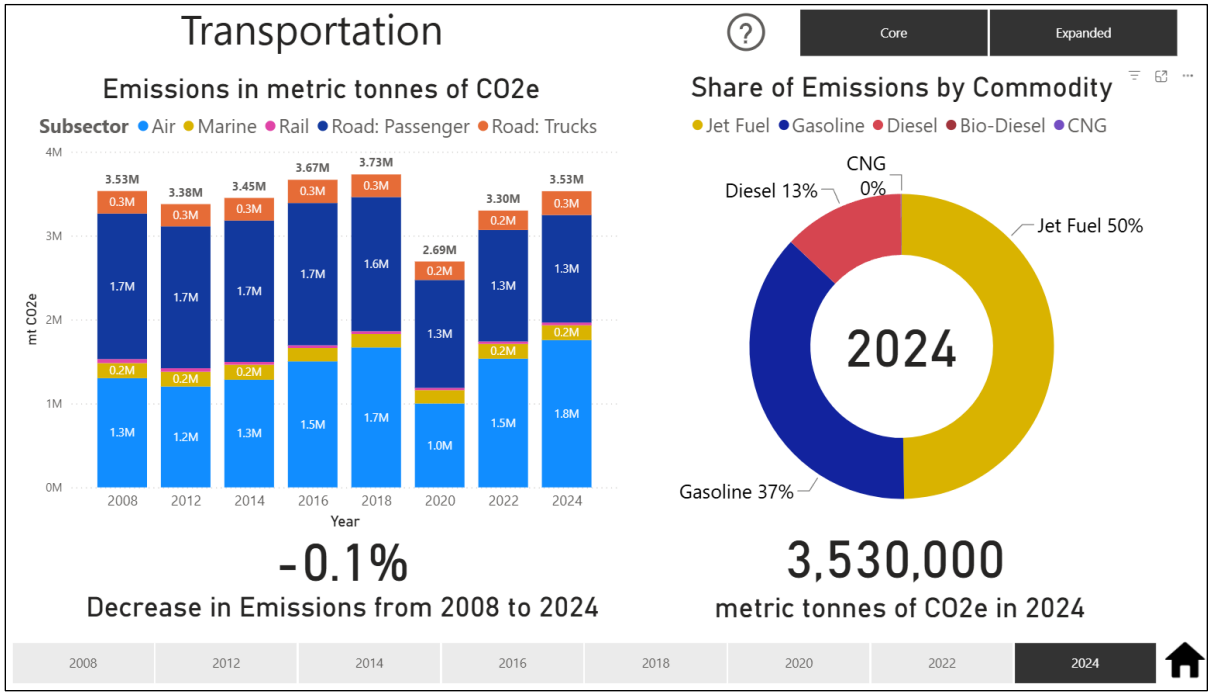
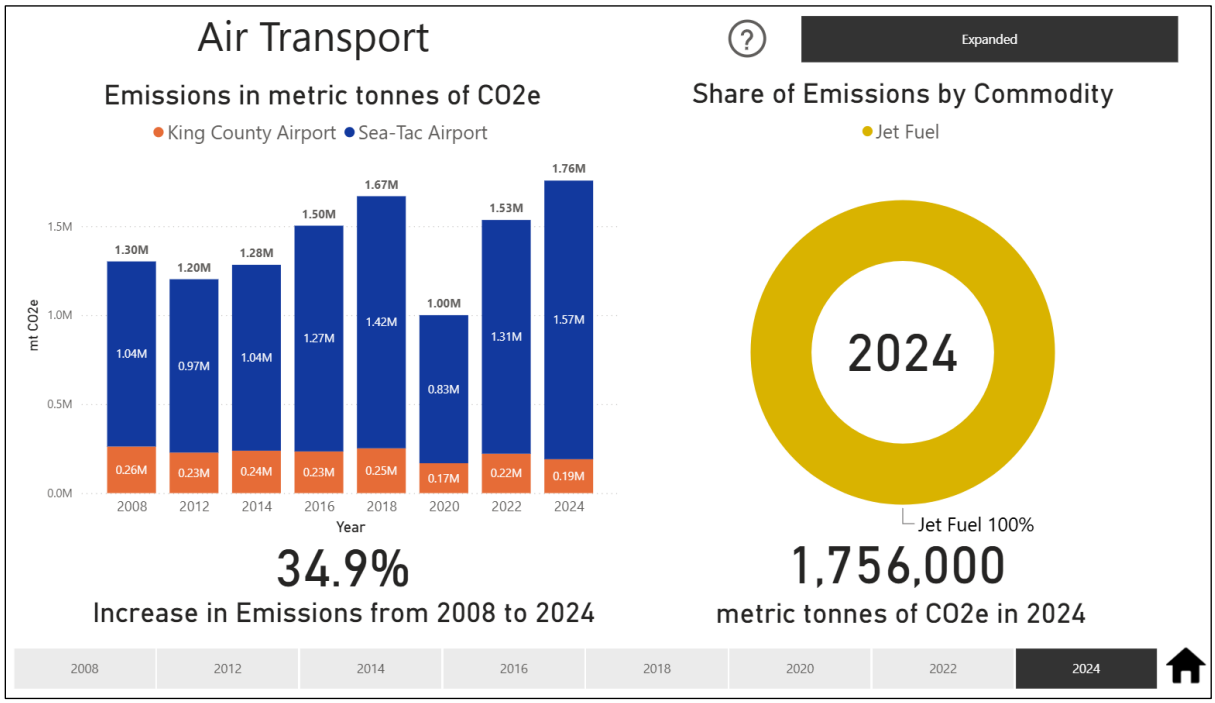


Figure 8: Expanded air transportation emissions by airport and commodity.



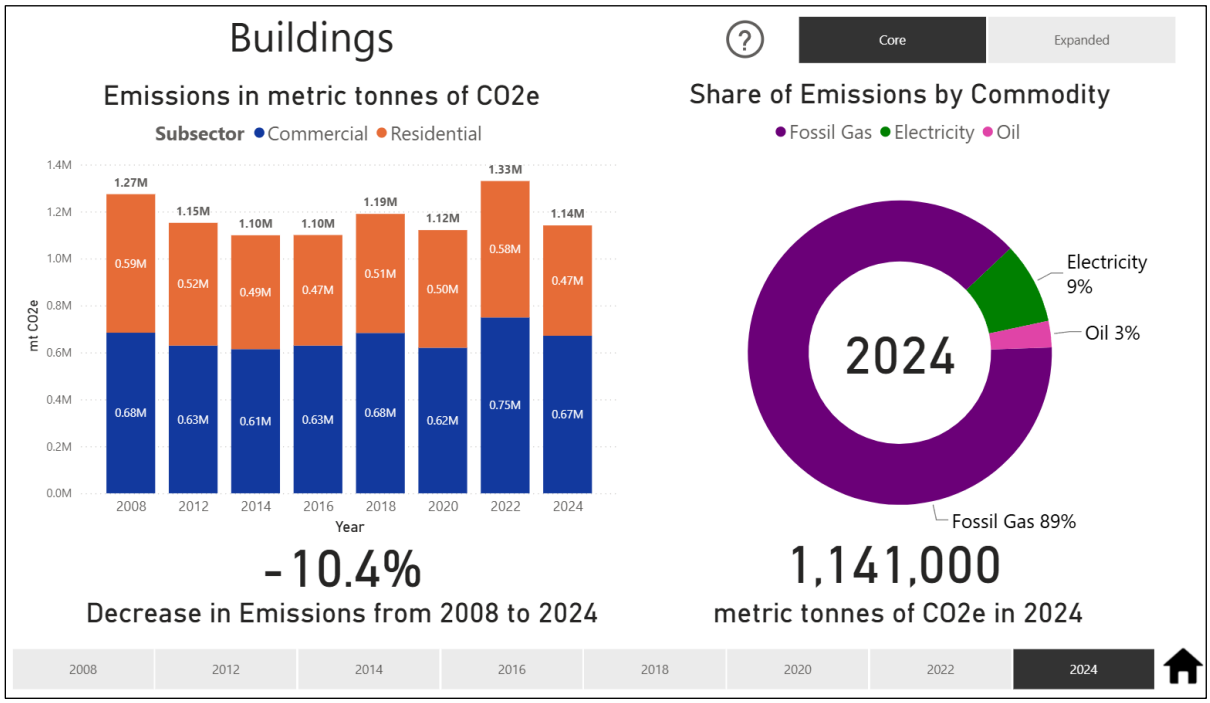
Building Emissions

In the building sector, core GHG emissions decreased by around 10% since 2008 – from about 1.3 million mtCO2e in 2008 to around 1.1 million mtCO2e in 2024. As shown in

Figure 9, emissions were also lower than in 2018 and 2022. Per-resident building emissions declined by about 32% since 2008 and by around 9% since 2018.

Residential emissions were about 470 thousand mtCO2e in 2024, while commercial emissions were about 672 thousand mtCO2e. Fossil gas remains the primary driver of building-sector emissions. Residential and commercial fossil gas use were both lower in 2024 than in 2022, and 2024 also had fewer heating degree days than 2022.

Figure 9: Core buildings emissions by subsector and commodity.



Building-sector emissions calculations rely primarily on measured electricity and fossil gas use reported by City Light, PSE, CenTrio, and UW Steam. As a result, these estimates have a higher level of certainty than the more model-dependent transportation estimates.

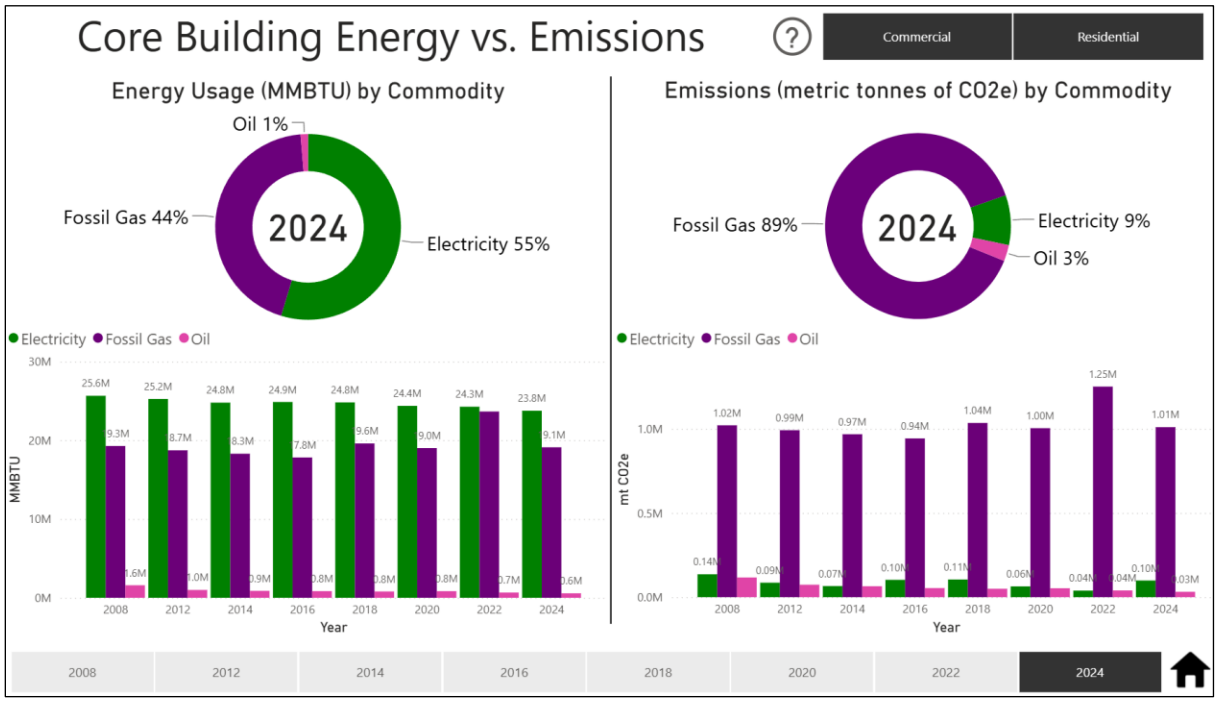
Close to 77% of the electricity City Light provides to Seattle customers comes from low-carbon hydroelectric dams. The emissions associated with retail electricity sales depend on City Light's generation mix, external power purchases, and the renewable energy certificates used in its electricity-supply accounting. Separately, City Light purchases high-quality carbon offsets equal to the greenhouse gas emissions resulting from all aspects of utility operations, including vehicles and equipment, employee travel, building energy use, and other operational sources.[3] Because hydroelectric production and external power

[3] https://powerlines.seattle.gov/2025/04/22/our-power-our-planet-staying-carbon-neutral-with-recs-and-offsets/

purchases vary from year to year, emissions attributable to electricity use can fluctuate even when electricity consumption is trending down.

As shown in Figure 10, electricity accounted for about 55% of core building energy use in 2024 but about 9% of core building emissions. Fossil gas accounted for about 44% of core building energy use but about 89% of core building emissions. Oil accounted for about 1% of energy use and about 3% of emissions.

Figure 10: Core building energy use and emissions by fuel source.



Compared with 2022, residential and commercial fossil gas use declined in 2024, and the year had fewer heating and cooling degree days. Building energy use and fossil gas consumption peaked in 2022 before declining substantially by 2024, suggesting that 2022 was a rebound year rather than a stable long-term trend. Colder weather contributed to higher fossil gas use in 2022, but the magnitude of the increase was larger than would be expected from the change in heating degree days alone. Seattle's post-2022 direction generally aligns with King County, where gas use also declined across sectors, though Seattle's year-to-year changes were larger, especially for residential gas use.

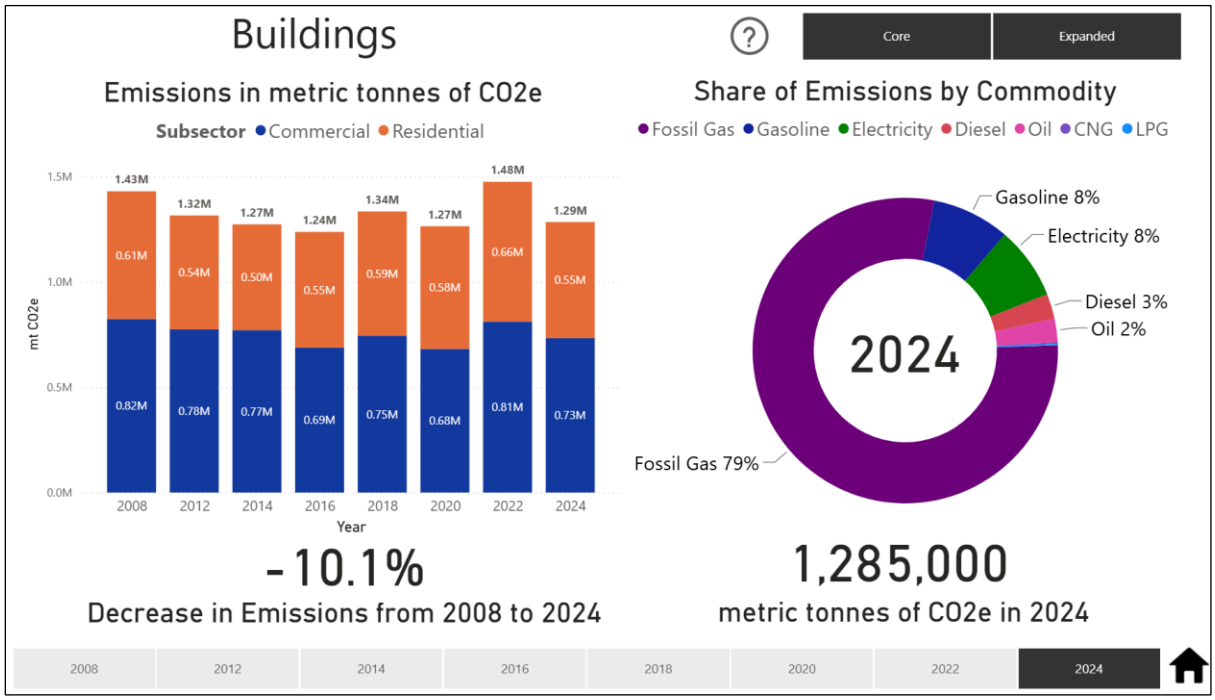
Seattle building benchmarking data provide another point of comparison for interpreting this pattern. Among benchmarked buildings, total reported GHG emissions were higher in 2022 than in 2018, then declined by 2024. Over the same period, reported building floor area continued to grow, while energy use intensity and emissions intensity declined by 17% and 15% respectively. This supports the interpretation that 2022 was a higher-

consumption year for buildings, but not a reversal of the longer-term trend toward lower energy and emissions intensity.

During quality assurance of Seattle's greenhouse gas inventory update, a discrepancy was identified in the 2022 gas consumption data used in the previous inventory. PSE determined that the original data extraction included query issues that understated 2022 consumption and subsequently provided a corrected dataset, which is used in this inventory. Based on PSE's review and validation by City staff, the issue is not believed to materially affect data provided for other years.

In the expanded inventory, building emissions were around 1.3 million mtCO2e in 2024, lower than both 2022 and 2008, as shown in Figure 11. The expanded 2024 building total includes about 734 thousand mtCO2e from commercial buildings and about 553 thousand mtCO2e from residential buildings.

Figure 11: Expanded buildings emissions by subsector and commodity.



Residential Building Emissions

Residential building emissions were around 470 thousand mtCO2e in 2024, lower than both 2022 and 2008. Residential fossil gas use was also lower than in 2022, while heating oil use has continued a long downward trend. Figures 12 and 13 compare core residential emissions with the expanded view, which also includes yard equipment. See Appendix D5: Residential Building Energy and Appendix D7: Residential & Commercial Building

Equipment for the methodology used to estimate residential building energy emissions and residential equipment emissions, respectively.

Figure 12: Core residential building emissions by source and commodity.

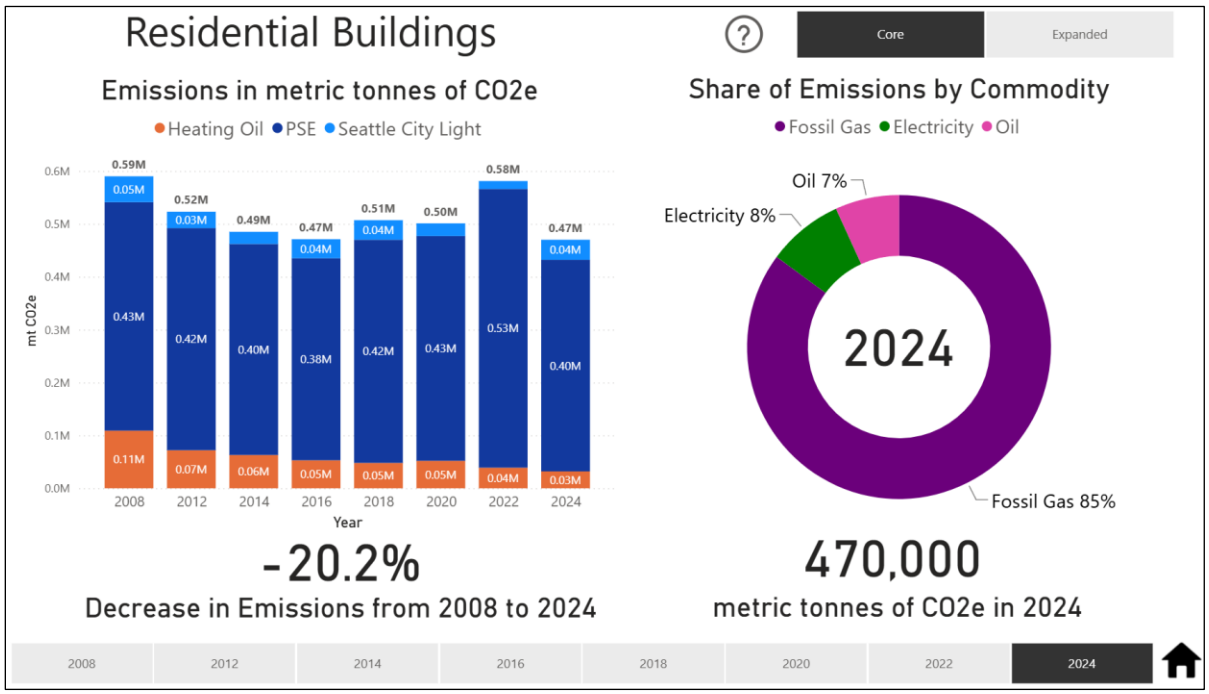
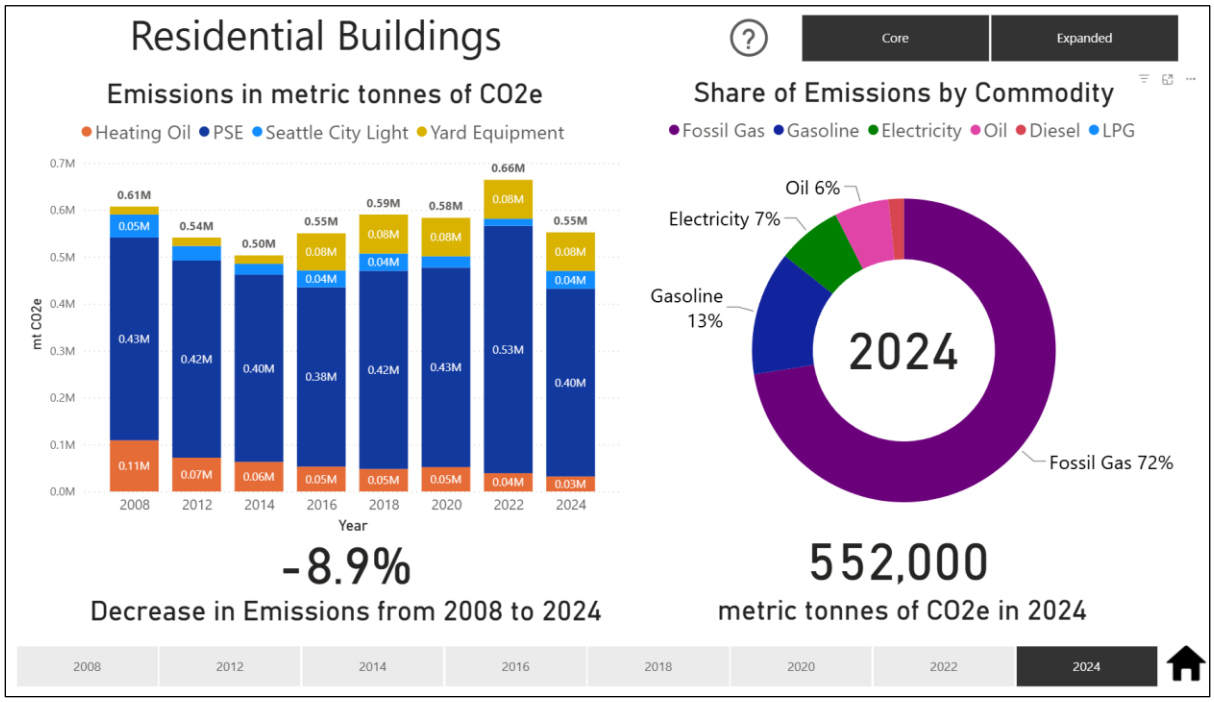


Figure 13: Expanded residential building emissions by source and commodity.



Commercial Building Emissions

Commercial building emissions were around 672 thousand mtCO2e in 2024, lower than in 2022, 2008, and 2018. Since building emissions are primarily driven by fossil gas, the combined use of fossil gas from PSE, UW, and CenTrio corresponds to the same emissions trend. Figures 14 and 15 compare core commercial emissions with expanded commercial emissions, which also includes commercial equipment. See Appendix D6: Commercial Building Energy and Appendix D7: Residential & Commercial Building Equipment for the methodology used to estimate commercial building energy emissions and commercial equipment emissions, respectively.

Figure 14: Core commercial building emissions by source and commodity.

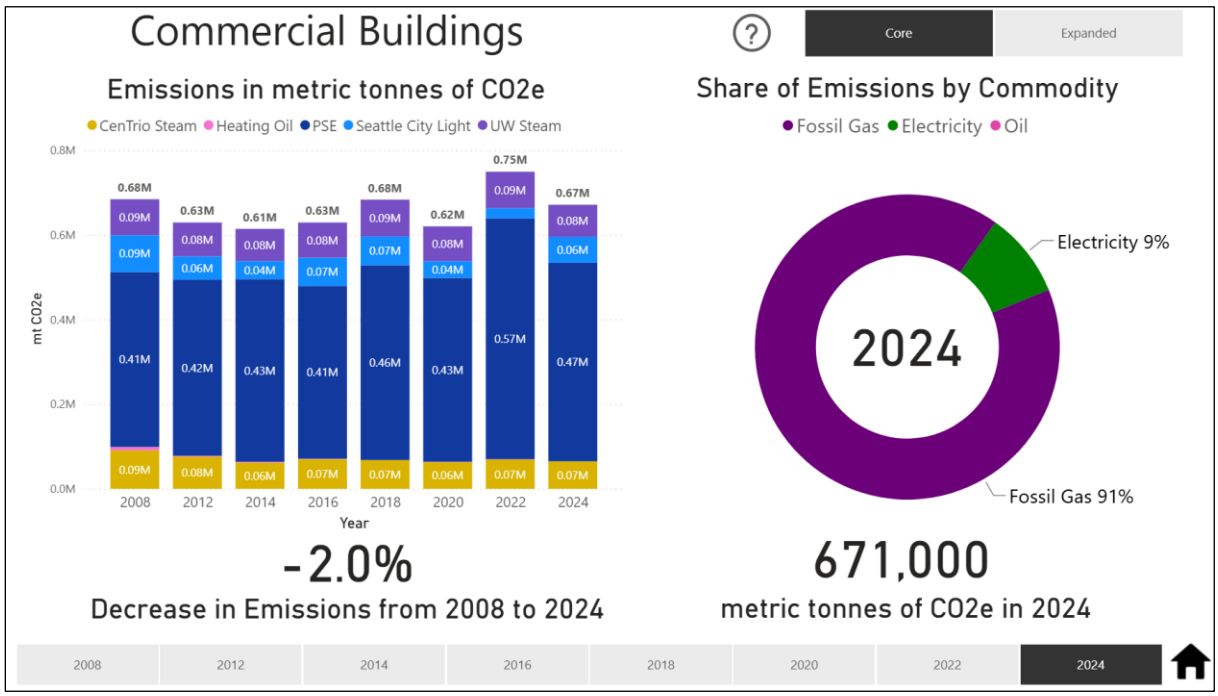
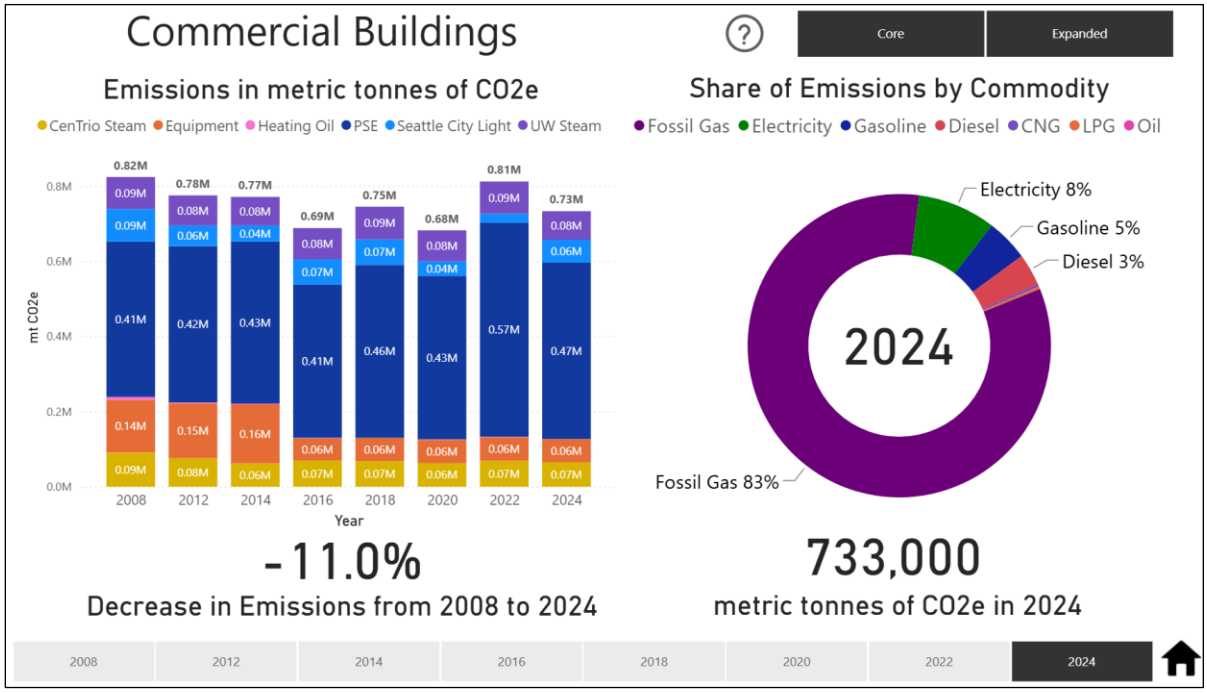


Figure 15: Expanded commercial building emissions by source and commodity.



Industry Emissions

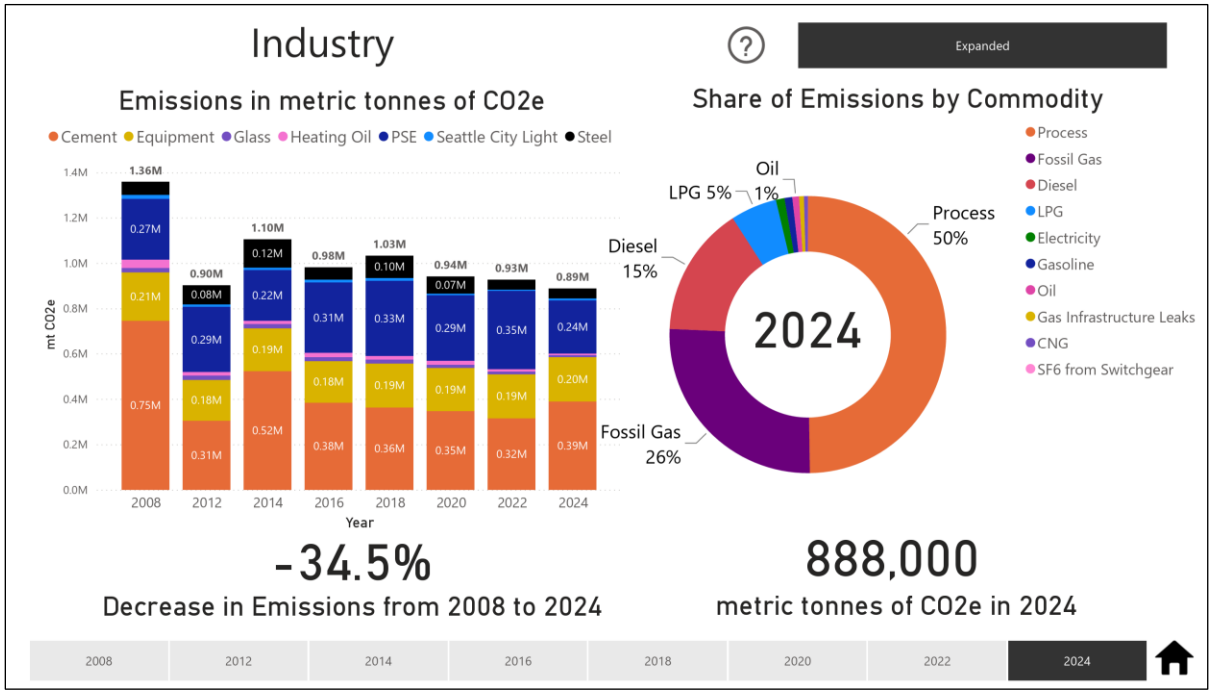
Industry-related emissions decreased by around 35% since 2008 – from about 1.4 million mtCO2e in 2008 to around 889 thousand mtCO2e in 2024, as shown in Figure 16. Industry emissions were about 4% lower than in 2022.

Process emissions remain the largest source of industrial emissions, with cement accounting for about 389 thousand mtCO2e in 2024. Cement-related emissions were about 48% lower than in 2008 and about 23% higher than in 2022. Steel emissions were about 43 thousand mtCO2e in 2024, while glass emissions were about 10 thousand mtCO2e.

Industrial energy-use emissions were around 440 thousand mtCO2e in 2024, lower than both 2022 and 2008. Fugitive gas emissions were about 5 thousand mtCO2e, substantially lower than in both comparison years.

The 2024 cement estimate was updated using Washington State's Greenhouse Gas Reporting Program data. For steel and glass, 2023 EPA FLIGHT data are the most recent available and are used in place of 2024 values for Nucor and Ardagh Glass; the EPA Large Emitters data source has since been deprecated. PSE gas-infrastructure leak data and City Light SF6 data remain current inputs for this inventory.

Figure 16: Industrial sector emissions by source and commodity.



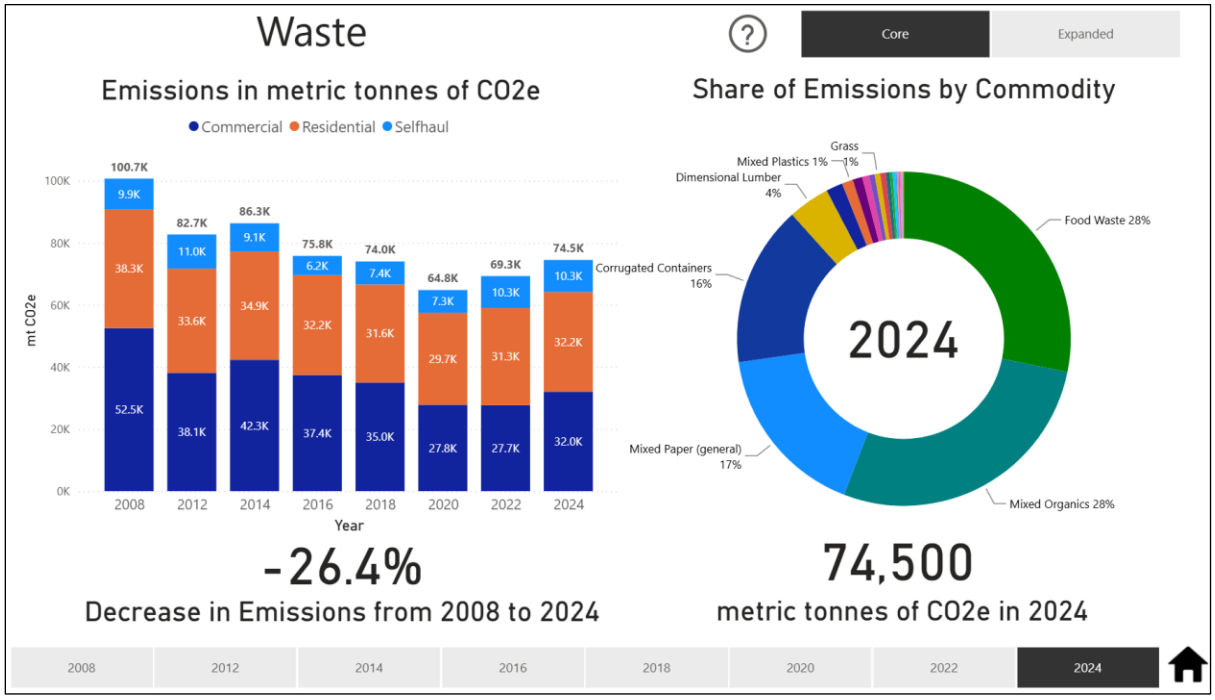
See Appendix D9: Industry for additional methodology details.

Waste Emissions

In the waste sector, core waste management emissions decreased by around 26% since 2008 – from about 101 thousand mtCO2e in 2008 to around 75 thousand mtCO2e in 2024. Waste emissions did not materially contribute to the citywide decline between 2018 and 2024 because they were roughly flat over that period. As shown in Figure 17, emissions were higher than in 2022, when waste management emissions were about 70 thousand mtCO2e.

Waste emissions per resident remain far below 2008 levels, even though they increased slightly from 2022 to 2024. The increase was driven primarily by commercial waste, while residential and self-haul emissions remained comparatively stable. Daily per-person waste generation has also decreased over the past decade and a half, from a high of 7.94 pounds per person per day in 2007 to 5.14 pounds per person per day in 2024.

Figure 17: Core waste emissions by subsector and material type.

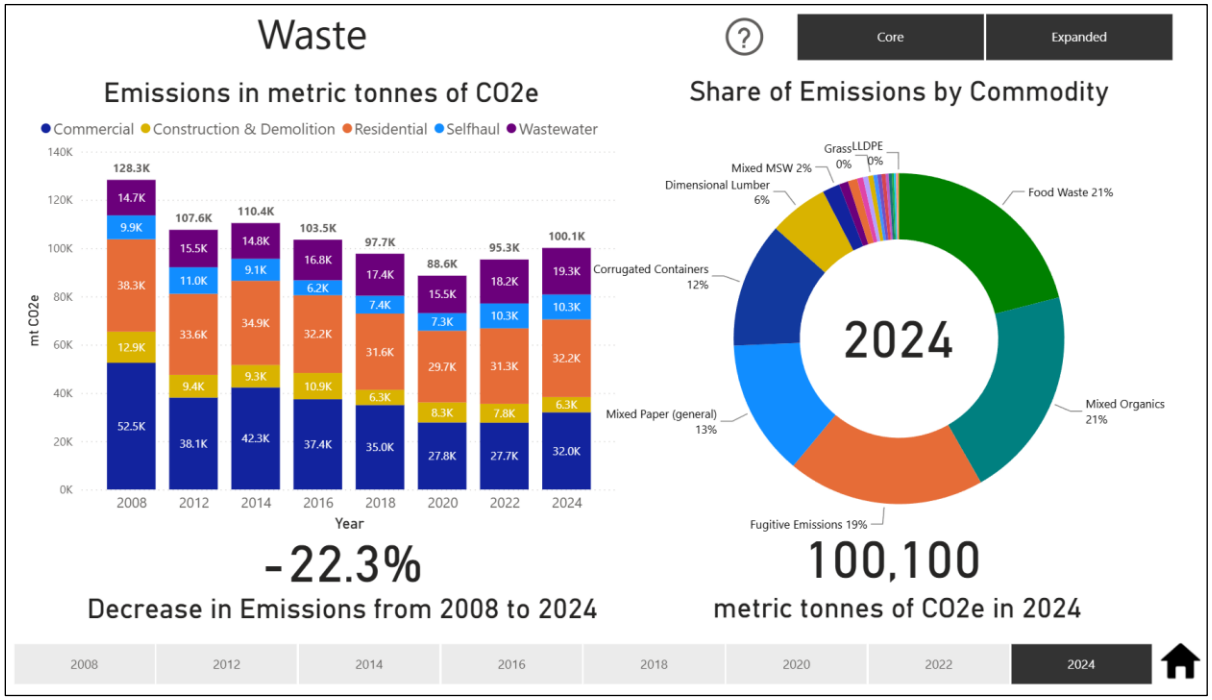


SPU annual reports and quarterly municipal solid waste reporting provide disposal tonnage, while waste composition studies estimate the material shares that affect methane generation and landfill emissions. This inventory uses the 2022 commercial and 2024 self-haul composition studies; residential and construction and demolition composition assumptions were carried forward.

Because the same commercial composition study and emissions factors were applied in 2022 and 2024, the recent increase should primarily be interpreted as a change in tonnage and stream mix rather than an emissions-factor change. Food waste continues to make up a substantial share of residential and commercial garbage, although its share declined from 32% in 2008 to 29% in 2024.

In the expanded inventory, waste emissions were about 100 thousand mtCO2e in 2024, higher than 2022 but still lower than 2008, as shown in Figure 18. The expanded 2024 waste total includes about 19 thousand mtCO2e from wastewater.

Figure 18: Expanded waste emissions by commodity and stream.



See Appendix D8: Waste & Wastewater for additional methodology details.

Sequestration and Offset Emissions

Two categories are reported as negative values in Seattle's GHG inventory: sequestration and offsets. Organic materials stored in landfills are treated as sequestered carbon because that carbon is removed from the atmosphere when the material is buried. Carbon offsets purchased by reporting agencies are also represented as negative values in the inventory.

Sequestration totaled around 162 thousand mtCO2e in 2024, compared with about 169 thousand mtCO2e in 2022 and about 187 thousand mtCO2e in 2008. Offsets totaled about 124 thousand mtCO2e in 2024, higher than 2022 but lower than 2008.

In 2024, reported offsets came from City Light and the King County Wastewater Treatment Division. Figures 19 and 20 show the sources of sequestration and offsets, respectively.

Figure 19: Sequestration emissions by subsector and commodity.

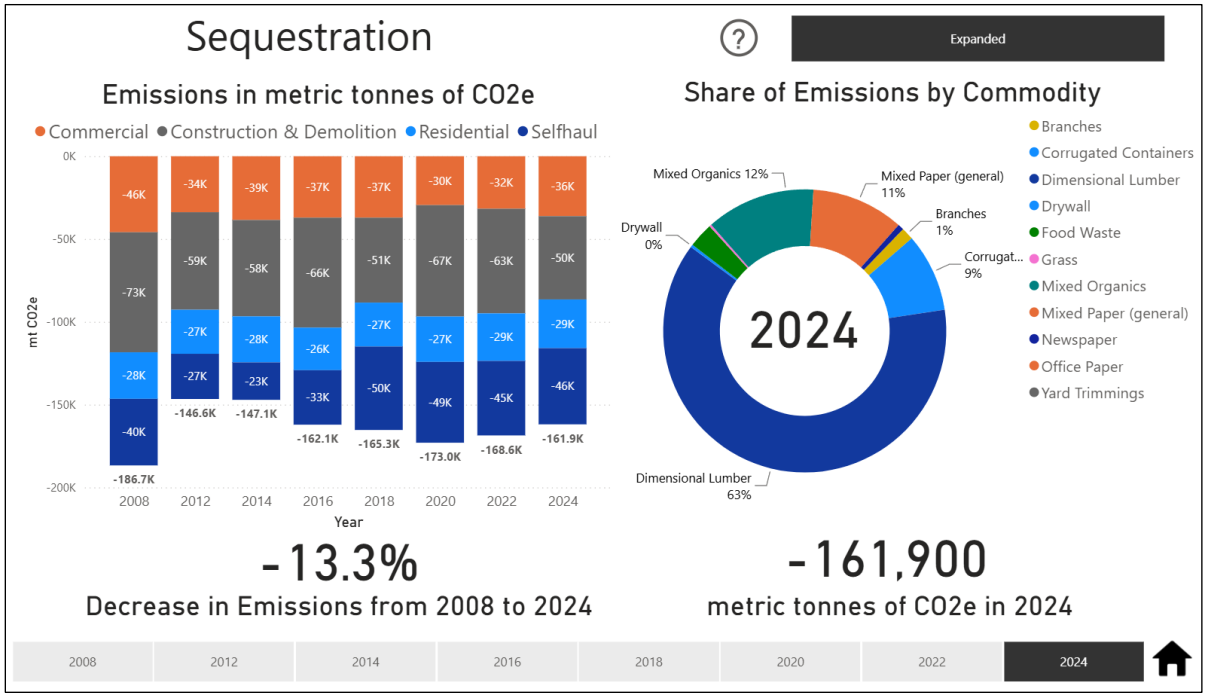
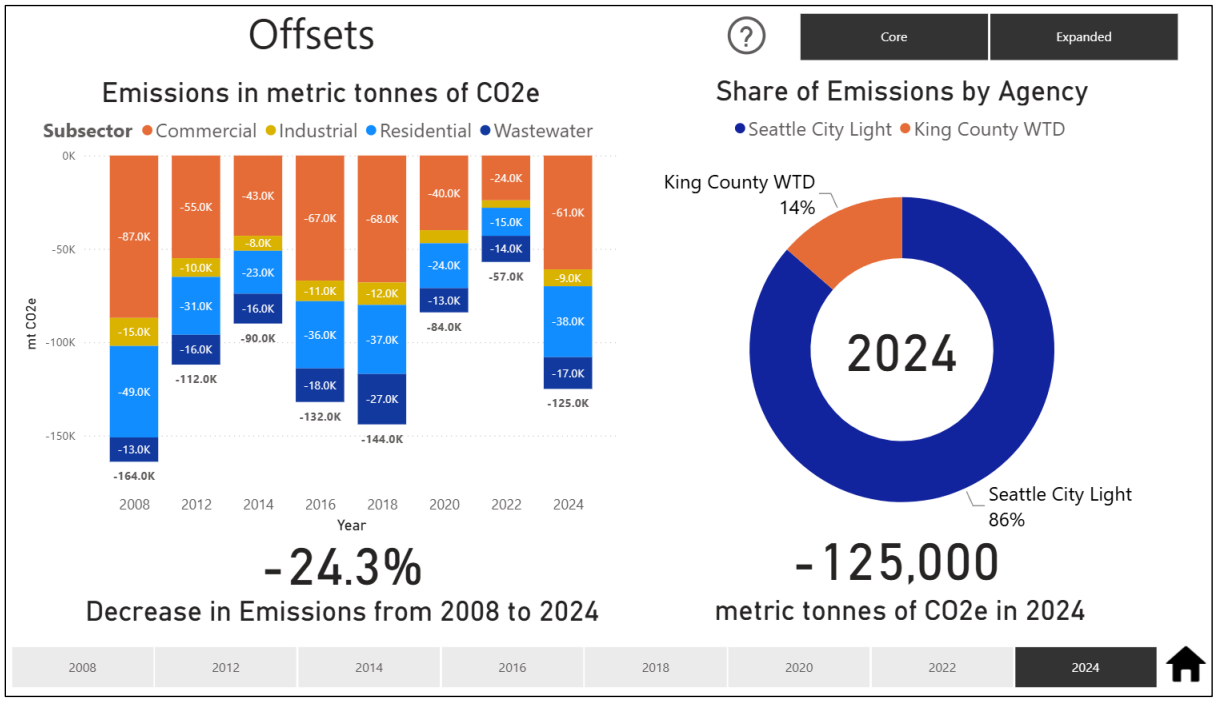


Figure 20: Emissions offsets by sector and reporting agency.



Appendix

Appendix A: Detailed Emissions Inventory Tables

Note: Values in this detailed table are rounded at the detailed-record level and then aggregated through the displayed hierarchy. Consequently, sector and grand totals may differ slightly from the summary tables, which use unrounded values and report-level rounding conventions. Negative values represent offsets and sequestration. These minor differences do not affect interpretation of the inventory results.

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Buildings	**1,431,000**	**1,316,000**	**1,274,000**	**1,238,000**	**1,335,000**	**1,265,000**	**1,476,000**	**1,285,000**
Commercial	**824,000**	**775,000**	**771,000**	**688,000**	**745,000**	**682,000**	**812,000**	**733,000**
CenTrio Steam	91,000	76,000	62,000	70,000	68,000	63,000	69,000	65,000
Fossil Gas	91,000	76,000	62,000	70,000	67,000	63,000	69,000	65,000
Oil	0	0	0	0	1,000	0	0	0
Equipment	140,000	146,000	157,000	59,000	62,000	62,000	63,000	62,000
CNG	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Diesel	39,000	45,000	49,000	24,000	25,000	25,000	25,000	25,000
Gasoline	95,000	94,000	101,000	31,000	33,000	33,000	33,000	33,000
LPG	4,000	5,000	5,000	2,000	2,000	2,000	3,000	2,000
Heating Oil	8,000	2,000	2,000	1,000	0	1,000	1,000	0
Oil	8,000	2,000	2,000	1,000	0	1,000	1,000	0
PSE	413,000	416,000	431,000	408,000	460,000	434,000	569,000	469,000
Fossil Gas	413,000	416,000	431,000	408,000	460,000	434,000	569,000	469,000
Seattle City Light	87,000	55,000	43,000	67,000	68,000	40,000	24,000	61,000
Electricity	87,000	55,000	43,000	67,000	68,000	40,000	24,000	61,000
UW Steam	85,000	80,000	76,000	83,000	87,000	82,000	86,000	76,000
Fossil Gas	85,000	80,000	76,000	83,000	86,000	82,000	86,000	76,000
Oil	0	0	0	0	1,000	0	0	0
Residential	**607,000**	**541,000**	**503,000**	**550,000**	**590,000**	**583,000**	**664,000**	**552,000**
Heating Oil	109,000	72,000	63,000	53,000	48,000	52,000	39,000	32,000
Oil	109,000	72,000	63,000	53,000	48,000	52,000	39,000	32,000
PSE	432,000	420,000	399,000	382,000	422,000	425,000	527,000	400,000
Fossil Gas	432,000	420,000	399,000	382,000	422,000	425,000	527,000	400,000
Seattle City Light	49,000	31,000	23,000	36,000	37,000	24,000	15,000	38,000
Electricity	49,000	31,000	23,000	36,000	37,000	24,000	15,000	38,000
Yard Equipment	17,000	18,000	18,000	79,000	83,000	82,000	83,000	82,000
CNG	0	0	0					
Diesel	0	0	0	9,000	9,000	9,000	9,000	9,000
Gasoline	17,000	18,000	18,000	70,000	74,000	73,000	74,000	73,000
LPG	0	0	0	0	0	0	0	0
Industry	**1,357,000**	**902,000**	**1,104,000**	**982,000**	**1,033,000**	**940,000**	**927,000**	**888,000**
Energy Use	**510,000**	**475,000**	**419,000**	**507,000**	**533,000**	**486,000**	**528,000**	**441,000**
Equipment	213,000	179,000	190,000	183,000	193,000	191,000	194,000	195,000
CNG	2,000	2,000	2,000	3,000	3,000	3,000	3,000	4,000
Diesel	172,000	149,000	157,000	128,000	135,000	134,000	136,000	135,000
Gasoline	6,000	3,000	3,000	8,000	8,000	8,000	8,000	8,000
LPG	33,000	25,000	28,000	44,000	47,000	46,000	47,000	48,000

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Heating Oil	36,000	16,000	14,000	19,000	16,000	18,000	11,000	7,000
Oil	36,000	16,000	14,000	19,000	16,000	18,000	11,000	7,000
PSE	246,000	270,000	207,000	294,000	312,000	270,000	319,000	230,000
Fossil Gas	246,000	270,000	207,000	294,000	312,000	270,000	319,000	230,000
Seattle City Light	15,000	10,000	8,000	11,000	12,000	7,000	4,000	9,000
Electricity	15,000	10,000	8,000	11,000	12,000	7,000	4,000	9,000
Fugitive Gases	**24,000**	**20,000**	**18,000**	**19,000**	**22,000**	**20,000**	**29,000**	**5,000**
PSE	22,000	18,000	16,000	17,000	21,000	20,000	28,000	5,000
Gas Infrastructure Leaks	22,000	18,000	16,000	17,000	21,000	20,000	28,000	5,000
Seattle City Light	2,000	2,000	2,000	2,000	1,000	0	1,000	0
SF6 from Switchgear	2,000	2,000	2,000	2,000	1,000	0	1,000	0
Process	**823,000**	**407,000**	**667,000**	**456,000**	**478,000**	**434,000**	**370,000**	**442,000**
Cement	746,000	305,000	523,000	384,000	363,000	346,000	315,000	389,000
Process	746,000	305,000	523,000	384,000	363,000	346,000	315,000	389,000
Glass	20,000	19,000	20,000	18,000	17,000	14,000	12,000	10,000
Process	20,000	19,000	20,000	18,000	17,000	14,000	12,000	10,000
Steel	57,000	83,000	124,000	54,000	98,000	74,000	43,000	43,000
Process	57,000	83,000	124,000	54,000	98,000	74,000	43,000	43,000
Offsets	**-164,000**	**-112,000**	**-90,000**	**-132,000**	**-144,000**	**-84,000**	**-57,000**	**-125,000**
Commercial	**-87,000**	**-55,000**	**-43,000**	**-67,000**	**-68,000**	**-40,000**	**-24,000**	**-61,000**
Seattle City Light	-87,000	-55,000	-43,000	-67,000	-68,000	-40,000	-24,000	-61,000
Electricity	-87,000	-55,000	-43,000	-67,000	-68,000	-40,000	-24,000	-61,000
Industrial	**-15,000**	**-10,000**	**-8,000**	**-11,000**	**-12,000**	**-7,000**	**-4,000**	**-9,000**
Seattle City Light	-15,000	-10,000	-8,000	-11,000	-12,000	-7,000	-4,000	-9,000
Electricity	-15,000	-10,000	-8,000	-11,000	-12,000	-7,000	-4,000	-9,000
Residential	**-49,000**	**-31,000**	**-23,000**	**-36,000**	**-37,000**	**-24,000**	**-15,000**	**-38,000**
Seattle City Light	-49,000	-31,000	-23,000	-36,000	-37,000	-24,000	-15,000	-38,000
Electricity	-49,000	-31,000	-23,000	-36,000	-37,000	-24,000	-15,000	-38,000
Wastewater	**-13,000**	**-16,000**	**-16,000**	**-18,000**	**-27,000**	**-13,000**	**-14,000**	**-17,000**
King County WTD	-13,000	-16,000	-16,000	-18,000	-27,000	-13,000	-14,000	-17,000
Electricity	-13,000	-16,000	-16,000	-18,000	-27,000	-13,000	-14,000	-17,000
Sequestration	**-185,000**	**-144,000**	**-146,000**	**-160,000**	**-165,000**	**-170,000**	**-168,000**	**-163,000**
Commercial	**-45,000**	**-32,000**	**-39,000**	**-36,000**	**-36,000**	**-29,000**	**-31,000**	**-37,000**
Construction Materials	-12,000	-9,000	-10,000	-12,000	-12,000	-9,000	-9,000	-11,000
Dimensional Lumber	-12,000	-9,000	-10,000	-12,000	-12,000	-9,000	-9,000	-11,000
Drywall	0	0	0	0	0	0	0	0
Food Waste	-5,000	-3,000	-4,000	-3,000	-3,000	-2,000	-2,000	-2,000
Food Waste	-5,000	-3,000	-4,000	-3,000	-3,000	-2,000	-2,000	-2,000
Mixed Materials	-6,000	-5,000	-6,000	-7,000	-7,000	-6,000	-6,000	-7,000
Mixed Organics	-6,000	-5,000	-6,000	-7,000	-7,000	-6,000	-6,000	-7,000
Paper	-21,000	-15,000	-19,000	-13,000	-13,000	-11,000	-14,000	-17,000
Corrugated Containers	-7,000	-1,000	-3,000	-4,000	-4,000	-3,000	-7,000	-8,000

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Mixed Paper (general)	-11,000	-12,000	-13,000	-8,000	-8,000	-7,000	-7,000	-8,000
Newspaper	-3,000	-2,000	-3,000	-1,000	-1,000	-1,000	0	-1,000
Office Paper	0	0	0	0	0	0	0	0
Yard Trimmings	-1,000	0	0	-1,000	-1,000	-1,000	0	0
Branches	-1,000	0	0	-1,000	-1,000	-1,000	0	0
Grass	0	0	0	0	0	0	0	0
Construction & Demolition	**-72,000**	**-59,000**	**-58,000**	**-66,000**	**-52,000**	**-67,000**	**-63,000**	**-51,000**
Construction Materials	-68,000	-56,000	-55,000	-63,000	-49,000	-64,000	-60,000	-48,000
Dimensional Lumber	-68,000	-56,000	-55,000	-63,000	-49,000	-64,000	-60,000	-48,000
Mixed Materials	0	0	0	0	0	0	0	0
Mixed Organics	0	0	0	0	0	0	0	0
Paper	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000
Corrugated Containers	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Mixed Paper (general)	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Yard Trimmings	-2,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Branches	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Grass	0	0	0	0	0	0	0	0
Yard Trimmings	-1,000	0	0	0	0	0	0	0
Residential	**-29,000**	**-26,000**	**-27,000**	**-25,000**	**-27,000**	**-26,000**	**-29,000**	**-29,000**
Construction Materials	-3,000	-4,000	-3,000	-2,000	-3,000	-4,000	-4,000	-4,000
Dimensional Lumber	-3,000	-4,000	-3,000	-2,000	-3,000	-4,000	-4,000	-4,000
Drywall	0	0	0	0	0	0	0	0
Food Waste	-4,000	-3,000	-3,000	-3,000	-3,000	-2,000	-2,000	-2,000
Food Waste	-4,000	-3,000	-3,000	-3,000	-3,000	-2,000	-2,000	-2,000
Mixed Materials	-10,000	-10,000	-10,000	-9,000	-10,000	-11,000	-12,000	-12,000
Mixed Organics	-10,000	-10,000	-10,000	-9,000	-10,000	-11,000	-12,000	-12,000
Paper	-11,000	-8,000	-11,000	-11,000	-11,000	-9,000	-11,000	-11,000
Corrugated Containers	-2,000	-1,000	-1,000	-1,000	-1,000	-3,000	-3,000	-3,000
Mixed Paper (general)	-7,000	-6,000	-7,000	-7,000	-7,000	-6,000	-7,000	-7,000
Newspaper	-2,000	-1,000	-3,000	-3,000	-3,000	0	-1,000	-1,000
Office Paper	0	0	0	0	0	0	0	0
Yard Trimmings	-1,000	-1,000	0	0	0	0	0	0
Branches	-1,000	-1,000	0	0	0	0	0	0
Grass	0	0	0	0	0	0	0	0
Selfhaul	**-39,000**	**-27,000**	**-22,000**	**-33,000**	**-50,000**	**-48,000**	**-45,000**	**-46,000**
Construction Materials	-35,000	-19,000	-16,000	-30,000	-47,000	-45,000	-38,000	-39,000
Dimensional Lumber	-35,000	-19,000	-16,000	-30,000	-47,000	-45,000	-38,000	-39,000
Drywall	0	0	0	0	0	0	0	0

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Food Waste	0	0	0	0	0	0	0	0
Food Waste	0	0	0	0	0	0	0	0
Mixed Materials	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Mixed Organics	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Paper	-3,000	-7,000	-5,000	-2,000	-2,000	-2,000	-5,000	-5,000
Corrugated Containers	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-3,000	-3,000
Mixed Paper (general)	-2,000	-5,000	-4,000	-1,000	-1,000	-1,000	-2,000	-2,000
Newspaper	0	-1,000	0	0	0	0	0	0
Office Paper	0	0	0	0	0	0	0	0
Yard Trimmings	0	0	0	0	0	0	-1,000	-1,000
Branches	0	0	0	0	0	0	-1,000	-1,000
Grass	0	0	0	0	0	0	0	0
Transportation	**3,532,000**	**3,376,000**	**3,450,000**	**3,666,000**	**3,730,000**	**2,692,000**	**3,299,000**	**3,530,000**
Air	**1,302,000**	**1,202,000**	**1,283,000**	**1,502,000**	**1,668,000**	**1,000,000**	**1,534,000**	**1,756,000**
King County Airport	262,000	228,000	238,000	234,000	252,000	168,000	221,000	191,000
Jet Fuel	262,000	228,000	238,000	234,000	252,000	168,000	221,000	191,000
Sea-Tac Airport	1,040,000	974,000	1,045,000	1,268,000	1,416,000	832,000	1,313,000	1,565,000
Jet Fuel	1,040,000	974,000	1,045,000	1,268,000	1,416,000	832,000	1,313,000	1,565,000
Marine	**179,000**	**176,000**	**179,000**	**159,000**	**160,000**	**159,000**	**176,000**	**176,000**
Hotelling	53,000	43,000	37,000	36,000	36,000	36,000	21,000	21,000
Diesel	53,000	43,000	37,000	36,000	36,000	36,000	21,000	21,000
Other Boat Traffic	59,000	62,000	76,000	74,000	74,000	85,000	118,000	117,000
Diesel	59,000	62,000	76,000	74,000	74,000	85,000	118,000	117,000
Pleasure Craft	32,000	30,000	25,000	5,000	5,000	5,000	5,000	5,000
Diesel	6,000	6,000	6,000	1,000	1,000	1,000	1,000	1,000
Gasoline	26,000	24,000	19,000	4,000	4,000	4,000	4,000	4,000
State Ferries	35,000	41,000	41,000	44,000	45,000	33,000	32,000	33,000
Bio-Diesel	0	1,000	2,000	2,000	2,000	3,000	3,000	3,000
Diesel	35,000	40,000	39,000	42,000	43,000	30,000	29,000	30,000
Rail	**48,000**	**42,000**	**33,000**	**32,000**	**33,000**	**27,000**	**29,000**	**33,000**
Rail - Freight	41,000	34,000	24,000	23,000	23,000	23,000	23,000	23,000
Diesel	41,000	34,000	24,000	23,000	23,000	23,000	23,000	23,000
Rail - Passenger	7,000	8,000	9,000	9,000	10,000	4,000	6,000	10,000
Diesel	7,000	8,000	9,000	9,000	10,000	4,000	6,000	10,000
Road: Passenger	**1,734,000**	**1,691,000**	**1,685,000**	**1,696,000**	**1,599,000**	**1,286,000**	**1,329,000**	**1,281,000**
Buses	61,000	68,000	66,000	65,000	66,000	52,000	45,000	48,000
CNG	1,000	1,000	1,000	0	1,000	1,000	1,000	1,000
Diesel	60,000	67,000	65,000	65,000	65,000	51,000	44,000	47,000
Cars & Light Duty Trucks	1,673,000	1,623,000	1,619,000	1,631,000	1,533,000	1,234,000	1,284,000	1,233,000
Gasoline	1,673,000	1,623,000	1,619,000	1,631,000	1,533,000	1,234,000	1,284,000	1,233,000
Road: Trucks	**269,000**	**265,000**	**270,000**	**277,000**	**270,000**	**220,000**	**231,000**	**284,000**
Medium & Heavy Duty	269,000	265,000	270,000	277,000	270,000	220,000	231,000	284,000
Diesel	190,000	189,000	194,000	201,000	192,000	155,000	164,000	205,000

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Gasoline	79,000	76,000	76,000	76,000	78,000	65,000	67,000	79,000
Waste	**128,300**	**107,600**	**110,400**	**103,500**	**97,700**	**88,600**	**95,300**	**100,100**
Commercial	**52,500**	**38,100**	**42,300**	**37,400**	**35,000**	**27,800**	**27,700**	**32,000**
Construction Materials	1,000	700	700	900	700	500	500	600
Asphalt Concrete	0	0	0	0	0	0	0	0
Asphalt Shingles	0	0	0	0	0	0	0	0
Carpet	0	0	0	0	0	0	0	0
Clay Bricks	0	0	0	0	0	0	0	0
Concrete	100	0	0	0	0	0	0	0
Dimensional Lumber	900	700	700	900	700	500	500	600
Drywall	0	0	0	0	0	0	0	0
Fiberglass Insulation	0	0	0	0	0	0	0	0
Electronics	100	400	0	0	0	0	0	100
CRT Displays	0	0	0	0	0	0	0	0
Mixed Electronics	100	400	0	0	0	0	0	100
Portable Electronic Devices	0	0	0	0	0	0	0	0
Food Waste	22,900	16,400	17,100	13,900	13,300	10,600	8,800	10,100
Food Waste	22,900	16,400	17,100	13,900	13,300	10,600	8,800	10,100
Glass	100	100	100	100	100	100	100	100
Glass	100	100	100	100	100	100	100	100
Metals	300	100	100	200	100	100	200	200
Aluminum Cans	0	0	0	0	0	0	0	0
Mixed Metals	300	100	100	200	100	100	200	200
Steel Cans	0	0	0	0	0	0	0	0
Mixed Materials	7,200	6,400	6,900	8,600	7,900	6,300	6,200	7,100
Mixed MSW	700	700	500	500	300	200	300	300
Mixed Organics	6,500	5,700	6,400	8,100	7,600	6,100	5,900	6,800
Paper	19,100	13,300	16,400	12,300	11,900	9,400	11,100	12,800
Corrugated Containers	6,400	600	3,100	3,800	3,700	2,900	5,900	6,700
Mixed Paper (general)	8,900	9,700	10,200	6,600	6,400	5,100	5,100	5,900
Newspaper	700	600	600	300	300	200	100	100
Office Paper	3,100	2,400	2,500	1,600	1,500	1,200	0	100
Plastics	900	400	700	900	500	400	500	600
HDPE	0	0	0	0	0	0	0	0
LDPE	400	100	400	500	300	200	200	200
Mixed Plastics	500	300	300	400	200	200	300	400
PET	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Yard Trimmings	900	300	300	500	500	400	300	400
Branches	400	0	0	200	200	200	100	200

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Grass	500	300	300	300	300	200	200	200
Construction & Demolition	**12,900**	**9,400**	**9,300**	**10,900**	**6,300**	**8,300**	**7,800**	**6,300**
Construction Materials	7,700	5,900	5,800	6,700	3,700	4,900	4,600	3,700
Asphalt Concrete	100	0	0	0	0	0	0	0
Asphalt Shingles	1,100	500	500	600	300	400	300	300
Clay Bricks	400	400	400	500	200	300	300	200
Concrete	100	0	0	0	0	0	0	0
Dimensional Lumber	5,100	4,200	4,100	4,700	2,800	3,700	3,500	2,800
Drywall	900	800	800	900	400	500	500	400
Fiberglass Insulation	0	0	0	0	0	0	0	0
Electronics	0	0	0	0	0	0	0	0
CRT Displays	0	0	0	0	0	0	0	0
Mixed Electronics	0	0	0	0	0	0	0	0
Portable Electronic Devices	0	0	0	0	0	0	0	0
Glass	0	100	100	100	0	100	100	0
Glass	0	100	100	100	0	100	100	0
Metals	300	100	100	200	100	100	100	100
Mixed Metals	300	100	100	200	100	100	100	100
Mixed Materials	1,900	1,200	1,200	1,300	700	900	900	700
Mixed MSW	1,800	900	900	1,000	500	600	600	500
Mixed Organics	100	300	300	300	200	300	300	200
Paper	1,800	1,600	1,600	1,900	1,400	1,800	1,700	1,400
Corrugated Containers	1,000	800	800	900	700	900	800	700
Mixed Paper (general)	800	800	800	1,000	700	900	900	700
Plastics	300	200	200	300	100	200	100	100
Mixed Plastics	300	200	200	300	100	200	100	100
Tires	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Yard Trimmings	900	300	300	400	300	300	300	300
Branches	400	200	200	200	200	200	200	200
Grass	200	100	100	200	100	100	100	100
Yard Trimmings	300	0	0	0	0	0	0	0
Residential	**38,300**	**33,600**	**34,900**	**32,200**	**31,600**	**29,700**	**31,300**	**32,200**
Construction Materials	300	300	300	200	100	200	200	200
Asphalt Concrete	0	0	0	0	0	0	0	0
Asphalt Shingles	0	0	0	0	0	0	0	0
Carpet	100	0	100	0	0	0	0	0
Clay Bricks	0	0	0	0	0	0	0	0
Concrete	0	0	0	0	0	0	0	0

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Dimensional Lumber	200	300	200	200	100	200	200	200
Drywall	0	0	0	0	0	0	0	0
Fiberglass Insulation	0	0	0	0	0	0	0	0
Electronics	100	0	0	0	0	0	0	0
CRT Displays	0	0	0	0	0	0	0	0
Mixed Electronics	100	0	0	0	0	0	0	0
Portable Electronic Devices	0	0	0	0	0	0	0	0
Food Waste	17,400	13,600	13,600	12,600	12,400	9,200	9,700	10,000
Food Waste	17,400	13,600	13,600	12,600	12,400	9,200	9,700	10,000
Glass	100	100	100	100	100	100	100	200
Glass	100	100	100	100	100	100	100	200
Metals	100	200	100	100	100	100	100	100
Aluminum Cans	0	0	0	0	0	0	0	0
Mixed Metals	100	200	100	100	100	100	100	100
Steel Cans	0	0	0	0	0	0	0	0
Mixed Materials	10,800	11,200	11,100	10,300	10,000	11,900	12,500	12,800
Mixed MSW	200	200	100	100	100	200	200	200
Mixed Organics	10,600	11,000	11,000	10,200	9,900	11,700	12,300	12,600
Paper	8,300	7,200	8,900	8,100	8,300	7,500	7,900	8,100
Corrugated Containers	1,600	1,300	1,000	900	900	2,300	2,400	2,500
Mixed Paper (general)	5,300	4,700	5,800	5,300	5,400	5,000	5,300	5,400
Newspaper	500	300	700	600	600	100	100	100
Office Paper	900	900	1,400	1,300	1,400	100	100	100
Plastics	600	400	500	500	300	500	500	500
HDPE	0	0	0	0	0	0	0	0
LDPE	300	200	300	300	200	200	200	200
LLDPE	0	0	0	0	0	100	100	100
Mixed Plastics	300	200	200	200	100	200	200	200
PET	0	0	0	0	0	0	0	0
PLA	0	0	0	0	0	0	0	0
PP	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Yard Trimmings	600	600	300	300	300	200	300	300
Branches	200	300	100	100	100	100	200	200
Grass	400	300	200	200	200	100	100	100
Selfhaul	**9,900**	**11,000**	**9,100**	**6,200**	**7,400**	**7,300**	**10,300**	**10,300**
Construction Materials	3,400	1,900	1,600	2,800	3,000	2,900	2,700	2,700
Asphalt Concrete	0	0	0	0	0	0	0	0
Asphalt Shingles	100	0	0	0	0	0	100	100
Carpet	200	100	100	200	100	100	100	100

Emissions Category	2008	2012	2014	2016	2018	2020	2022	2024
Clay Bricks	100	0	0	100	100	100	100	100
Concrete	200	100	100	100	0	0	100	100
Dimensional Lumber	2,600	1,500	1,200	2,300	2,700	2,600	2,200	2,200
Drywall	200	200	200	100	100	100	100	100
Fiberglass Insulation	0	0	0	0	0	0	0	0
Electronics	0	0	0	0	0	0	100	100
CRT Displays	0	0	0	0	0	0	0	0
Mixed Electronics	0	0	0	0	0	0	100	100
Portable Electronic Devices	0	0	0	0	0	0	0	0
Food Waste	800	1,400	1,200	500	700	700	900	900
Food Waste	800	1,400	1,200	500	700	700	900	900
Glass	100	100	100	0	0	0	100	100
Glass	100	100	100	0	0	0	100	100
Metals	200	100	100	200	200	200	200	200
Aluminum Cans	0	0	0	0	0	0	0	0
Mixed Metals	200	100	100	200	200	200	200	200
Steel Cans	0	0	0	0	0	0	0	0
Mixed Materials	2,200	1,700	1,400	1,100	1,300	1,300	1,900	1,900
Mixed MSW	800	600	500	500	500	500	700	700
Mixed Organics	1,400	1,100	900	600	800	800	1,200	1,200
Paper	2,700	5,200	4,400	1,300	1,900	1,900	3,800	3,800
Corrugated Containers	1,300	700	600	800	1,200	1,200	2,400	2,400
Mixed Paper (general)	1,300	3,600	3,000	500	700	700	1,300	1,300
Newspaper	0	100	100	0	0	0	0	0
Office Paper	100	800	700	0	0	0	100	100
Plastics	200	300	100	200	200	200	200	200
HDPE	0	0	0	0	0	0	0	0
LDPE	0	100	0	0	0	0	0	0
Mixed Plastics	200	200	100	200	200	200	200	200
PET	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Tires	0	0	0	0	0	0	0	0
Yard Trimmings	300	300	200	100	100	100	400	400
Branches	100	0	0	0	0	0	300	300
Grass	200	300	200	100	100	100	100	100
Wastewater	**14,700**	**15,500**	**14,800**	**16,800**	**17,400**	**15,500**	**18,200**	**19,300**
Fugitive	14,700	15,500	14,800	16,800	17,400	15,500	18,200	19,300
Fugitive Emissions	14,700	15,500	14,800	16,800	17,400	15,500	18,200	19,300
Grand Total	**6,099,300**	**5,445,600**	**5,702,400**	**5,697,500**	**5,886,700**	**4,731,600**	**5,572,300**	**5,515,100**

Appendix B: Data Model Changes

Each inventory update incorporates new data, revised models, and quality-assurance corrections. These changes can affect both the current inventory year and the historical emissions series. The 2024 inventory includes the material changes described below. Revised historical values in this report supersede values published in earlier inventories.

B1: Road Transportation Unit-Conversion Correction

During quality assurance, a unit-conversion error was identified in how PSRC-modeled road data were used in the inventory. The error caused road transportation emissions for 2018 through 2022 to be over-reported in prior inventories. The calculation has been corrected in the 2024 inventory, and revised road emissions for those years are roughly 10% lower than previously reported. This change corrects the historical emissions series; it does not reflect a change in actual travel activity.

B2: Corrected 2022 PSE Fossil Gas Data

During quality assurance, a discrepancy was identified in the 2022 fossil gas consumption data used in the previous inventory. PSE determined that the original extraction included query issues that understated 2022 consumption by about 18% and subsequently provided a corrected dataset. The corrected 2022 data are used throughout this report. Based on PSE's review and validation by City staff, the issue is not believed to materially affect data provided for other years. The revised 2022 value changes the building-sector trend shown in this report and should be used in place of the previously published value.

B3: MOVES5 Model Update

The 2024 inventory incorporates a new PSRC SoundCast 2023 output for road transportation and EPA MOVES5 estimates for several expanded emissions categories. PSRC provides Seattle VMT and associated road-emissions estimates, including adjusted inventory-year values. Expanded estimates for residential yard equipment, commercial and industrial non-road equipment, and pleasure craft use King County MOVES5 results scaled to Seattle by population. Legacy NONROAD estimates remain in the historical series through 2014. These sources are modeled rather than measured from local fuel use and therefore have lower certainty than utility consumption data.

B4: KCWTD Offset Classification Correction

King County Wastewater Treatment Division electricity-use emissions and the associated offsets are classified as expanded emissions for all applicable years. The 2024 inventory corrects the prior classification of the KCWTD offsets as core. Expanded totals are unchanged, while core offset totals and net core totals are revised. Core emissions before offsets are not affected by this correction.

B5: Waste Composition Data Updates

The 2024 inventory uses the 2022 commercial waste composition study and the 2024 self-haul waste composition study. Residential and construction and demolition composition assumptions are carried forward from the most recent available studies. Because the same commercial composition study and emissions factors are applied to 2022 and 2024, the change in commercial waste emissions between those years primarily reflects changes in tonnage and the mix of reported waste streams rather than an emissions-factor change. The updated self-haul composition study is incorporated into the 2024 estimate for that stream.

Appendix C: Source Documentation

This appendix summarizes the principal datasets used to prepare the 2024 inventory and the source archive maintained by the Office of Sustainability and Environment. The source-document structure follows the prior inventory and has been updated to reflect the data, model, and quality-assurance changes incorporated into the 2024 analysis. Source files include publicly available reports and datasets, utility and agency data provided directly to the City, and calculation files developed for the inventory.

C1: Index file

Community-Dataset-Index.xlsx is the inventory source register. Each source is assigned a call number and categorized by sector and subject. The index records the document title, public or internal source, file type, update frequency, date coverage, data format, receipt or publication date, notes, unresolved questions, and staff point of contact. It also identifies the source used for each 2024 calculation and retains prior-year files that remain part of the historical series.

C2: Source files

The table below identifies the primary source families used in the 2024 inventory. The complete archive includes the raw source file or correspondence, any intermediate calculation workbook, and the final export used in the report. Utility, agency, and facility data provided directly to the City are identified as communications or internal source files and are not reproduced in this report.

Table 3: Primary data sources used in the 2024 inventory.

Source area	Primary source(s)	Use in inventory	Update/limitations
Road transportation	PSRC SoundCast 2023 output, including modeled VMT and emissions estimates	Passenger/light-duty and medium-/heavy-duty road VMT and emissions for model and adjusted inventory years	Modeled data; 2018–2022 values revised for the unit-conversion correction; PSRC supplied adjusted 2024 values
Transit buses	National Transit Database fuel and energy data; King County Metro and Sound Transit service or route data	Bus fuel use and Seattle service allocation	Annual; allocation depends on route/service information
Air transportation	Port of Seattle airport statistics and Sea-Tac jet-fuel uplift; King County International Airport fuel-use data	Airport fuel consumption allocated to Seattle	Annual; Seattle share is estimated rather than directly observed
Marine transportation	Washington State Ferries route/fuel data; Washington biodiesel reports; 2016 Puget Sound Maritime Air Emissions Inventory; King County MOVES5 pleasure-craft estimates	Ferries, pleasure craft, hotelling, and other vessel emissions	Mixed reported and modeled sources; regional maritime inventory has not been updated
Passenger rail	Amtrak Cascades passenger activity and national passenger-rail energy-intensity data; Sound Transit and National Transit Database Sounder fuel and service data	Amtrak Cascades and Sounder emissions attributed to Seattle using passenger-activity and geographic service allocations	Passenger activity and fuel data are updated annually where available. Amtrak relies on a national energy-intensity factor and trip allocation; Sounder regional fuel use is allocated to Seattle service.
Freight rail	Most recent Puget Sound Maritime Air Emissions Inventory and freight-rail calculation files from the 2022 Seattle inventory	Locomotive emissions at Seattle port facilities and freight activity associated with the Port of Seattle and Northwest Seaport Alliance North Harbor	No comparable updated freight-rail dataset was available for 2024; the 2022 estimate is carried forward unchanged and has high uncertainty.
Electricity	Seattle City Light sales by customer class; City Light retail-supply emissions factors and renewable energy certificate accounting	Residential, commercial, and industrial electricity use and emissions	Measured sales; annual emissions factor varies with generation and purchases
Fossil gas	Puget Sound Energy customer consumption by sector; corrected 2022 extraction; PSE emissions and gas-infrastructure information	Residential, commercial, and industrial fuel use; fugitive methane estimates	Measured or billed consumption; 2022 source data corrected in this inventory
Steam and district energy	CenTrio and University of Washington reported steam or fuel-use data	Commercial steam and associated emissions	Reported annual data; limited spatial and subannual detail
Heating oil and petroleum	American Community Survey heating-fuel data; U.S. Energy Information Administration state and sector petroleum data	Residential, commercial, and industrial petroleum estimates	Estimated from regional/state data; lower certainty than utility consumption
Non-road equipment	King County EPA MOVES5 estimates; legacy EPA NONROAD estimates through 2014	Residential yard equipment and commercial/industrial equipment emissions	Modeled and scaled to Seattle; equipment and fuel detail available

Source area	Primary source(s)	Use in inventory	Update/limitations
Industry process emissions	Washington State Greenhouse Gas Reporting Program for cement; 2023 EPA FLIGHT facility reports for steel and glass	Facility-reported cement, steel, and glass process emissions	Annual facility-reported data; Washington State data are used for 2024 cement, while 2023 steel and glass values are used as proxies for 2024
Waste management	SPU quarterly and annual tonnage reports; 2022 commercial, 2024 self-haul, and prior residential/C&D composition studies; EPA WARM factors	Waste-stream emissions and landfill carbon storage	Tonnage reported; composition sampled periodically; emissions modeled
Wastewater	King County Wastewater Treatment Division process-emissions, facility-energy, and offset data	Wastewater process emissions, energy emissions, and offsets associated with treatment serving Seattle	Annual agency-reported data
Population, employment, and GDP	U.S. Census/Seattle population estimates; PSRC employment estimates; U.S. Bureau of Economic Analysis real GDP series	Per-capita, per-employee, and growth comparisons	Annual or periodic; geographic boundaries and series definitions should remain consistent across inventory updates.
Reference methods	ICLEI U.S. Community Protocol; EPA GHG Emission Factors Hub; EPA WARM; U.S. GHG Inventory methodological annexes	Accounting boundaries, emission factors, global warming potentials, and waste methods	Updated when newer protocol or factor versions are adopted

Appendix D: Methodology & Source Notes

The methodology notes below retain the sector structure used in the prior inventory and describe the principal activity data, allocation methods, emissions factors, uncertainty, and data needs for the 2024 update. Historical values may be recalculated when improved models or corrected source data become available; Appendix B identifies the changes that materially affect comparison with earlier published inventories.

D1: Road Transportation

Road transportation emissions include passenger cars, light-duty trucks, medium- and heavy-duty trucks, and transit buses. The methodology follows the general structure of ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, which recommends combining community-attributed travel activity with locally appropriate emissions information. The protocol distinguishes the source of travel activity, the method used to estimate energy or emissions, and any local adjustment for fleet composition, fuel, or vehicle technology.

With the exception of operator-reported transit fuel and electricity, Seattle's road estimates are modeled rather than derived from fuel sold within the city. Puget Sound Regional Council (PSRC) provides the primary modeled output. For the 2024 inventory, PSRC supplied a SoundCast 2023 output containing vehicle miles traveled (VMT) and associated emissions estimates by geography and vehicle category, including adjusted values for the requested inventory years. OSE aggregates the PSRC output to the

categories used in the inventory rather than independently applying an emissions rate to the 2018-and-later VMT estimates.

D1.1 Light-, Medium-, and Heavy-Duty Vehicles

SoundCast is PSRC's activity-based regional travel-demand model. It represents the daily travel behavior of households and individuals using demographic, employment, land-use, roadway, transit, and travel-behavior inputs. The model produces trip and VMT estimates by geography, roadway and vehicle category. PSRC's emissions output also reflects the regional fleet and technology assumptions used in its analysis.

The light-duty and truck methods differ because passenger travel can be represented using trip origins and destinations, while commercial truck activity is modeled using a separate freight framework. Both sets of results are provided by PSRC and incorporated into the city inventory at the reporting-category level.

D1.1.1 Light-Duty Vehicles

Light-duty vehicles include passenger cars and light-duty trucks. PSRC uses an origin-destination approach to identify travel associated with Seattle. Trips with an origin or destination in Seattle are included even when part of the trip occurs outside the city boundary. Trips that pass through Seattle with both endpoints outside the city are excluded. This approach is consistent with community-inventory guidance and reflects travel choices that Seattle policies, land use, infrastructure, and transportation programs may influence.

For each modeled trip, SoundCast estimates travel along the roadway network and summarizes the resulting VMT for the Seattle geography. PSRC's accompanying emissions output incorporates vehicle class, speed, roadway type, time of day, fleet composition, fuel, efficiency standards, and the vehicle technologies represented in the regional analysis. OSE combines the supplied passenger-car and light-duty-truck results into the inventory's passenger/light-duty category while retaining VMT and emissions-intensity measures for trend interpretation.

D1.1.2 Medium- and Heavy-Duty Vehicles

Medium- and heavy-duty trucks are estimated separately because freight vehicles have different travel patterns, vehicle weights, fuel use, and emissions per mile. PSRC's freight output summarizes truck VMT and emissions for the Seattle geography, including activity that serves or passes through the city as represented by the regional freight model. This differs from the origin-destination method used for light-duty travel because freight movements cannot be attributed to households and destinations in the same manner.

The inventory reports truck VMT, total truck emissions, and emissions per mile separately from passenger vehicles. This allows changes in freight activity to be distinguished from changes in fleet efficiency or emissions intensity, which is important because increases in truck VMT can offset reductions in passenger-vehicle emissions.

D1.1.3 Non-Model Year VMT Adjustments

SoundCast is developed around a model year rather than rerun independently for every inventory year. PSRC therefore provides adjusted VMT and emissions estimates for requested non-model years as part of its inventory output. The 2024 values used in this report were supplied by PSRC and had already been adjusted from the SoundCast 2023 model year; OSE did not independently scale the 2024 VMT.

When a new SoundCast output is incorporated, the inventory retains the historical series supplied by PSRC and the archived calculation files needed to reproduce earlier values. This can result in revisions to prior inventory years because a new model may use updated land-use assumptions, network conditions, fleet information, or annual adjustment data.

D1.1.4 Emissions

For 2018 and later, PSRC provides the emissions estimates associated with the modeled VMT. OSE aggregates the supplied vehicle categories into passenger/light-duty and medium-/heavy-duty reporting categories and incorporates those totals into the inventory model. The emissions output therefore reflects PSRC's regional modeling assumptions; the city does not separately multiply the 2018-and-later VMT by a MOVES rate.

Historical values for 2008 through 2016 retain the methodology documented in prior inventories. Annual VMT by vehicle class was combined with PSRC fuel-economy estimates for King County to estimate fuel consumption. Composite fuel economy was calculated using the modeled fleet mix for the relevant passenger or truck category, and fuel consumption was converted to emissions using fuel-specific carbon-content factors from the U.S. Environmental Protection Agency's national greenhouse gas inventory.

During quality assurance for the 2024 inventory, a unit-conversion error was identified in the prior treatment of PSRC's road-emissions output. The error overstated road transportation emissions for 2018 through 2022 by roughly 10%. The corrected historical values in this inventory supersede the values published previously.

D1.2 King County Metro and Sound Transit Buses

Transit-bus emissions are calculated using fuel and energy use reported for King County Metro and Sound Transit, primarily through the Federal Transit Administration's National Transit Database and operator data. Diesel, gasoline, and compressed natural gas are converted to CO2e using fuel-specific emissions factors. Compressed natural gas

reported in diesel-gallon equivalents is converted to a mass or standard-volume basis before the emissions factor is applied because the physical volume of a gas varies with pressure and temperature.

Regional operator fuel use is allocated to service operating within Seattle using route, platform-mile, service-mile, or equivalent service information available for the inventory year. Electricity used by electric trolley buses is converted using the applicable Seattle City Light retail electricity emissions factor. The resulting estimate therefore combines reported operator energy use with a geographic allocation to the portion of service attributed to Seattle.

D1.3 Uncertainty & Data Needs

Road transportation has a lower level of certainty than building energy because VMT and road emissions are modeled rather than measured from fuel sales within Seattle. Results depend on travel-demand assumptions, trip attribution, roadway and vehicle classification, the fleet and technology assumptions in PSRC's model, and the geographic aggregation used to create the Seattle output. Model revisions can change historical values even when underlying travel activity has not changed.

Transit fuel totals have higher certainty because they are operator-reported, although allocating regional service to Seattle introduces uncertainty. More frequent locally observed VMT, stronger information on the Seattle fleet and electric-vehicle share, and more detailed freight activity and emissions-intensity data would improve interpretation between SoundCast updates. Automated traffic counts and aggregated location-based travel data may provide useful validation, but they would need consistent coverage, transparent methods, and appropriate privacy protections before being used as inventory inputs.

D2: Air Transportation

Air-transportation emissions are calculated using a fuel-based approach consistent with ICLEI community-inventory guidance. Annual aviation-fuel volumes reported for Seattle–Tacoma International Airport and King County International Airport are converted to CO2e using the applicable fuel properties and greenhouse gas emission factors. The method estimates emissions associated with fuel uplift at each airport; it does not calculate emissions from individual flight segments or passenger itineraries.

For Seattle–Tacoma International Airport, the reported airport fuel total is first adjusted using the estimated share of passenger trips that originate or end in King County. Seattle's portion of that King County share is then estimated using Seattle's share of King County

population. This population-based allocation is a proxy for Seattle-associated passenger and business travel.

King County International Airport is located within Seattle. Consistent with the inventory's established geographic treatment, the reported airport fuel total is attributed to Seattle. Where airport reporting distinguishes jet fuel from aviation gasoline, the applicable fuel-specific emission factors are used.

Reported airport fuel volumes have relatively low uncertainty, but Seattle's attributed share has high uncertainty. The allocation does not account for differences in income, business travel, freight, connecting passengers, visitors, trip distance, or air-travel behavior across the region. Improved passenger-origin-and-destination, business-travel, visitor, cargo, and route-distance data would strengthen future estimates.

D2.1 Sea-Tac International Airport

The Port of Seattle provides total jet fuel dispensed at Seattle-Tacoma International Airport. Consistent with the approach documented in the 2022 inventory, the calculation first applies the share of airport passengers whose trips originate or end in King County, then allocates the King County share to Seattle using the Seattle-to-King County population ratio. The same sequence is applied in the 2024 inventory.

D2.2 King County International Airport

King County International Airport provides jet-fuel and aviation-gasoline data through direct correspondence. Consistent with the methodology used in the prior inventory, the full reported fuel total is attributed to Seattle because the airport is within the city boundary.

D2.3 Uncertainty

Uncertainty in the reported airport fuel totals is relatively low because fuel uplift is documented. Uncertainty in Seattle's attributed share is high. A population-based allocation assumes similar air-travel behavior across the regional population and does not account for differences in income, employment, business travel, freight, connecting passengers, trip distance, or visitors from outside the region.

Pandemic-related changes also affected passenger patterns and the availability of airport origin-and-destination survey data. Air transportation should therefore be interpreted as an estimate of Seattle-associated activity rather than a direct measurement of travel by Seattle residents and businesses.

D2.4 Data Needs

Regular passenger-origin and destination surveys, resident and business travel data, route distance, cargo activity, and sustainable-aviation-fuel use would improve the estimate. These data could replace or refine the population allocation and better distinguish activity associated with Seattle residents, visitors, businesses, and freight.

D3: Rail Transportation

Rail emissions include Amtrak Cascades passenger service, Sound Transit Sounder commuter rail, and freight-rail activity associated with Seattle. The calculation differs by source because available data include a combination of reported fuel use, passenger or service activity, and previously published freight-rail estimates.

D3.1 Rail - Passenger

Amtrak Cascades emissions are estimated from passenger activity associated with Seattle and a national passenger-rail energy-intensity factor. Trips that begin or end in Seattle are used to estimate Seattle-associated passenger miles. Estimated energy use is then converted to CO2e using the applicable diesel emission factors.

Sounder commuter-rail emissions are based on fuel use reported by Sound Transit or through the National Transit Database. Because Sounder operates beyond Seattle, regional fuel totals are allocated to the city using available route, station, or service information.

D3.2 Rail - Freight

Freight-rail emissions have historically been based on the Puget Sound Maritime Air Emissions Inventory. The estimate includes locomotive activity at Seattle port facilities, idling at the ports, and regional locomotive activity associated with trains moving cargo to or from the Port of Seattle and Northwest Seaport Alliance North Harbor. No updated freight-rail information was available from the 2021 Port of Seattle GHG inventory or another newer source for the 2024 inventory. The freight-rail values used in the 2022 inventory are therefore carried forward unchanged.

D3.3 Uncertainty

Passenger-rail estimates have moderate certainty because operator fuel, ridership, or service data are reported, but energy-intensity and geographic allocations are required. Freight rail has higher uncertainty because the underlying maritime inventory is periodic and direct annual locomotive fuel use or train miles within Seattle are not available. Because the 2024 value is carried forward from the prior inventory, it should not be interpreted as evidence that freight-rail activity or emissions were unchanged.

Scaling an older emissions study by cargo tonnage does not fully represent changes in locomotive engines, fuel, idling, train length, or operating practices. Annual operator-level fuel, locomotive, train-mile, and cargo data for activity within Seattle would substantially improve the freight estimate.

D4: Marine Transportation

Marine transportation includes recreational pleasure craft, Washington State Ferries, ocean-going vessels, and harbor craft. The category combines modeled equipment estimates, reported ferry fuel use, and activity from a regional maritime emissions inventory. The certainty and update frequency vary considerably among these sources.

D4.1 Pleasure Craft

Pleasure-craft emissions use King County EPA MOVES5 non-road estimates for inboard and sterndrive boats, outboard motors, personal watercraft, and the applicable gasoline and diesel fuels. King County results are scaled to Seattle using the ratio of Seattle population to King County population. This replaces the older practice of carrying forward the 2014 Washington Department of Ecology/EPA NONROAD estimate for every subsequent year.

Legacy values through 2014 remain based on the historical NONROAD method used in prior inventories. The MOVES5 model adds a more current model year and updated equipment, activity, fuel, and technology assumptions, but it still does not measure actual recreational boating activity within Seattle.

D4.2 State Ferries

Washington State Ferries emissions are based on annual route statements and reported fuel cost, fuel volume, and route information. Fuel is allocated to routes serving Seattle terminals, adjusted for biodiesel content where applicable, and converted to CO2e using the relevant fuel factor. Because the method is based on reported fuel use and route activity, this component has relatively high certainty.

D4.3 Other Ship and Boat Traffic

Ocean-going vessels and harbor craft rely on the Puget Sound Maritime Air Emissions Inventory. Ocean-going vessels include container ships, bulk carriers, tankers, and cruise ships. The inventory includes energy used while vessels are secured at berth, known as hoteling, and while maneuvering into and out of port. Seattle estimates combine activity associated with the Port of Seattle and Northwest Seaport Alliance North Harbor.

Harbor craft include tugboats, towboats, fishing vessels, and other commercial or government vessels. The prior inventory began with the regional harbor-craft estimate, attributed the relevant activity to Seattle's port facilities, and deducted recreational craft

and Washington State Ferries to avoid double counting. Non-study years were adjusted using available port activity or cargo data.

D4.4 Uncertainty

Uncertainty varies substantially across marine sources. Ferry emissions have relatively high certainty because they use reported fuel. Pleasure-craft results are modeled and scaled by population. Ocean-going vessels and harbor craft rely on an older regional study, so changes in vessel calls, engine standards, fuel composition, shore-power use, and port operating practices may not be fully represented.

Cargo or vessel-call scaling can reflect changes in activity but does not directly capture emissions intensity. The use of different model years and source methods also limits comparisons among marine subsectors.

D4.5 Data Needs

Priority needs include a current Puget Sound maritime emissions inventory, annual vessel-call and hoteling activity by location, shore-power use, updated ferry fuel and service data, and locally resolved recreational-boating activity. A current regional maritime study would improve both total emissions and the separation of ocean-going vessels, harbor craft, rail, and cargo-handling equipment.

D5: Residential Building Energy

Residential building emissions include electricity, fossil gas, and heating oil used in Seattle homes. Electricity and fossil gas are based primarily on measured utility consumption. Heating oil is estimated from state fuel-sales data, housing characteristics, and weather. Fuel-specific combustion factors are drawn from EPA or the national greenhouse gas inventory.

D5.1 Electricity

Seattle City Light provides annual residential electricity sales within Seattle and the annual retail-supply emissions factor. Residential electricity consumption is multiplied by the applicable emissions factor to calculate emissions. The factor reflects the emissions associated with City Light's generation mix and external power purchases, including the applicable renewable energy certificate accounting for retail electricity.

City Light's operational carbon offsets are separate from the retail electricity emissions factor and do not reduce emissions attributed to customer electricity use. Because hydroelectric generation and external power purchases vary from year to year, electricity-related emissions can fluctuate even when electricity consumption is stable or declining.

D5.2 Direct Fuel Use (Fossil Gas)

Puget Sound Energy provides the annual number of residential customers and fossil gas consumption in therms for Seattle. Consumption is converted to CO2e using the inventory's fossil-gas combustion factor. The utility data comprises of measured or billed consumption and therefore has relatively high certainty.

The 2024 inventory uses PSE's corrected 2022 extraction. During quality assurance, PSE determined that the original 2022 query understated consumption. The corrected dataset is used for the historical series in this report; PSE and OSE did not identify a material effect on the other inventory years reviewed.

D5.3 Direct Fuel Use (Heating Oil)

The historical residential heating-oil method uses Washington State distillate fuel oil and kerosene sales by end use from the U.S. Energy Information Administration. State fuel sales are scaled using the ratio of Seattle homes using oil heat to oil-heated homes statewide, based on U.S. Census data. The estimate is also adjusted for the ratio of Seattle heating degree days to the population-weighted statewide average because heating demand in Seattle differs from colder parts of Washington.

The EIA end-use sales series was discontinued after 2020. Subsequent inventory-year values are estimated using a linear forecast method rather than a directly observed Seattle fuel-sales series.

D5.4 Uncertainty

Uncertainty in electricity and fossil-gas emissions is relatively low because the estimates use utility consumption and annual emissions factors. Heating-oil uncertainty is high because the estimate begins with statewide fuel sales and uses housing and weather ratios to infer Seattle consumption.

There is also uncertainty in the allocation of utility energy among residential, commercial, and industrial categories because customer classes are based on utility rate or billing categories and do not perfectly correspond to inventory sectors.

D5.5 Data Needs

A direct or regional estimate of delivered residential heating oil would improve the inventory. Building-level fuel-switching, heat-pump adoption, and end-use information would also help distinguish structural electrification and efficiency trends from weather-related changes in annual consumption.

D6: Commercial Building Energy

Commercial building emissions include electricity, fossil gas, petroleum, and district steam used in commercial and institutional buildings. Electricity, fossil gas, and steam are based on utility or provider data. Petroleum is estimated from state fuel-sales data and commercial employment. Fuel-specific combustion factors are drawn from EPA or the national greenhouse gas inventory.

D6.1 Electricity

Seattle City Light provides annual commercial electricity consumption within Seattle and the annual retail-supply emissions factor. Commercial consumption is multiplied by the applicable factor to calculate emissions. As with residential electricity, the factor reflects the emissions associated with the generation mix and external power purchases; City Light operational offsets are accounted for separately from retail electricity emissions.

D6.2 Direct Fuel Use

Direct fuel use includes fossil gas delivered by Puget Sound Energy and petroleum products used in commercial buildings. The fossil-gas estimate is based on measured utility consumption, while petroleum is inferred from state-level sales because a Seattle-specific delivered-fuel series is not available.

D6.2.1 Fossil Gas

Puget Sound Energy provides the annual number of commercial customers and fossil gas delivered in therms within Seattle. Consumption is converted to CO2e using the inventory's fossil-gas combustion factor. Fossil gas used at district steam plants and modeled for commercial equipment is treated separately in the inventory to avoid double counting within commercial building energy.

The corrected PSE 2022 extraction is also applied to the commercial series. The correction increases the previously reported 2022 commercial consumption and changes the apparent 2022-to-2024 trend.

D6.2.2 Petroleum

Commercial petroleum use is estimated from Washington State distillate fuel oil and kerosene sales by commercial end use reported by the U.S. Energy Information Administration. State sales are allocated to Seattle using Seattle's share of statewide commercial employment. This method assumes that commercial fuel use per employee is similar in Seattle and the state as a whole.

The EIA end-use sales series was discontinued after 2020. Subsequent values use a linear forecast method rather than a directly observed Seattle fuel-sales series.

D6.3 Steam

CenTrio, formerly Enwave, reports annual fuel use or emissions through OSE's district-energy reporting process. The University of Washington provides fossil-gas use associated with campus steam production through direct communication. Reported fuel is converted to emissions using the applicable factor and attributed to the commercial or institutional building category.

Steam-plant fossil gas is separated from the commercial PSE total where necessary to prevent the same fuel from being counted both as commercial gas consumption and as district steam.

D6.4 Uncertainty

Commercial electricity, fossil gas, and steam have relatively high certainty because they use measured or provider-reported consumption. Petroleum has high uncertainty because it is estimated from statewide sales and commercial employment. Customer-class allocation and the separation of district energy and equipment fuel introduce additional uncertainty.

Changes in occupancy, remote and hybrid work, building operations, weather, and efficiency can affect commercial energy use, but the inventory does not isolate the contribution of each factor.

D6.5 Data Needs

A direct regional or Seattle estimate of commercial petroleum use would improve the inventory. More detailed district-energy allocation, consistent building benchmarking coverage, occupancy indicators, and end-use information would help explain annual changes and compare utility trends with building-level performance.

D7: Residential & Commercial Building Equipment

Expanded building emissions include petroleum used by residential yard equipment and fossil gas or petroleum used by commercial and industrial non-road equipment. These sources fall outside the core building-energy boundary and are modeled rather than measured through utility sales.

D7.1 Residential Yard Equipment (Petroleum)

Residential yard-equipment emissions use King County estimates from EPA MOVES5. The model estimates equipment populations, hours of use, load factors, fuel use, and emissions by equipment and fuel type. King County results are scaled to Seattle using the ratio of Seattle population to King County population.

Historical values through 2014 retain the Washington Department of Ecology/EPA NONROAD 2014a estimates used in prior inventories. The MOVES5 update provides a newer model year and updated assumptions, but the estimates remain modeled rather than based on local fuel consumption.

D7.2 Commercial Equipment (Fossil Gas and Petroleum)

Commercial and industrial equipment emissions use the applicable King County MOVES5 non-road categories and fuels. King County results are scaled to Seattle using population, consistent with the 2024 inventory calculation. Commercial equipment is reported in the expanded building sector, while industrial equipment is reported within industry.

Legacy historical values retain the earlier Washington Department of Ecology/EPA NONROAD estimates. Because MOVES5 changes model inputs and emissions factors, incorporating the new model can revise the level and trend of the historical series.

D7.3 Uncertainty

Uncertainty is high because the estimates rely on national and regional equipment populations, activity assumptions, and King County model outputs rather than measured Seattle fuel use. Population may not track construction, landscaping, warehouse, or industrial equipment activity closely, and local electrification may differ from regional model assumptions.

D7.4 Data Needs

Local equipment surveys, fuel sales by equipment type, construction and landscaping activity, and locally specific electrification rates would improve the estimates. Future inventories should also document model-version changes and retain enough detail to distinguish real activity changes from changes caused by model updates.

D8: Waste & Wastewater

The expanded waste sector includes solid-waste management and wastewater treatment. Solid-waste estimates combine reported disposal tonnage, sampled material composition, modeled landfill factors, transportation to the landfill, and modeled biogenic carbon storage. Wastewater estimates use agency-reported treatment-process and energy information.

D8.1 Waste Management

Seattle Public Utilities provides annual or quarterly disposed tonnage for residential, commercial or nonresidential, self-haul, and construction and demolition streams. The most recent waste-composition study available for each stream is applied to annual tonnage to estimate the quantity of each material disposed. For the 2024 inventory, the

2022 commercial study and 2024 self-haul study are used; residential and construction and demolition composition assumptions are carried forward from the most recent available studies.

Material-specific landfill emissions and carbon-storage factors are drawn from EPA's Waste Reduction Model (WARM) or the equivalent factors retained in the inventory workbook. Emissions are calculated by applying the material factors to disposed tonnage. Transportation emissions associated with hauling waste are added separately. The 2022 inventory documented a default 20 miles of truck travel plus 234 miles of class-1 freight rail travel to the landfill facilities in Arlington, Oregon.

Because the same commercial composition assumptions and emissions factors are used for 2022 and 2024, the change in commercial waste emissions between those years primarily reflects tonnage. Changes in composition-study years can create step changes in the series that reflect updated sampling rather than an abrupt one-year change in actual waste composition.

D8.2 Wastewater Treatment

King County Wastewater Treatment Division provides wastewater-treatment process emissions for the West Point, South, Brightwater, Carnation, and Vashon treatment facilities, along with relevant facility energy and offset information. When an inventory-year value is unavailable, the historical series may use interpolation between reported years as documented in the calculation files.

Beginning with the 2020 inventory, KCWTD revised its wastewater methodology to better reflect the 2019 IPCC Guidelines. The updated approach includes methane and nitrous oxide from treatment processes and receiving waters, revises nitrous oxide from aeration, includes additional methane-release pathways such as digester-cover gaps and biogas scrubber water, and removes the prior estimate for incomplete methane combustion in flares. These changes were applied to the historical wastewater series supplied by KCWTD.

The 2024 inventory also corrects the classification of KCWTD electricity-use emissions and associated offsets. Both are treated as expanded emissions for all applicable years. This correction changes core offset and net-core totals but does not change expanded totals.

Table 4: KCWTD wastewater methodology changes associated with the 2019 IPCC Guidelines.

Source	Description	Treatment in revised method
Biogas scrubber water	Methane released when scrubber water is discharged to the primary effluent distribution channel	Included

Source	Description	Treatment in revised method
Incomplete combustion in flares	Methane release associated with flare combustion efficiency below 100%	Removed
N2O from aeration	Nitrous oxide produced during the wastewater-treatment process	Revised
Digester-cover gaps	Methane released through gaps in digester covers	Included
CH4 from receiving waters	Methane released in receiving water bodies	Added
N2O from receiving waters	Nitrous oxide released in receiving water bodies	Added

D8.3 Uncertainty

Solid-waste tonnage is reported and has relatively high certainty. Composition is sampled periodically, and landfill methane, carbon storage, and transportation emissions are modeled. Results are sensitive to material composition, methane-generation and collection assumptions, and the treatment of future landfill conditions.

Wastewater uncertainty includes methane capture, fugitive releases, treatment-process factors, and the allocation of regional treatment activity to Seattle. These sources are a small share of Seattle's total emissions, but methodology revisions can materially change the wastewater category itself.

D8.4 Data Needs

More frequent and coordinated composition studies would improve comparisons among waste streams and reduce step changes caused by study updates. Direct landfill operating information and clearer documentation of wastewater allocation would also strengthen the estimates. Consumption-based information is needed alongside the sector inventory to describe upstream emissions avoided through waste prevention, reuse, and material substitution.

D9: Industry

Industry emissions include facility process emissions, industrial electricity and fossil-gas use, modeled non-road equipment, and fugitive gases. The category combines utility consumption, facility-reported emissions, and modeled estimates. Large facility reports are generally required under federal or state greenhouse gas reporting programs when emissions exceed the applicable reporting threshold.

Several major industrial facilities are located in the Duwamish Valley, including cement, steel, glass, and other manufacturing operations. The concentration of industrial activity

and historical pollution in this area is important context for interpreting the inventory, although the citywide GHG inventory does not measure local exposure to co-pollutants or health burdens.

D9.1 Cement

Cement process emissions are taken from Washington State's Greenhouse Gas Reporting Program for the Seattle facility. Cement is produced by heating limestone, clay, and other materials to create clinker. Emissions result both from the fuel used to heat the kiln and from the chemical conversion of limestone calcium carbonate to lime, which releases carbon dioxide.

The facility-reported value is used directly for the applicable reporting year. Washington State reporting is used as the successor source for cement in the 2024 inventory. Cement process emissions are reported separately from the facility's purchased electricity, fossil gas, and modeled equipment emissions.

D9.2 Steel & Glass

Steel and glass process emissions use facility reports from EPA's Greenhouse Gas Reporting Program/FLIGHT system. Steel emissions are associated with Nucor's electric-arc-furnace operations, and glass emissions are associated with Ardagh Glass manufacturing. Facility values are self-reported under the applicable federal reporting requirements.

Because 2024 facility values were not available for the current inventory, the most recent 2023 reports for steel and glass are used as proxies for 2024. These values should be updated in a future inventory if revised reports or a successor public source become available.

Archived copies of the 2023 EPA FLIGHT steel and glass reports are retained in the 2024 source archive because the former public interface has been deprecated.

D9.3 Fugitive SF6 Emissions

Sulfur hexafluoride emissions from electrical equipment are reported by Seattle City Light or obtained from the utility's greenhouse gas reporting. SF6 is used as an insulating gas in electrical equipment and has a very high global warming potential, so relatively small releases can contribute materially to CO2e. The inventory uses the most current annual utility value available for the inventory year.

D9.4 Fugitive Methane Emissions

Methane emissions from the fossil-gas distribution system are taken from Puget Sound Energy's greenhouse gas inventory and utility operating statistics. The estimate represents

leakage or other releases from distribution infrastructure and is reported separately from combustion emissions associated with customer gas use.

D9.5 Uncertainty

Industrial electricity and fossil-gas use have relatively high certainty because they are based on utility consumption. Facility process emissions have moderate certainty because they are self-reported and may rely on facility-specific monitoring, testing, or estimation methods. Steel and glass use prior-year proxy data, equipment emissions are modeled, and fugitive-gas estimates depend on utility reporting and geographic allocation.

Year-to-year process emissions can vary with production levels, product mix, raw-material chemistry, control equipment, and testing conditions. For facilities where process testing occurs during a limited period, the test may not fully represent annual operations. The inventory therefore reports annual facility values but does not assume that every change reflects a long-term efficiency trend.

D10: Offsets & Sequestration

Offsets and sequestration are reported as negative values and are presented separately from positive sector emissions. The report's primary trend comparisons use emissions before offsets and sequestration so that changes in direct emissions remain visible. Net totals are provided for accounting completeness.

D10.1 Offsets

Offset entries use the quantities reported by the responsible agency for the applicable year. They do not change the underlying positive emissions values. Seattle City Light operational offsets are distinct from renewable energy certificates and the retail electricity emissions factor used to calculate customer electricity emissions. King County Wastewater Treatment Division offsets are associated with expanded wastewater and facility-energy accounting.

KCWTD electricity-use emissions and their associated offsets are classified as expanded emissions for all applicable years. The 2024 inventory corrects the earlier classification of those offsets as core; expanded totals are unchanged, while core offset and net-core totals are revised.

D10.2 Sequestration

Landfill sequestration represents biogenic carbon estimated to remain stored in disposed organic materials rather than being released to the atmosphere. The estimate is calculated by applying material-specific WARM carbon-storage factors to disposed tonnage and composition. It is reported as a negative value in the expanded inventory.

Sequestration is an accounting estimate, not a substitute for waste prevention. Materials placed in a landfill can still produce methane and require upstream extraction, manufacturing, and transportation that are not fully represented by the sector inventory.

D10.3 Uncertainty & Data Needs

Offset values depend on agency reporting, program boundaries, and the accounting treatment applied in the inventory. Sequestration is modeled and sensitive to material composition, landfill conditions, and carbon-storage assumptions. Future reports should continue to distinguish retail electricity accounting, operational offsets, wastewater offsets, and modeled landfill carbon storage.

Source records should document the vintage, quantity, retirement or accounting status, and organizational boundary of each offset entry. Waste calculation files should retain the WARM version and material-specific sequestration factors used for every inventory year.

Appendix E: Tracking Metrics

E1: Purpose and Interpretation

The tracking metrics table supplements the inventory totals with activity, intensity, demographic, and weather indicators used to interpret changes over time. The table retains exact or source-reported values where available; values in the report narrative are rounded for readability. Blank cells indicate that a value was unavailable or was not tracked for that year. Per-capita, per-employee, per-mile, and emissions-intensity metrics are calculated from the underlying activity, emissions, population, or employment data. These indicators provide context but should not be interpreted as a causal decomposition of the emissions trend.

E2: Tracking Metrics Table

Metric	1990	2005	2008	2012	2014	2016	2018	2020	2022	2024
Population										
Population	516,259	563,204	593,588	635,063	668,342	704,352	744,955	735,157	749,256	780,995
Employment										
Employment	363,932	417,057	436,943	441,043	469,907	508,264	548,468	587,781	670,001	587,281
Buildings: Residential & Commercial										
Building Emissions per resident (MT CO2e/resident)	2.69	2.17	2.15	1.81	1.65	1.56	1.60	1.53	1.77	1.46
Buildings Emissions (MT CO2e)	1,390,310	1,221,080	1,274,257	1,152,079	1,099,691	1,098,370	1,191,674	1,121,740	1,328,947	1,141,595
Commercial Electricity (MMBtu)	11,232,799	15,469,646	16,426,275	16,195,285	16,089,965	16,214,747	16,017,614	15,139,720	14,902,404	14,592,490
Commercial Emissions (MT CO2e)	657,698	667,231	685,118	629,230	614,492	628,011	683,988	620,544	748,163	671,593
Commercial emissions per employee (MT CO2e/employee)	1.81	1.60	1.57	1.43	1.31	1.24	1.25	1.06	1.12	1.14
Commercial emissions per resident (MT CO2e/resident)	1.27	1.18	1.15	0.99	0.92	0.89	0.92	0.84	1.00	0.86
Commercial energy per employee (MMBtu/employee)	54.75	61.30	63.33	61.25	57.19	52.77	50.42	44.44	42.69	44.52
Commercial Energy Use (MMBtu)	19,923,951	25,567,395	27,672,290	27,014,228	26,873,319	26,820,471	27,653,825	26,121,758	28,600,328	26,144,908
Commercial Fossil gas (MMBtu)	7,900,044	9,866,318	11,125,978	10,795,743	10,752,903	10,595,295	11,610,293	10,963,510	13,687,154	11,543,461
Commercial GHG intensity of energy (kg CO2e/MMBtu)	33.01	26.10	24.76	23.29	22.87	23.42	24.73	23.76	26.16	25.69

Metric	1990	2005	2008	2012	2014	2016	2018	2020	2022	2024
Commercial Heating oil (MMBtu)	791,107	231,432	120,038	23,200	30,451	10,430	25,917	18,528	10,770	8,957
Cooling degree days (CDD)	250.00	164.00	195.00	181.00	372.00	291.00	411.00	428.90	494.90	411.10
Energy use per capita per heat demand (GJ per capita per 1000 HDD)	8.01	6.71	6.27	5.96	6.47	6.20	5.80	5.46	5.22	4.63
Heating degree days (HDD)	4,840.00	4,489.00	5,062.00	4,738.00	3,948.00	3,827.00	4,065.00	4,504.70	5,109.10	4,781.50
Residential Electricity (MMBtu)	11,135,416	8,430,934	9,221,131	9,048,915	8,687,005	8,645,691	8,790,445	9,229,291	9,358,877	9,158,490
Residential Emissions (MT CO2e)	732,612	553,848	589,139	522,849	485,199	470,359	507,686	501,196	580,784	470,001
Residential emissions per resident (MT CO2e/resident)	1.42	0.98	0.99	0.82	0.73	0.67	0.68	0.68	0.78	0.60
Residential energy per resident (MMBtu/resident)	38.77	30.13	31.74	28.26	25.55	23.71	23.56	24.62	26.66	22.13
Residential Energy use (MMBtu)	20,015,498	16,969,510	18,841,311	17,948,088	17,077,941	16,699,192	17,550,683	18,097,594	19,977,050	17,279,597
Residential Fossil gas (MMBtu)	4,903,337	7,004,371	8,148,439	7,927,928	7,539,972	7,220,722	7,985,580	8,045,041	9,963,882	7,563,178
Residential GHG intensity of energy (kg CO2e/MMBtu)	36.60	32.64	31.27	29.13	28.41	28.17	28.93	27.69	29.07	27.20
Residential Heating oil (MMBtu)	3,976,744	1,534,205	1,471,740	971,245	850,964	832,780	774,659	823,262	654,290	557,929
Total energy use (residential + commercial) (MMBtu)	39,939,449	42,536,905	46,513,601	44,962,315	43,951,260	43,519,664	45,204,508	44,219,352	48,577,378	43,424,505
Transportation										
Emissions per mile (kgCO2e/VMT)	0.49	0.49	0.49	0.48	0.45	0.44	0.40	0.40	0.38	0.40
Freight emissions per person (MT CO2e/resident)	0.44	0.50	0.45	0.42	0.40	0.39	0.36	0.30	0.31	0.36
Freight truck emissions per mile (kgCO2e/VMT)	1.03	1.03	1.03	1.02	1.00	0.98	0.93	0.92	0.89	1.03
Freight Truck VMT (miles)	218,139,633	271,875,801	260,986,760	260,016,132	268,634,819	282,620,955	288,895,572	237,899,373	258,855,985	275,552,094
Freight Truck VMT/person (miles/resident)	422.54	482.73	439.68	409.43	401.94	401.25	387.80	323.60	345.48	352.82
Passenger emissions per mile (kgCO2e/VMT)	0.45	0.45	0.45	0.44	0.42	0.40	0.37	0.36	0.34	0.35
Passenger emissions per person (MT CO2e/resident)	2.81	3.19	2.92	2.66	2.52	2.41	2.15	1.75	1.77	1.64

Metric	1990	2005	2008	2012	2014	2016	2018	2020	2022	2024
Passenger VMT (miles)	3,222,003,352	4,013,279,511	3,863,722,736	3,849,921,650	4,026,978,273	4,235,706,512	4,330,675,875	3,571,760,230	3,875,151,593	3,621,701,818
Passenger VMT/person (miles/resident)	6,241.06	7,125.80	6,509.10	6,062.27	6,025.33	6,013.62	5,813.34	4,858.50	5,172.00	4,637.29
Road Emissions (MT CO2e)	1,675,551	2,078,482	2,002,996	1,955,669	1,954,369	1,974,336	1,868,611	1,505,262	1,559,866	1,565,359
Road Emissions per person (MT CO2e/resident)	3.25	3.69	3.37	3.08	2.92	2.80	2.51	2.05	2.08	2.00
VMT (miles)	3,440,142,985	4,285,155,312	4,124,709,496	4,109,937,783	4,295,613,093	4,518,327,468	4,619,571,447	3,809,659,602	4,134,007,578	3,897,253,912
VMT per resident (miles/resident)	6,664	7,609	6,949	6,472	6,427	6,415	6,201	5,182	5,517	4,990
Waste Management										
Commercial waste (tons)	236,125	205,846	176,782	134,091	139,457	138,004	138,009	109,891	116,074	132,933
Commercial Waste Emissions per resident (MT CO2e/resident)	0.13	0.11	0.09	0.06	0.06	0.05	0.05	0.04	0.04	0.04
Commercial waste per employee (tons/employee)	0.65	0.49	0.40	0.30	0.30	0.27	0.25	0.19	0.17	0.23
Residential waste (tons)	140,528	134,557	127,219	111,420	112,211	103,735	107,485	119,903	126,365	129,241
Residential Waste Emissions per resident (MT CO2e/resident)	0.09	0.07	0.07	0.05	0.05	0.05	0.04	0.04	0.04	0.04
Residential waste per resident (tons/resident)	0.27	0.24	0.21	0.18	0.17	0.15	0.14	0.16	0.17	0.17
Waste Emissions (MT CO2e)	127,946	114,116	101,225	83,317	86,941	76,409	74,461	65,276	69,583	74,552
Waste Emissions per resident (MT CO2e/resident)	0.25	0.20	0.17	0.13	0.13	0.11	0.10	0.09	0.09	0.10