

Pierce Transit Sustainability Report 2023

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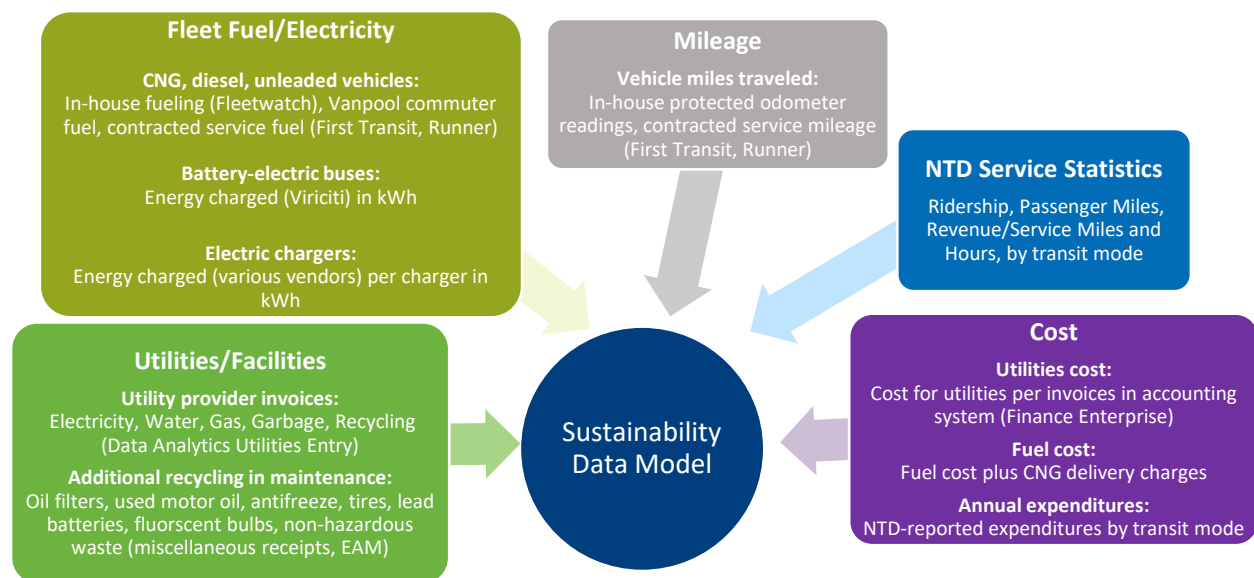
2023 Sustainability Framework

Sustainable transit reduces a community's environmental footprint from transportation and enhances its quality of life by making travel more enjoyable, affordable and timely. At Pierce Transit, sustainability is a core value that is addressed in terms of both the services we provide and how we operate. In our 2024-29 Strategic Plan, Goal #4 calls out the ways in which our agency incorporates sustainability practices and measures achievement. The activities reported in the following pages reflect the steps we have taken thus far to lay a foundation of sustainability practices that we'll build upon to meet this Goal.

Pierce Transit sustainability data model

An inventory of Pierce Transit's fleet, fuel consumption (in-house and contracted service), odometer readings, utility usage, waste/recycling disposal, and service statistics is conducted annually to calculate the agency's total emissions, emissions savings, and offsets. This report highlights the key results of this annual effort.

Figure 1. Components of the Pierce Transit sustainability data model



Greenhouse gas inventory

The greenhouse gas emissions in this report are calculated by analyzing Scope 1 and Scope 2 emissions as outlined by the American Public Transit Association's (APTA) *Quantifying Greenhouse Gas Emissions from Transit*.

- **Scope 1** emissions include direct operational emissions from mobile combustion (e.g., fleet fuel for revenue and non-revenue vehicles) and stationary combustion (e.g., gas used for heating facilities).
- **Scope 2** emissions include indirect operational emissions from purchased energy (e.g., electricity use).
- **Scope 3** emissions are not explored in this report and may be explored in the future (e.g., supply chain emissions, usage/disposal emissions).

Organizational boundary

Pierce Transit's emissions report includes modes of transit in which the agency has full operational control, including directly operated fixed route service (MBDO), Vanpool (VPDO), and paratransit (DRDO), as well as directly purchased paratransit and microtransit services (DRPT/DRPUR). This report does not include emissions data from

contracted services provided by regional partner Sound Transit. In this report, DRDO and paratransit DRPT are aggregated into one mode: SHUTTLE.

Ridership, Passenger Miles, Vehicle Miles, Revenue Hours

Many emissions measures are normalized by boardings, passenger miles, or vehicle miles to reflect changes in operational and/or fuel efficiency. Boardings and passenger miles reflect NTD-reported totals, whereas vehicle miles are calculated by actual odometer readings (not service miles).

Table 1. Boardings, passenger miles, vehicle miles, revenue hours in 2023

Mode	Boardings	Passenger Miles	Vehicle Miles	Revenue Hours
Fixed Route	6,096,759	26,266,538	5,021,267	387,028
SHUTTLE	262,611	2,074,823	2,326,208	147,455
Rideshare	412,041	11,904,323	3,404,497	102,663
Runner	15,786	56,585	93,967	6,300
Total	6,787,197	40,302,269	10,845,939	643,446

Key Emissions & Sustainability Data Points 2023

Table 2. 2023 Emissions and Utility Use

Measure	2023 Value	Percent change from 2022
Total CO2 Emissions	14,112 metric tons	+3%
Fleet CO2 Emissions	13,601 metric tons	+3%
Facilities CO2 Emissions	511 metric tons	-2%
Criteria Air Pollutants	138 metric tons	+11%
CO2 per 10,000 VMT	11.77 metric tons	-7%
CO2 per VMT	2.59 metric tons	-7%
CO2 per PMT	0.77 pounds	-14%
CO2 per Revenue Hour	48.25 pounds	-7%
Gasoline displaced by public transit	846,348 gallons	+19%
CO2 Savings	7,456 metric tons	+19%
CO2 Savings per 10,000 VMT	6.22 metric tons	+8%
Water use	14,259,395 gallons	+7%
Garbage	1,036,450 pounds	+27%
Recycling	519,414 pounds	-9%
Recycling Ratio	33%	-19%
Electricity use	6,594,217	+3%
Gas use	59,315 therms	-8%

Greenhouse gas emissions

Total Agency CO2 Emissions

CO2 Emissions

In 2023, Pierce Transit produced **14,112 metric tons of CO2**, a 3% increase from the previous year. The increase is attributed to a 10% increase in total vehicle miles traveled in 2023 as service levels continue to recover post-pandemic.

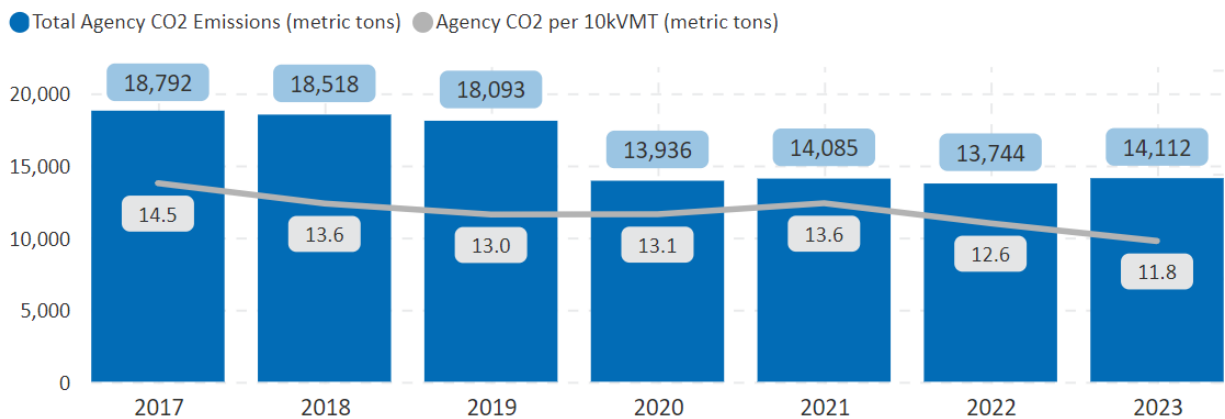
Normalized CO2 Emissions

Normalizing total emissions by vehicle miles demonstrates vehicle efficiencies year over year. The normalized value in 2023 is **11.8 metric tons of CO2 per 10,000 vehicle miles traveled**, a 7% decrease from the previous year. Pierce Transit's normalized emissions, our best metric to balance service levels with annual agency emissions, have been steadily decreasing since 2017.

Strategic Plan Goal 4 Performance Metric: Decrease emissions by 40% compared to 2017 emissions

Total CO2 emissions in 2023 (14,112MTCO2) are a **25% decrease from 2017 baseline** CO2 emissions (18,792MTCO2). The normalized CO2 emissions in 2023 (11.8 MTCO2/10k miles) are a **19% decrease from 2017 baseline value** (14.5 MTCO2/10k miles).

Figure 2. Pierce Transit CO2 emissions and normalized emissions

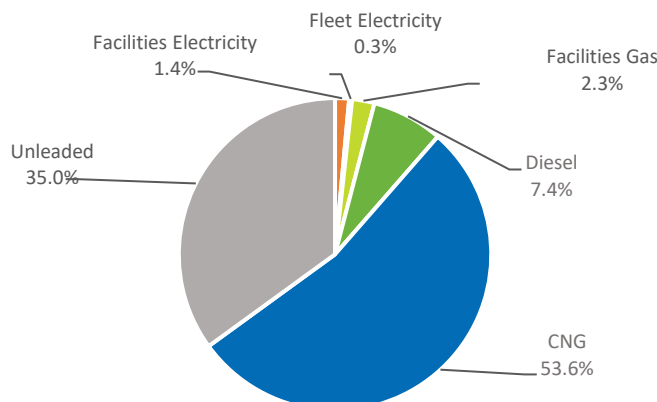


Data source: Pierce Transit Sustainability Framework

Emissions Mix

Fleet fuel emissions make up 96% of total agency emissions annually (4% facilities). Figure 3 presents the breakdown of Pierce Transit's CO2 emissions mix.

Figure 3. Pierce Transit CO2 emissions mix in 2023



Fleet Emissions

Fleet CO2 emissions

In 2023 Pierce Transit’s fleet produced **13,601 metric tons of CO2**, a 3% increase from the previous year. Fleet emissions primarily include mobile combustion from diesel, CNG, and unleaded fuel. This total includes the indirect emissions from electricity used by CNG pump stations and electric buses, which contribute only 0.33% of total fleet CO2 emissions (45 metric tons in 2023).

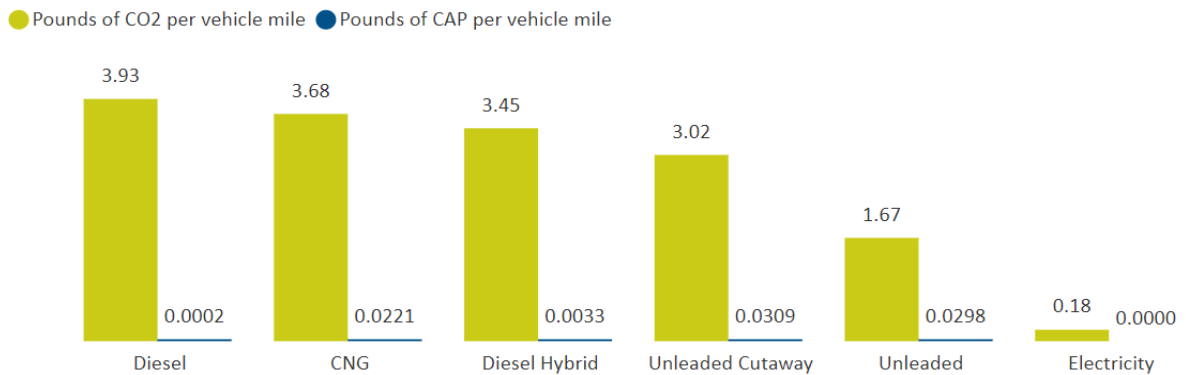
Fleet criteria air pollutant (CAP) emissions

Pierce Transit’s fleet emitted **138 metric tons of criteria air pollutants (CAP)** (carbon monoxide, nitrogen oxides, nonmethane hydrocarbons, particulate matter, and sulfur oxides), an increase of 11% from the previous year. The increase can be attributed to an 11% increase in total unleaded fuel used by Pierce Transit’s Runner (105% increase), Rideshare (13% increase), and SHUTTLE (14% increase) transit mode services.

Normalized fleet emissions

It is important to normalize CO2 and CAP emissions by vehicle miles traveled to examine fuel efficiency. In 2023 these normalized values were **2.49 pounds of CO2 per vehicle mile traveled** and **0.0254 pounds of CAP per vehicle mile traveled**. However, as Figure 4 and Table 2 show, these normalized values can vary drastically depending on the vehicle and fuel type.

Figure 4. Total pounds of CO2 and criteria air pollutant (CAP) emissions per vehicle mile traveled in 2023, by vehicle and fuel type



Note: Regional electricity providers generate most electricity through hydroelectric, which produces little to no CAP in production.

Table 2. Vehicle miles and fuel consumption by fuel type in 2023

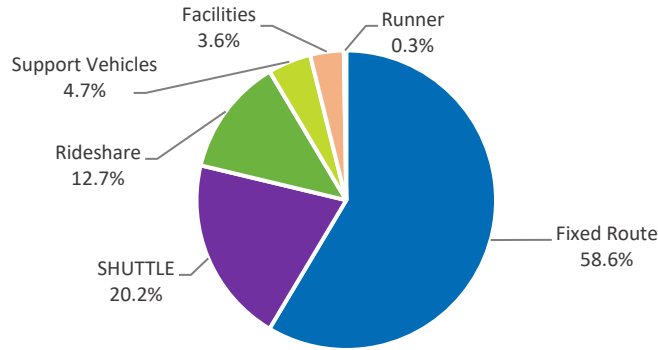
Fuel Type	#	VMT	Fuel Qty. (GGE/DGE)	Electricity Use (kWh)	Fuel efficiency	MTCO2	CO2/VMT (pounds)	MTCAP	CAP/VMT (pounds)
CNG	154	4,372,598	1,053,106	1,305,631	4.15 MPG	7,321	3.68	44	0.0221
Diesel	4	2,698	472		5.72 MPG	5	3.92	0	0.0002
Diesel Hybrid	20	634,314	97,443		6.51 MPG	995	3.45	1	0.0033
Electricity	9	91,007		265,806	0.34 mi/kWh	8	0.18	0	0
Unleaded	417	6,852,431	59,4174		11.53 MPG	5,216	1.67	93	0.0298
Unleaded Cutaway	9	40,757	6,369		6.39 MPG	56	3.02	1	0.0308

CO2 Emissions by Transit Mode

CO2 emissions by transit mode

Pierce Transit offers versatile transit options to meet the needs of regional customers. In 2023, the Fixed-Route bus service made up 59% of total agency emissions.

Figure 5. CO2 emissions mix by transit mode in 2023



CO2 per passenger mile traveled (PMT)

In 2023, Pierce Transit emitted 0.77 pounds of CO2 per passenger mile traveled (PMT) across all modes of transit, a 14% decrease from the previous year. This encouraging decrease can be attributed to increased ridership levels and increased passenger load size, which maximize shared transit's benefits.

For reference, a private commuter vehicle produces 0.96 pounds of CO2 per PMT (*Public Transportation's Role in Responding to Climate Change, 2011*).

Figure 6. Pounds of CO2 per PMT, by transit mode

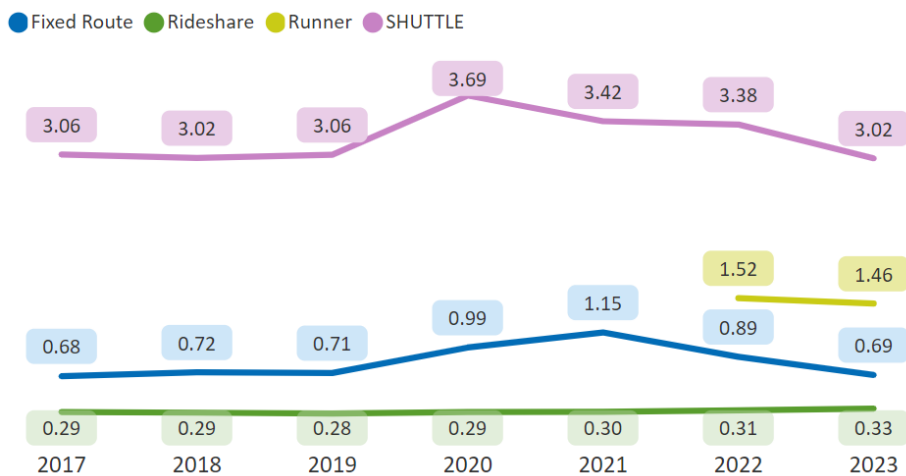


Table 3. National averages of CO2 per PMT by transit mode

Transit Mode	National Average
Fixed Route	0.64 pounds of CO2 per PMT
Demand Response (SHUTTLE)	3.10 pounds of CO2 per PMT
Rideshare	0.22 pounds of CO2 per PMT

Greenhouse gas savings

Total Agency CO2 Savings

CO2 Savings from mode-shift

Greenhouse gas savings are calculated by identifying the number of transit passenger miles traveled annually and using a *mode-shift factor* (a ratio of car miles displaced by public transit miles) and an average MPG for local vehicles to estimate the gallons of gasoline displaced. Using guidance from APTA's "*Recommended Practice for Quantifying Greenhouse Gas Emissions from Transit*" (2009), the emissions savings calculation assumes a medium service area population of < 1,250,000 people with a mode-shift factor of 0.42 and a 20 MPG average for personal vehicles in the region.

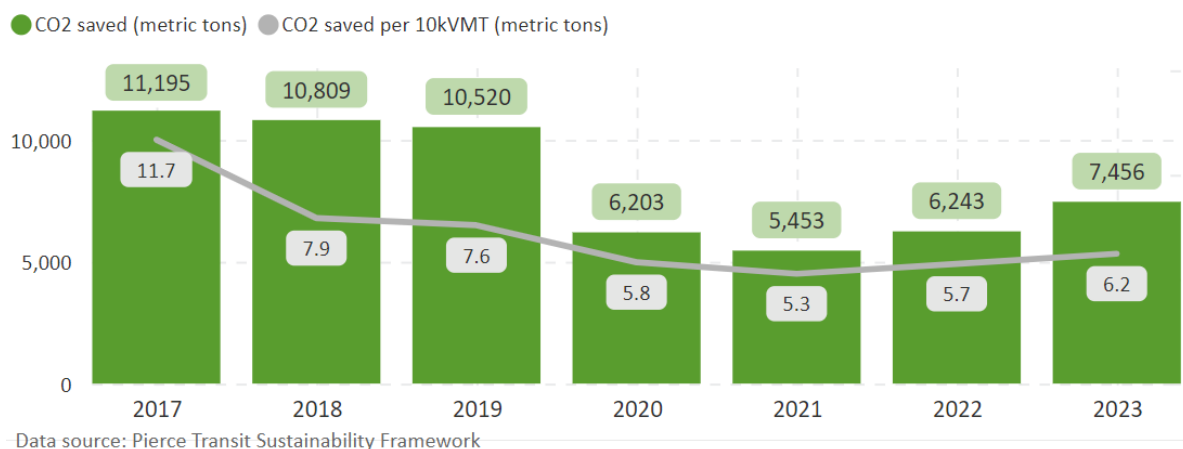
In other words, of the 40,302,269 passenger miles traveled by all modes at Pierce Transit in 2023, we infer that 42% of those miles were displaced by public transit (i.e., 42% of passenger miles *could have* been traveled by personal commuter vehicle instead of transit). This mode-shift **saved 846,348 gallons of gasoline** from personal commuter vehicles, which **saved 7,456 metric tons of CO2 emissions!**

While land-use benefits are widely discussed in public transit savings literature, this report does not calculate these benefits.

Normalized CO2 Savings from mode-shift

The normalized value of these savings in 2023 was **6.2 metric tons of CO2 saved per 10,000 public transit vehicle miles traveled!**

Figure 7. Mode-shift CO2 emissions savings and normalized savings



Carbon offsets

CO2 offset from renewable fuel sources

In late 2023, Pierce Transit began using renewable natural gas (RNG) in the CNG fleet and renewable diesel fuel (R99) in the diesel fleet. By using RNG and R99 fuels, Pierce Transit is utilizing renewable and sustainable fuel sources.

Renewable Natural Gas (RNG)

- RNG is derived from organic waste sources; when organic matter decomposes, it releases methane, a potent greenhouse gas.

- By capturing and processing this methane into RNG, it can be used as a fuel source, thereby preventing the methane from entering the atmosphere and contributing to climate change. This process is often referred to as biomethane recovery.
- When RNG is used as a fuel in vehicles, it still produces emissions, including carbon dioxide (CO2) and other pollutants, like CNG.
- However, because the methane used to produce RNG would have otherwise been emitted into the atmosphere as a potent greenhouse gas, using RNG effectively recycles and offsets these emissions.

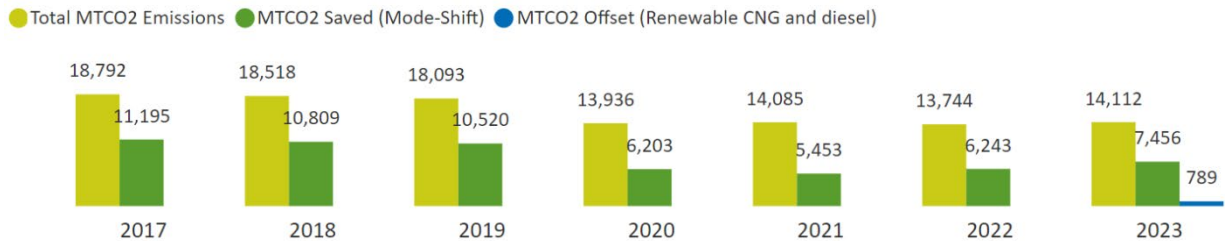
R99 Diesel

- R99 is produced from renewable sources like vegetable oils or animal fats, which absorb carbon dioxide (CO2) as they grow.
- When R99 fuel is burned, it releases CO2 but doesn't add new carbon to the atmosphere because the plants previously absorbed that same amount of CO2.
- This cycle makes it a "carbon-neutral" fuel, effectively offsetting its own emissions.

Thus, Pierce Transit’s carbon offsets can be calculated from the combustion of the total quantity of RNG and R99 fuels. In 2023, Pierce Transit used 65,209 GGE of RNG and 33,136 DGE of R99 fuel in fleet operations, resulting in a **carbon offset of 789 metric tons of CO2**. In other words, 789 metric tons of tailpipe emissions were offset by using renewable fuel that has already captured these emissions in the fuel’s production.

It is important to note there are lifecycle emissions savings benefits associated with renewable fuel that are beyond the scope of this report.

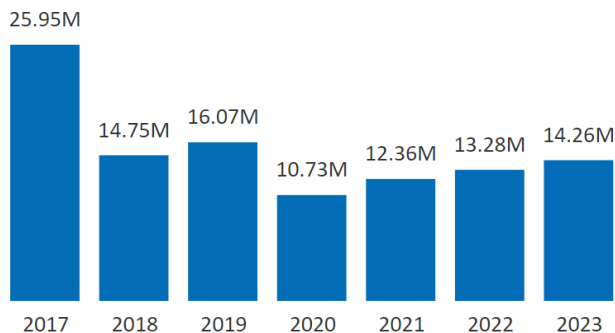
Figure 8. Annual Pierce Transit CO2 emissions, emissions saved, and emissions offset



Water Consumption

In 2023, Pierce Transit facilities **used 14,259,395 gallons of water**, a 7% increase from the previous year.

Figure 9. Pierce Transit annual water consumption (gallons)

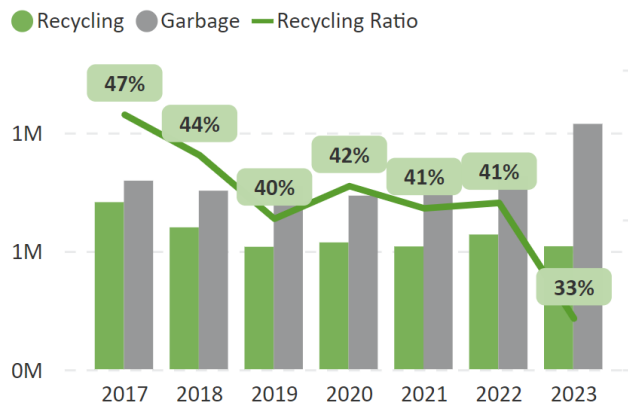


Garbage & Recycling

In 2023, Pierce Transit facilities disposed of **1,036,450 pounds of garbage** and **519,414 pounds of recycling**, a 27% increase in garbage and 9% decrease in recycling. **33% of total waste was recycled**, including vehicle tires, vehicle batteries, oil filters, used oil, paper, and miscellaneous office recyclables.

The increase in garbage in 2023 was the result of adding more garbage bins at facilities for regular trash pick-ups.

Figure 10. Pierce Transit annual garbage and recycling (pounds)

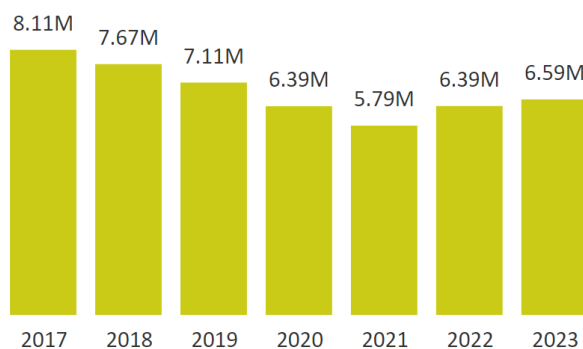


Electricity

In 2023, Pierce Transit used **6,594,217 kWh of electricity**, a 3% increase from the previous year.

- Facilities account for 81% of the total electricity used,
- CNG pump stations account for 16%
- Electric bus charging stations account for around 3%

Figure 11. Pierce Transit annual electricity use (kWh)

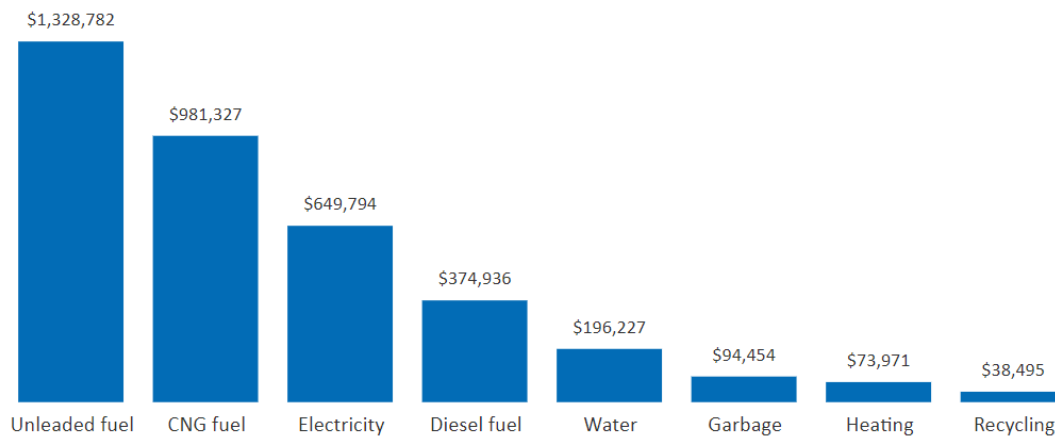


Utilities & Fuel Costs

Total Costs

In 2023, Pierce Transit **spent approximately \$3.7 million on utilities and fuel**, a 7% increase from the previous year (this total subtracts the estimated fuel cost allocated to Sound Transit fleet, 13% CNG and 80% diesel costs). Fuel costs include delivery charges.

Figure 12. Pierce Transit utilities and fuel costs in 2023



Future Data Projects

It is important for public transit agencies to diligently track their emissions and other sustainability measures to assess what can be improved. For future sustainability reports, it may be in the agency's best interest to examine the following data:

Indirect "Scope 3" Emissions

These are all other indirect emissions within Pierce Transit's value chain.

- Employees traveling to work and business travel (non-revenue support vehicles are already included in Scope 1 emissions)
- Waste and recycling
- Customer transit access trips (e.g., passenger traveling to transit center prior to boarding bus)
- Vehicle and equipment manufacturing and disposal
- Upstream (well-to-tank) emissions from fuel extraction, refining and transportation

However, most emissions in Scope 3 are reported by the supplier or manufacturer as their Scope 1 emissions.

Land-Use Benefit CO2 Savings

The current report examines mode-shift as a factor for emissions savings. However, land-use benefit incorporates the added benefit of public transit within a specific area; walking, cycling, and density affect emissions. When private vehicle travel is reduced, through either mode-shift or land-use benefit, emissions are further saved. An analysis of this scope has been conducted for larger cities such as Seattle, San Francisco, and Portland. However, a similar analysis could be done for the Pierce Transit Benefit Area (PTBA).

Appendices

Appendix A. CO2 fuel emissions by vehicle fuel type

Fuel Type	Units	kg CO2/gallon	lbs CO2/gallon	MTCO2/gallon
CNG	Gasoline Gallon Equivalent (GGE)	6.916	15.2152	0.006916
Diesel	Diesel Gallon Equivalent (DGE)	10.21	22.462	0.01021
Unleaded	Gallons	8.78	19.316	0.00878

Note: Gallons of fuel used come from Pierce Transit’s Fleetwatch database; however, DRPUR contractors and VPDO commuter fuel use are recorded separately on an annual basis.

Appendix B. APTA vehicle classification and criteria air pollutant calculations table

Asset Category	Fuel Category	APTA Category	Transit Mode	Carbon Monoxide (g)	Nitrogen Oxides (g)	Nonmethane Hydrocarbons (g)	Particulate Matter (g)	Sulfur Oxides (g)
MBDO	CNG	PT Bus	Fixed Route	Miles *10.01	Miles *.22	Miles *.02	Miles *.003	0
MBDO	Diesel	PT Bus	Fixed Route	Miles *0.74	Miles *0.49	Miles *0.14	Miles *0.12	0
MBDO	Unleaded	Van	Fixed Route	Miles *11.84	Miles *0.95	Miles *1.224	Miles *.0094	0
MBDO	Electric	PT Bus	Fixed Route	N/A	N/A	N/A	N/A	N/A
VPDO	Unleaded	Van	Vanpool	Miles *11.84	Miles *0.95	Miles *1.224	Miles *.0094	0
DPDO	CNG	Van	SHUTTLE	Miles *2.632	Miles *0.226	Miles *0.143	Miles *0.0334	0
DRDO	Unleaded	Van	SHUTTLE	Miles *11.84	Miles *0.95	Miles *1.224	Miles *.0094	0
DRPUR	Unleaded	Van	SHUTTLE	Miles *11.84	Miles *0.95	Miles *1.224	Miles *.0094	0
DRPUR	Unleaded	Van	Runner	Miles *11.84	Miles *0.95	Miles *1.224	Miles *.0094	0
Non-Revenue	Unleaded	Single Occupied Vehicle	Non-Revenue	Miles *9.4	Miles *.693	Miles *1.034	Miles *.0085	Miles *.007
Non-Revenue	CNG	N/A	Miscellaneous Shop Equipment	N/A	N/A	N/A	N/A	N/A
Non-Revenue	Diesel	N/A	Miscellaneous Shop Equipment	N/A	N/A	N/A	N/A	N/A

Note: Gallons of fuel used come from Pierce Transit’s Fleetwatch database; however, DRPUR contractors and VPDO commuter fuel use are recorded separately on an annual basis.

Appendix C. Utilities unit conversions table

Utility Type	Unit Type (from invoice)	Converted to gallons	Converted to pounds	Converted to kWh	CO2
Water	CCF	748.051948			
Water	CF	7.48051948			
Electricity	kvah			Kvah x PF	
Electricity	kWh				0.00002878 (Metric tons) 0.063316 (pounds)
Gas	Therms				0.0053 (metric tons) 11.66 (pounds)
Garbage	Gallon		3*		
Garbage	Ton		2000		
Garbage (uncompacted)	Cubic yard		275*		
Garbage (compacted)	Cubic yard		550*		
Oil filters (crushed)	Drum		700		
Oil filters (not crushed)	Drum		175		
Antifreeze	Gallon		8.42		
Used motor oil	Gallon		7.4		
Lead bus battery	One battery		47		
Bus tire	One tire		120		
Yard waste (uncompacted)	Cubic yard		250		
Yard waste (compacted)	Cubic yard		640		
Recycling	Cubic yard		111		
Recycling	Gallon		0.55		
Paper shredding	Cubic yard		128		
Paper shredding	Gallon		0.64		
Fluorescent bulb	One bulb		0.3		
Non-hazardous waste recycling	Gallon		8.42		

*Average within a range provided by the EPA

Appendix D. Power factor conversion

$$P_{(kW)} = S_{(kVA)} \times PF$$

1 kvah with a power factor of 1 (100%) = 1 kWh

1 kvah with a power factor of 0.5 (50%) = 0.5 kWh

Appendix E. Pierce Transit power mix analysis

Each year, power companies report their [sources for electricity](#) to Washington State in a market analysis. Using these breakdowns, Pierce Transit can calculate an estimated agency-wide CO2 per kWh. The 2023 electricity to CO2 emissions conversion uses the following 2022 Power Mix Analysis to **calculate 0.097076 CO2 per kWh used**:

Company	KWH 2022	Weighted CO2 per kWh based on market analysis	% of PT usage	weighted based on % usage
Lakeview	5,156,688	0.0944	80.7%	0.0761
Parkland	36,859	0.0944	0.6%	0.0005
Peninsula	92,457	0.0927	1.4%	0.0013
PSE	61,424	0.8881	1.0%	0.0085
TPU	1,044,128	0.0645	16.3%	0.0105
Total	6,391,556			0.097076 CO2 per kWh

For the full 2022 Power Mix Analysis please reach out to Pamela Gant (pgant@piercetransit.org)

Company	KWH 2022	Weighted CO2 per kwh	% of usage	weighted based on % usage
Lakeview	5,156,688	0.0944	80.7%	0.0761
Parkland	36,859	0.0944	0.6%	0.0005
Peninsula	92,457	0.0927	1.4%	0.0013
PSE	61,424	0.8881	1.0%	0.0085
TPU	1,044,128	0.0645	16.3%	0.0105
	6,391,556			0.097076

Appendix F. References

- “Electricity in the United States” (USEIA) [Link](#)
- “Alternative Fuels Data Center” (Energy.gov) [Link](#)
- “Quantifying Greenhouse Gas Emissions from Transit” (APTA, 2009) [Link](#)
- “Recommended Practices for Quantifying Greenhouse Gas Emissions from Transit” (APTA, 2009) [Link](#)
- “Quantifying and Reporting Transit Sustainability Metrics” (APTA, 2012) [Link](#)
- “Criteria Air Pollutants” (EPA, 2015) [Link](#)
- “Public Transit’s Role in Reducing Greenhouse Gas Emissions” (USDOT, 2010) [Link](#)
- “Greenhouse Gases Equivalencies Calculator” (EPA) [Link](#)
- “Utility Fuel Mix Market Summary 2022” (Washington Department of Commerce) [Link](#)
- “CHC Factsheet: Renewable Diesel (R100 or R99)” (California Air Resources Board) [Link](#)
- “REC vs. Carbon Offset: Do you know the difference?” (Green Biz, Aimee Barnes, 2009) [Link](#)