Greenhouse Gas Emissions and Energy Usage Report

2019-2020

Seattle Public Utilities

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Letter from Andrew Lee, General Manager & CEO, Seattle Public Utilities

The effects of climate change are already apparent to Seattle residents, as the city experiences worsening heat waves, wildfire smoke events, and coastal flooding episodes in recent years. These impacts are most disproportionately felt by Seattle's frontline residents, who are most likely to be harmed by the consequences of a changing climate. As a provider of essential water, wastewater, and solid waste services, Seattle Public Utilities is already at the front lines of confronting and adapting to climate change. That is why we are taking action to equitably decarbonize our operations by 2030 and ensure that we are ready to continue serving Seattle's residents into the future.

Central to these efforts is this Operational Greenhouse Gas Inventory, which characterizes the greenhouse gas emissions that our organization has released into the atmosphere as a result of our work. While we have completed one-off inventories in the past, this effort represents the first consistent and annual effort to benchmark our emissions and track our improvements over time. Within this report, we characterize the contributions the utility makes to climate change when we treat and deliver water, clear and maintain wastewater pipes, and manage solid waste.

Over the coming years, SPU will use the results of this inventory to aggressively reduce our contributions to climate change. Already, SPU is working to electrify our vehicle fleet and transition our facilities away from fossil gas. SPU is also working proactively to protect our most vulnerable residents from some of the acute impacts of climate change, such as sea level rise and impacts from extreme storms. While we are encouraged by these early steps, we also know that there is so much more we can do moving forward. That's why this inventory also includes a series of action items that SPU can take to continue our pursuit of carbon neutrality and further our transition away from fossil fuels in our operations.

We at SPU know that we are simply one fraction of Seattle's contribution to climate change. But we also are committed to being a utility that drives for a more sustainable and equitable future for all of Seattle's residents. We intend to do our part to fulfill the One Seattle Climate Justice vision that generates a just transition away from fossil fuels and helps build healthy, resilient communities.

Andrew Lee
General Manager & CEO
Seattle Public Utilities

Executive Summary

In support of a One Water, Zero Waste, and Community Centered vision, SPU has prioritized the reduction of the utility's climate impact. One effort is to reduce carbon emissions with a goal to be carbon-neutral in operations by 2030. To reach this goal, SPU has begun tracking operational greenhouse gas (GHG) emissions through an annual inventory. This is the first annual SPU GHG Emissions and Energy Usage Report, summarizing 2019 and 2020 emissions and establishing 2019 as a baseline[1]. Moving forward, SPU will produce an annual report, including updated recommendations and progress made towards achieving our goals.

Emissions from SPU Operations

Total Emissions

In 2019, SPU generated emissions equivalent to 16.6 kilotonnes of carbon dioxide (ktCO2e)[2]. In 2020, SPU's overall emissions declined to 13.9 ktCO2e. These emissions included:

	Emissions Source	2019 (ktCO2e)	2020 (ktCO2e)
Infrastructure and Workforce Facilities	Electricity	8.6	6.2
	Gas	0.6	0.7
	Fugitive Emissions	2.2	2.3
	Historic Landfills	*1.8*	*2.0*
	Building AC	*0.2*	*0.3*
Fleet	Fleet Fuels	5.0	4.5
	Fugitive Emissions	0.4	0.3
	Fleets AC	*0.4*	*0.3*
	Total	**16.6**	**13.9**

Infrastructure and Workforce Facilities: SPU buildings include service delivery infrastructure that supports water and wastewater distribution and solid waste services (e.g., pump stations, historic landfills), as well as workforce facilities that support SPU's employees (e.g., office space, operation centers, water treatment facilities). All emissions sources from infrastructure and workforce facilities generated 11.6 ktCO2e in 2019 and 9.4 ktCO2e in 2020, representing 69.8% of total emissions in 2019, and 67.6% in 2020. Of all sources, emissions from electricity purchased is the single largest source of SPU's operational emissions, representing 51.5% of total emissions in 2019 and 44.4% in 2020.

[1] SPU completed GHG inventories in 2009 and 2016. The inventory described here represents the first annual inventory using a standardized and replicable methodology and will use 2019 as a baseline year for consistency.

[2] Unless otherwise identified, all quantities of emissions in both the text of this document and in each graph are calculated using the unit "ktCO2e", which refers to the equivalent of thousands of metric tons of carbon dioxide.

SPU purchases electricity from Seattle City Light (SCL) and Puget Sound Energy (PSE) since we have facilities located in both service areas. While PSE only supplied 42% of the electricity SPU purchased in 2020, 97% of all emissions from purchased electricity can be traced to PSE electricity due to the utility's high emission factors. Since SCL is a carbon-neutral electric utility with very low emission factors, just 3% of emissions in 2020 from purchased electricity can be traced to SCL electricity.

SPU's infrastructure and workforce facilities also generated 0.6 ktCO2e in 2019 and 0.7 ktCO2e by combusting fossil gas[3].

Fugitive Emissions: Fugitive Emissions are generated when planet-warming gases directly escape from equipment or facilities into the air. These emissions can include HFCs from air conditioning systems and methane escaping from historic landfills. Fugitive emissions from vehicle air conditioning units generated 0.4 ktCO2e in 2019 and 0.3 ktCO2e in 2020, while fugitive emissions from facilities generated 0.2 ktCO2e in 2019 and 0.3 ktCO2e in 2020.

> *Historic Landfills:* SPU maintains three historic landfills that are no longer collecting solid waste but continue to emit landfill gas as organic waste disposed in these sites decomposes. A key component of landfill gas is methane, which is 28 times more powerful a greenhouse gas than carbon dioxide. While the quantity of this gas is small, its potency leads to significant emissions. Historic landfills generated 1.8 ktCO2e (10.7% of total emissions) in 2019 and 2.0 ktCO2e (14.3% of total emissions) in 2020.

Fleet: Vehicles and equipment generated the equivalent of 5.4 ktCO2e in 2019 (32.3% of total emissions) and 4.8 ktCO2e in 2020 (34.2% of total emissions). These emissions include our equipment (generators, mobile pumps), light vehicles (sedans, SUVs, vans, and small trucks) as well as our heavy vehicles (large trucks, vactors, short-haul drayage trucks, construction equipment) that SPU uses to construct and maintain our infrastructure.

Emissions Reductions

SPU has options to reduce operation-related emissions in the coming years. Abatement strategies include:

- *Infrastructure and Workforce Facilities:* Engage PSE towards decarbonization and generate renewable energy throughout SPU's infrastructure.
- *Fleets*: Continue to transition light-duty and medium-duty fleet to electric vehicles
- *Historic Landfills*: Monitor improved methane destruction technologies.
- *Other Sources*: Require additional emissions reductions in future solid waste collection truck contracts.

A complete list of strategies and recommended action items can be found in section 4 of the report.

[3] This inventory utilizes the term "fossil gas" to describe methane gas utilized for heating and propulsion that is extracted from fossil sources; another common term for this fuel is "natural gas". We use the term "fossil gas" to differentiate between methane gas derived from fossil fuel extraction, compared to "landfill gas" to refer to methane generated from the decomposition of organic material in landfills.

1. Introduction and Background

Established in 1997, Seattle Public Utilities (SPU) provides drinking water to 1.5 million retail customers and 19 neighboring utility wholesale customers throughout the region, and provides drinking water, drainage, wastewater, and solid waste services directly to residents and businesses within the City of Seattle. SPU has organized these four essential services into three lines of business - water supply, drainage and wastewater, and solid waste - and has about 1,400 employees.

The utility manages two mountain watersheds: the Cedar River watershed and the South Fork Tolt River watershed. Its system includes almost 200 miles of water transmission pipelines, 1,680 miles of water distribution main, 1,400 miles of in-city sanitary and combined sewer mainlines, over 480 miles of drainage pipes, and two major garbage and recycling transfer stations that process an estimated 750,000 tons of garbage, recycling, and organic waste each year. SPU operates a fleet of over 600 vehicles. In addition, SPU contracts with providers for garbage, organics, and recycling collection. With operating revenues over $1.4 billion per year, SPU is considered a relatively large U.S. utility, and is uncommon in its consolidated water supply, drainage, wastewater, and solid waste services which allow it to have a broad purview over Seattle's resource management, environmental services, and pollution issues.

SPU's Strategic Business Plan outlines a vision of a Utility that centers a One Water model, pursues Zero Waste management of resources, and is Community Centered in its service to the residents of Seattle. In light of the ongoing climate crisis, the effective execution of SPU's vision requires the Utility to take urgent action to monitor, measure, and reduce our own GHG emissions.

Climate change presents an immediate threat to our region and residents. As the planet warms throughout the next 100 years, we can expect coastal flooding events to become more frequent, inland flooding events to increase in intensity, mountain snowpack to decline, and wildfire activity to increase the likelihood that neighboring communities are damaged and Seattle's air quality is worsened. While all these impacts represent painful realities to every one of Seattle's residents, it is our BIPOC and frontline communities – who have the least resources available to them to adapt to a changing planet – that are most likely to bear the greatest magnitude of impacts.

Within the societal impacts that we expect to impact Seattle is the acute risk that Climate Change poses to the essential services that SPU provides to ratepayers. Increasing sea levels will put additional stresses on SPU's drainage and wastewater infrastructure, in addition to the larger King County wastewater treatment system. In our watershed, increased variability of precipitation events, as well as the likelihood that more of our precipitation will fall as rain rather than snow, will require more careful management of our water resources to ensure water is delivered reliably. And with warm and dry summers more likely in the future, the risk that a wildfire would penetrate our watershed increases into the future, which would degrade the natural services that help purify and protect our water sources.

If SPU is to live up to our One Water, Zero-Waste, and Community Centered vision, SPU has a responsibility to adapt our utility's operations to succeed in an environment impacted by climate change and do our part to

eliminate our carbon emissions. SPU has already identified a goal to be carbon-neutral by 2030; by tracking SPU's emissions over time, this inventory can provide a more complete picture of our emissions profile and identify effective steps SPU can take to reduce emissions in the coming years.

This responsibility aligns with SPU's ongoing legacy of environmental responsibility. As a steward of the Cedar River watershed and a national leader in solid waste management, SPU has been a pioneer in responsibly leveraging the utility's assets to ensure environmental responsibility. As the utility now charts fleet and building electrification strategies, this inventory will provide the empirical foundation for SPU's decarbonization work.

Beginning with a baseline of 2019, SPU's operational GHG inventory analyzes the climate-warming emissions that SPU generates through the day-to-day operation of our facilities, vehicles, and service delivery infrastructure. In addition to tracking SPU's operational emissions, this inventory also includes some categories of emissions sources *outside* of SPU's day-to-day operations: namely solid waste collection truck contracts, and our employee's business travel and daily commutes. We believe this analysis provides further insight into areas where SPU can reduce our broader carbon footprint.

In addition to the analysis of our emissions, this report also outlines some of the existing emissions-reduction efforts already set in motion and recommends ways to build on the progress that SPU has achieved to date.

This report is the first annual SPU GHG Emissions and Energy Usage Report, summarizing 2019 and 2020 data. In subsequent years, SPU will produce an annual report and updates, including updated recommendations and progress on achieving our goals.

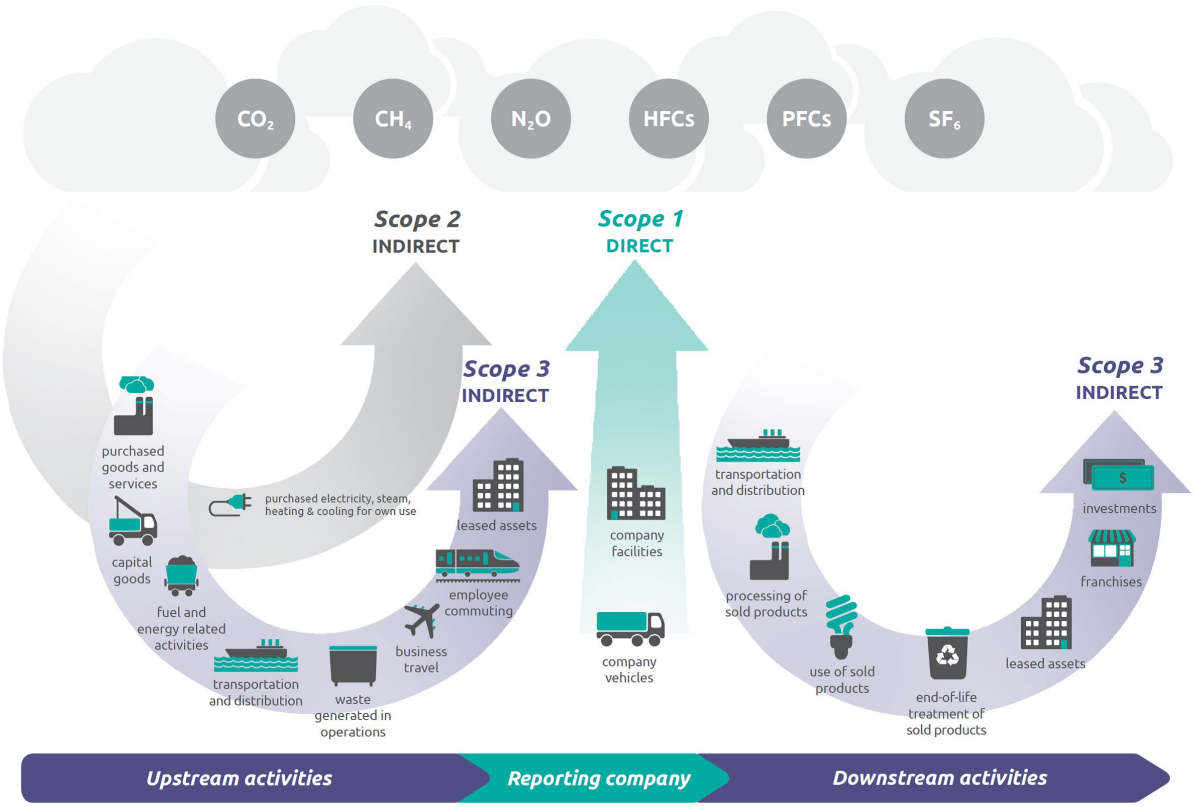
2. Summary of Methodology

For further details, see Appendix 2.

The 2019 and 2020 inventories were conducted with the use of a procedure modified from the Local Government Operations Protocol (LGOP) originally defined by The Climate Registry.

2.1 What is included in this inventory?

This inventory examines the emissions related to SPU's operations as defined below. In GHG accounting methodologies, emissions are categorized under three "Scopes" that outline how warming emissions are released into the atmosphere. [4]



Scope 1 emissions refers to any emissions that SPU releases directly into the atmosphere. These include:

- Emissions from the stationary combustion of fossil fuels in our equipment, buildings, and generators, as well as the mobile combustion of fossil fuels in our vehicles.
    - Stationary combustion includes:
        - Fossil gas supplied by Puget Sound Energy to our buildings.

[4] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

        - Equipment that uses fossil fuels as part of its operation but does not use fossil fuels to move itself. For example, a trailer-mounted generator which is towed by a truck.
    - Mobile combustion includes:
        - Emissions generated by equipment that uses fossil fuels to move itself. For example, fossil fuel-powered vehicles.

- "Fugitive" emissions[5], which result from GHGs escaping from our equipment, vehicles, and buildings.
    - Facility fugitive emissions are emitted when refrigerant escapes from HVAC systems and heat pumps, as well as from methane emissions created when organic waste decomposes in a landfill.
    - Mobile fugitive emissions are released when refrigerant escapes from a vehicle's air conditioning system.
    - Emissions from purchased industrial gases, such as acetylene and carbon dioxide, which may be used in welding or other applications.

Scope 2 emissions refer to any emission that SPU is indirectly responsible for releasing. In our inventory, these emissions come from generating the electricity that we purchase to power our infrastructure and workforce facilities. This electricity is supplied by two electricity utilities: Seattle City Light and Puget Sound Energy.

- Seattle City Light (SCL) provides electricity for all buildings within its service area, which roughly correlates with Seattle's city limits.
- Puget Sound Energy (PSE) supplies electricity to every SPU facility outside of SCL's service area, including infrastructure and workforce facilities located throughout King County.

Scope 3 refers to emissions that SPU does not control or own either directly or indirectly but still contributes to through our supply chain or the activities of our employees. For the purposes of this inventory, we have chosen to include estimates of the following categories of emissions that are categorized as Scope 3 emissions but that we believe can provide further insight into areas where SPU can reduce our broader carbon footprint.

1. Emissions related to business travel.
2. Emissions related to employee commuting.
3. The emissions that our solid waste contractors generate by operating solid waste collection trucks.

2.2 What is not included in this inventory?

Emissions outside of the scope of this inventory include any emissions generated by SPU that are not related to the utility's day-to-day operations and service delivery. This includes the Scope 3 emissions related to the

[5] https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf

materials in our supply chains, emissions related to construction projects, and emissions related to the disposal of materials beyond the purview of SPU's solid waste line of business.

For example, the emissions associated with the transportation and final disposal of solid waste at active landfills are generated by contractors like WM (previously named Waste Management); similarly, the treatment of wastewater is conducted by King County. In both cases, these emissions are considered within the operation of the downstream contractors.

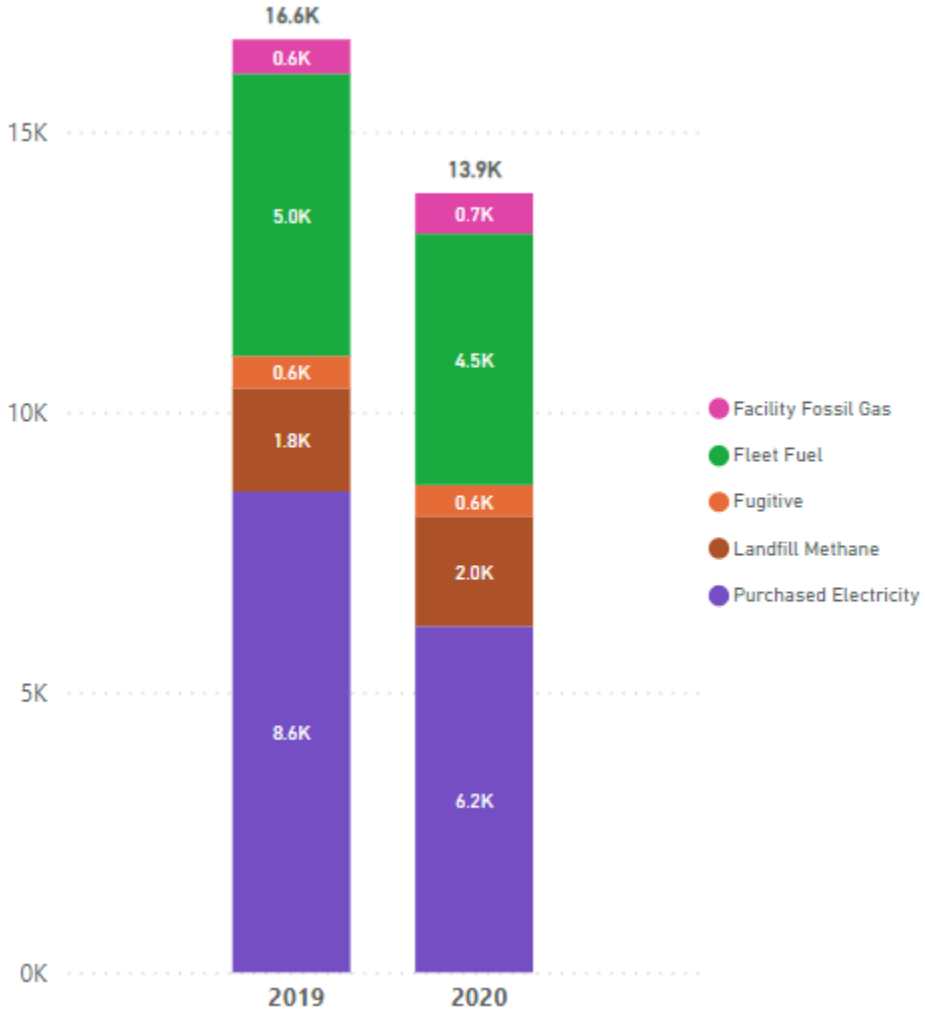
Some selected Scope 3 emissions, including emissions from contracted solid waste collection trucks, employee commuting, and business travel, were analyzed in this inventory to contextualize these emissions compared to the emissions that SPU generates through its Scope 1 and 2 operations. SPU's remaining Scope 3 emissions are included in the Purchasing & Contracting Inventory being conducted in parallel to this effort.

3. Inventory Results

In the year 2019, Seattle Public Utilities generated operational GHG emissions equivalent to 16.6 ktCO2e. Of these emissions, approximately 8.6 ktCO2e were produced through the consumption of purchased electricity, 5.0 ktCO2e were produced through the direct combustion of fossil fuels through our vehicle fleet and other equipment, 1.8 ktCO2e was emitted from historic landfills, and 0.6 ktCO2e were produced through the combustion of fossil gas in buildings.

In 2020, Seattle Public Utilities emitted 13.9 ktCO2e related to its operations. 6.2 ktO2e were associated with the consumption of purchased electricity, 4.5 ktCO2e associated with combusting fossil fuels, 2.0 ktCO2e emitted from historic landfills, and 0.7 ktCO2e were produced through the combustion of fossil gas in buildings.

Fig. 1: Overall Operational Emissions



Key Takeaways

- **SPU's emissions declined year-over-year, largely due to PSE's cleaner electricity profile:** Between 2019 and 2020, emissions declined from 16.6 ktCO2e to 13.9 ktCO2e. While this included a modest 0.6 ktCO2e decline in emissions from the utility's vehicle fleet, the bulk of this reduction can be traced to improvements that Puget Sound Energy made to their electricity profile. As PSE reduced the carbon intensity of their electricity generation, SPU saw a significant drop in emissions in 2020.
- **SPU's has inherent operational advantages that provide the utility with a low baseline emission level:** When compared to other water or solid waste utilities, SPU has several intrinsic advantages that lead to lower emissions relative to peer organizations. As SPU does not treat its own wastewater, nor does it manage or maintain an active landfill, some significant potential sources of emissions do not fall under SPU's responsibility. Additionally, SPU benefits from operating in part within Seattle City Light's service area. As Seattle City Light operates as a carbon neutral electricity utility, SPU's infrastructure, workforce facilities, and vehicles powered on SCL's grid emit extremely small amounts of warming emissions. SPU has a shorter path to operational carbon neutrality thanks to this context.
- **Seattle Public Utilities has the most capacity to directly influence vehicle and fuel emissions:** Emissions from direct fossil fuel combustion – primarily due to vehicle travel – make up a little less than half of SPU's operational emissions, while purchased electricity makes up most of the remaining amount. While the purchased electrical emissions are a greater share of SPU's emissions profile, the vast majority of those emissions come from electricity purchased under contract from Puget Sound Energy, of which SPU has limited direct influence. SPU's vehicle fleet falls directly under SPU's control, and procurement occurs in conjunction with FAS. As new electric vehicles come to market, SPU has a more defined path to confront emissions from vehicles in the near future compared to emissions sourced from purchased electricity.
- **SPU operates as an essential service – emissions trends do not always align with city-wide inventories:** Seattle's Office of Sustainability and the Environment (OSE) released an update to their GHG inventory in 2022 that identified significant reductions in warming emissions during 2020, including a 24.5% decrease in transportation emissions[6]. OSE concluded that Seattle's overall emissions reduction can be traced to changes in resident and commercial behaviors due to the COVID-19 pandemic and will likely rebound in future years. SPU experienced much smaller fluctuations during the acute phase of the pandemic due to the utility's operation as an essential service provider. While April and May of 2020 showed a temporary drop in fuel emissions, fuel consumption returned to pre-pandemic levels by July. In turn, 2020 experienced an 11.5% reduction in emissions related to vehicle combustion emissions. While this reduction is likely to be similarly

[6] https://www.seattle.gov/environment/climate-change/climate-planning/performance-monitoring

transient, its smaller magnitude reflects SPU's essential work that necessarily must continue through disruptive events.

3.1 Infrastructure, Historic Landfills and Workforce Facilities

SPU's buildings include the facilities supporting our workforce, infrastructure assets, including pump stations, treatment plants, transfer stations, watershed facilities, and historic landfills.

There are three categories of emissions that arise from our workforce facilities and infrastructure.

- **Purchased Electricity**: Most of our emissions traced to our facilities are emitted through the purchasing and consumption of electricity generated through fossil fuel use. Our electricity is sourced from either Seattle City Light (for assets located within SCL's service area), or Puget Sound Energy (for assets located outside of Seattle's boundaries).

  Example: CO2 emissions from electricity purchase for use operating the Cedar Treatment Plant.

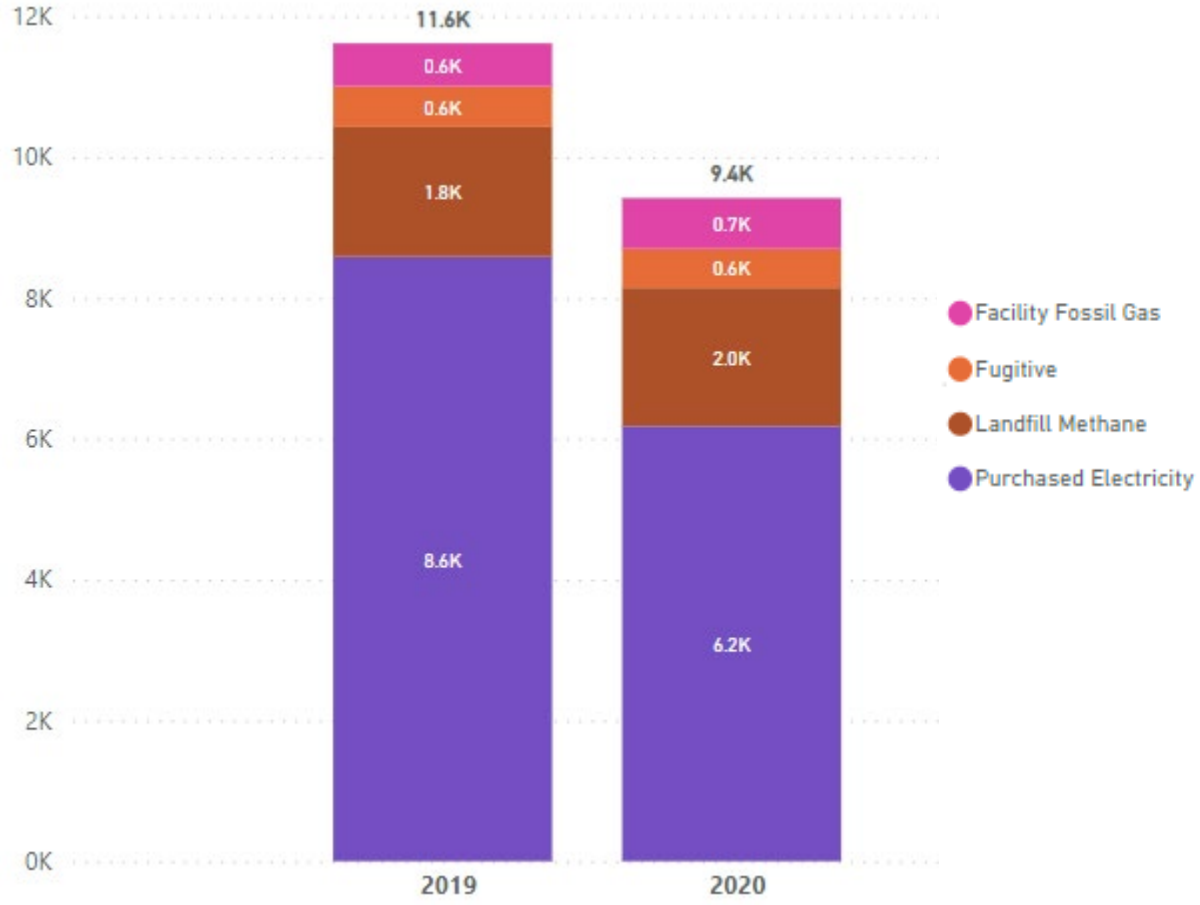
- **Stationary Combustion:** When fossil gas is utilized in building systems to heat water and warm spaces, the emissions generated from these sources are termed "stationary combustion."

  Example: Fossil gas used in the Operations Control Center to heat office space in the winter.

- **Fugitive Emissions:** GHGs that escape from building air conditioning systems, refrigerators, landfills, or fire extinguishers are referred to as fugitive emissions. The emissions in this inventory are most commonly HFCs or CFCs leaking from HVAC systems, or landfill methane escaping from organic solid waste stored in historic landfills.

- **Example**: Leakage of R-410a from HVAC systems in our office buildings.

Fig 2: Infrastructure, Historic Landfills and Workforce Facilities Emissions by Year and Source



In 2019, our infrastructure, historic landfills and workforce facilities generated 11.6 ktCO2e, with 74% of that coming from purchased electricity, 5% from stationary combustion, 16% from fugitive methane emissions emerging from historic landfills, and 5% from fugitive emissions escaping from facility equipment. In 2020, SPU generated a total of 9.4 ktCO2e, with 66% from purchased electricity, 8% from stationary combustion, 21% from fugitive methane emissions emerging from historic landfills, and 6% from fugitive emissions escaping from facility equipment.

SPU generated 0.61 ktCO2e from the combustion of facility fossil gas in 2019, and 0.78 ktCO2e in 2020. As a minority of SPU's infrastructure and workforce facilities utilize fossil gas combustion to warm spaces and water, these emissions are comparatively small compared to electricity consumption.

SPU generated a total of 2.4 ktCO2e in total fugitive emissions in 2019, with 0.6 ktCO2e originating from escaped refrigerants from HVAC systems and heat pumps, and the remaining 1.8 ktCO2e originating as methane emissions from historic landfills. In 2020, SPU's fugitive emissions rose slightly to 2.6 ktCO2e, with 2.0 ktCO2e coming from historic landfills and 0.6 ktCO2e from HVAC systems and heat pumps.

Electricity consumption represents the largest source of emissions for our infrastructure and workforce facilities. SPU operates with two suppliers of electricity: Seattle City Light powers all buildings operating within its service area – which roughly correlates to Seattle's city boundaries – while Puget Sound Energy supplies electricity to all other infrastructure or workforce facilities.

Fig 3: Energy Consumption by Utility in KWH - 2019

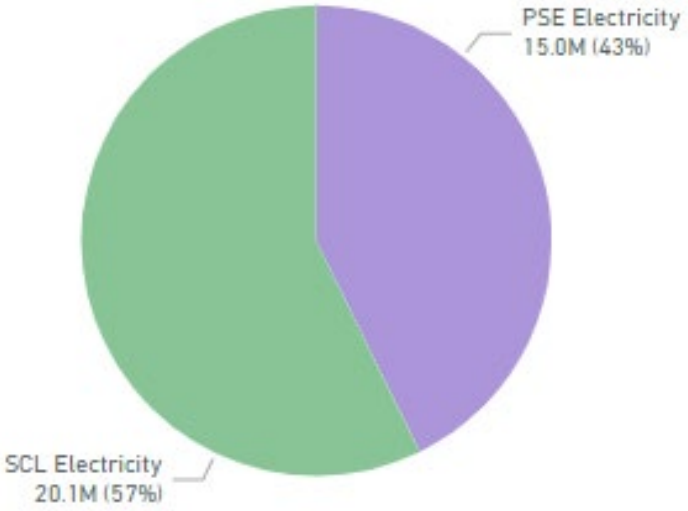
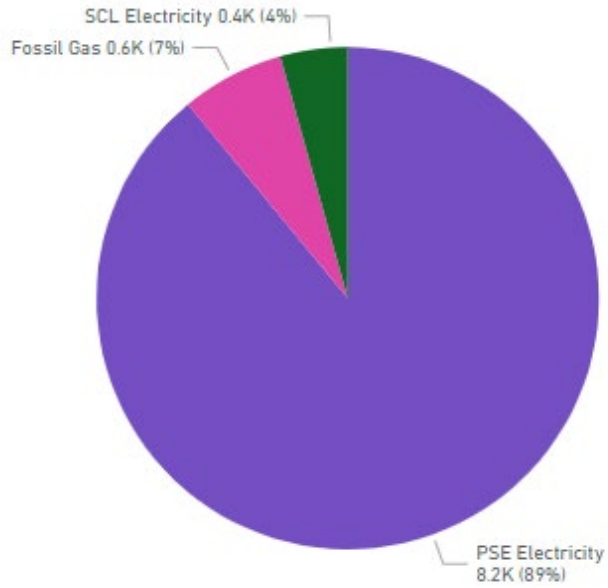


Fig. 4: Emissions by Energy Source, in ktCO2e - 2019

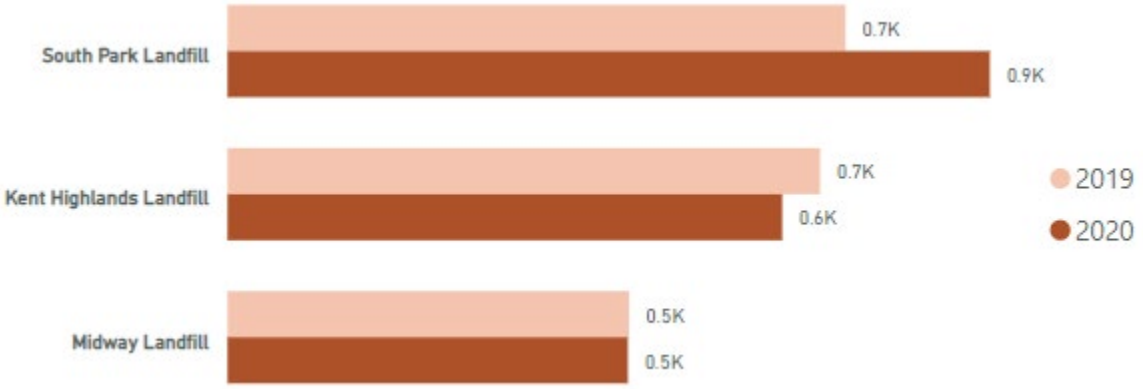


SCL operates as a carbon-neutral electrical utility, with very little warming emissions associated with the electricity that it supplies. Conversely PSE's energy profile was much more carbon intensive due to fossil-fuel powered generation facilities within its energy generation portfolio. Figures 3 and 4 outline how these differences affect SPU's emissions portfolio: while SCL supplied 58% of SPU's total electricity in 2019, PSE was responsible for 95% of emissions related to purchased electricity. When compared to the entire emissions profile of SPU, PSE-supplied electricity is the single largest source of SPU's GHG emissions, representing 8.2 ktCO2e or 49% of SPU's total emissions generated.

Notably, PSE's energy portfolio became less carbon intensive between 2019 and 2020, as fossil-fuel powered energy generating facilities were retired. This improvement was reflected in SPU's emissions results, as total emissions from purchased electricity declined from 8.6 ktCO2e in 2019 to 6.2 ktCO2e in 2020. This decline cannot be attributed to changes in electricity consumption: in 2019, SPU consumed a total of 20.1 million kwh, of which 57% was supplied by SCL. In 2020, SPU consumed 19.7 million kwh, of which 58% was supplied by SCL. However, emissions from PSE electricity declined to 6.1keCO2e, reflecting the substantial improvement that PSE made to their energy portfolio that led to significantly reduced emissions.

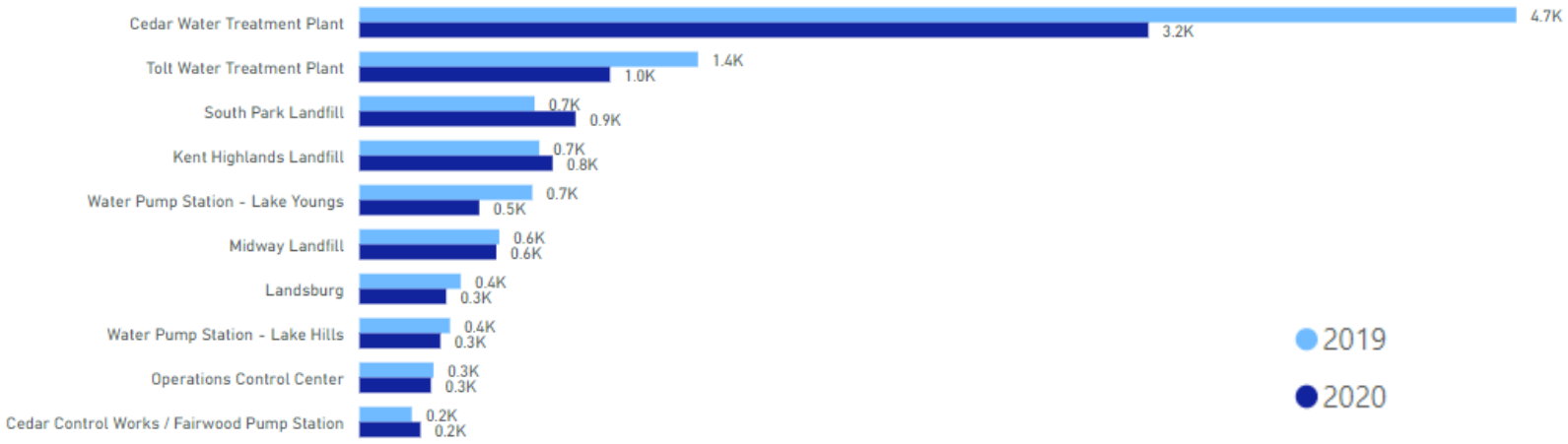
Both the Midway and Kent-Highlands landfills have working methane destruction technologies installed on site, which concentrates the escaping methane and combusts it, converting it into carbon dioxide. This results in substantially lower emissions than would otherwise be expected, given the volume of stored solid waste in these historic landfills. The South Park landfill does not have a methane destruction system on site, which is reflected in the emissions data. Despite the fact that the South Park landfill has the smallest volume of stored material on site, it releases a slightly higher equivalent of warming emissions compared to the two other facilities, as seen in Fig 5.

Fig. 5: Fugitive Emissions from Historic Landfills, in mtCO2e



While the South Park Landfill increased its emissions between 2019 and 2020, methane emissions from all three historic landfills are on a long-term decreasing trend, due to organic material finishing its decomposition process.

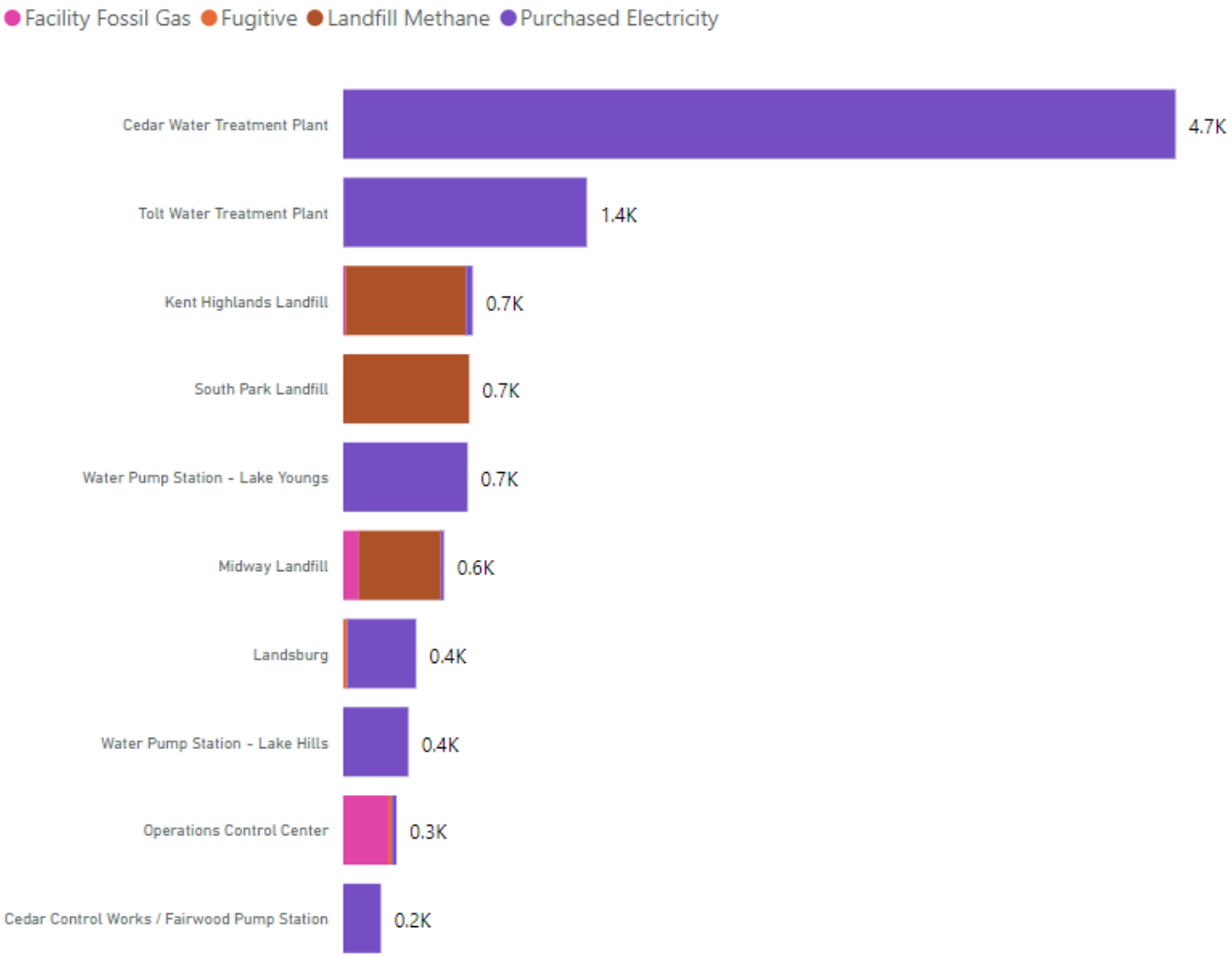
Fig 6: Facilities with the Largest Warming Emissions in MTCO2e



As we examine individual infrastructure assets or workforce facilities, we can see the impact that PSE's emissions improvements had on SPU's buildings. Fig. 6 outlines the ten infrastructure or workforce facilities with the largest emissions profile among all of SPU's facilities, comparing 2019 and 2020 emissions rates. Three locations are historic landfills which can attribute their emissions to fugitive methane emissions. Of the remaining seven buildings, only one facility – the Operations Control Center – is within SCL's service area. Additionally, the two highest emitting infrastructure or workforce facilities are the energy-intensive water treatment plants at the Cedar and Tolt watersheds. The reduced carbon intensity from PSE electricity can be most clearly observed as part of the Cedar Water Treatment Plant, which saw emissions decline from 4.7 ktCO2e in 2019 to 3.2 ktCO2e.

Furthermore, in Fig. 7, we can examine the composition of each facility's emissions profile by source during 2019. Of the ten highest-emitting sites, every facility or infrastructure asset that can trace most of its emissions to electricity operates within PSE's territory. Of the other four locations, three are historic landfills with high methane emissions, while the one outlier – the Operations Control Center – is the largest consumer of fossil gas for heating purposes, as described in Fig. 10.

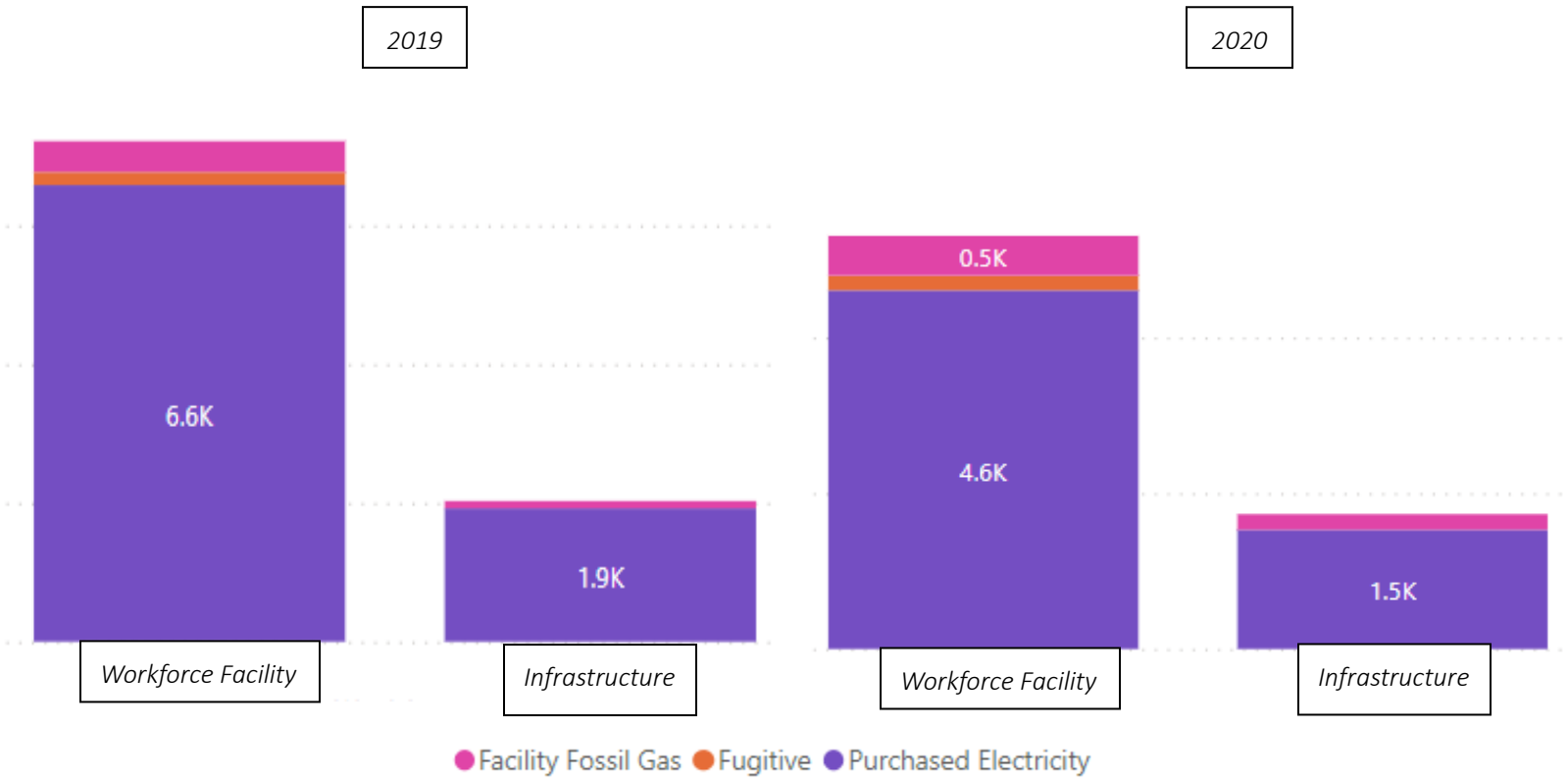
Fig. 7: Highest Emitting Infrastructure or Workforce Facilities during 2019, by Emissions Type, in mtCO2e



The Operations Control Center is also a very large consumer of electricity, utilizing about 1.3 million kwh annually as outlined in Fig. 9. However, its emissions from purchased electricity remain very small, emphasizing the benefits of SCL's supply of low-carbon electricity.

Despite their improvements, PSE still contributed 97% of SPU's purchased electricity emissions in 2020. While PSE has made notable improvements, its energy supply is still our largest source of emissions. PSE has pledged to become carbon neutral in its energy supply by 2030. If PSE can accomplish that goal, SPU can expect to see its emissions from purchased electricity decline significantly in the coming years.

Fig. 8: Emissions from Workforce Facilities vs. Infrastructure by ktCO2e in 2019 and 2020



There is also a notable difference between facilities that support SPU's workforce, and facilities that primarily act as infrastructure for service delivery. Workforce facilities generated 6.6 ktCO2e compared to 1.9 ktCO2e for infrastructure facilities in 2019. These amounts declined in 2020 to 4.6 ktCO2e for workforce facilities and 1.7 ktCO2e for infrastructure facilities, as seen in fig. 8. Workforce facilities – such as the water treatment plants, OCC, and Transfer Stations – often are large consumers of electricity and require climate control systems that contribute to emissions.

However, a few specific facilities – namely facilities associated with the watersheds and water treatment – are not only large consumers of electricity, but also are necessarily outside of the SCL service area due to the nature of their operations. As such, workforce facilities make up the majority of emissions that can be attributed to all buildings and infrastructure sites that SPU operates.

As the facilities that support our employees in their duties, many workforce facilities have high energy consumption. These facilities can support both service delivery needs – such as treating water or transferring solid waste – as well as supporting office staff in conditioned environments. A few notable workforce facilities include Seattle Municipal Tower, both Transfer Stations, the Operation Control Center, and both the Cedar River and Tolt River treatment facilities.

The treatment facilities represent the two of the three highest emitting facilities that SPU operates, consuming 8.5 million kwh and 2.5 million kwh in 2019, respectively. But these facilities also demonstrate the high carbon intensity of Puget Sound Energy's electrical portfolios. These two facilities combined generated 6.0 ktCO2e in 2019 and 4.2 KtCO2e in 2020, representing 83.6% of all workforce facility emissions in 2019, and 79.0% in 2020.

Fig. 9: Facilities with Largest Electricity Consumption

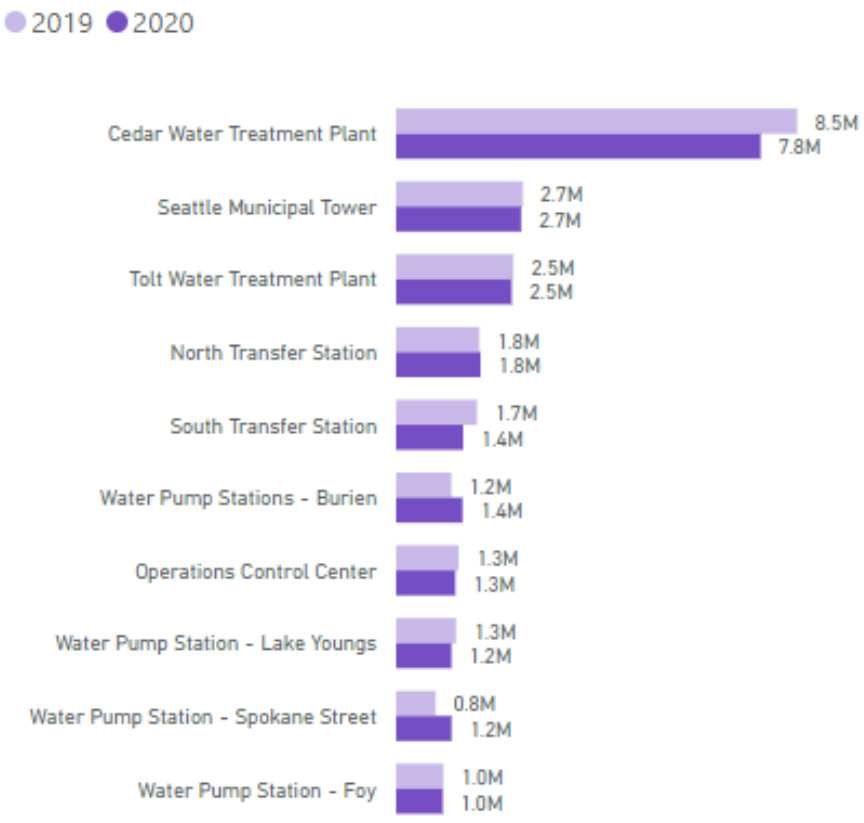
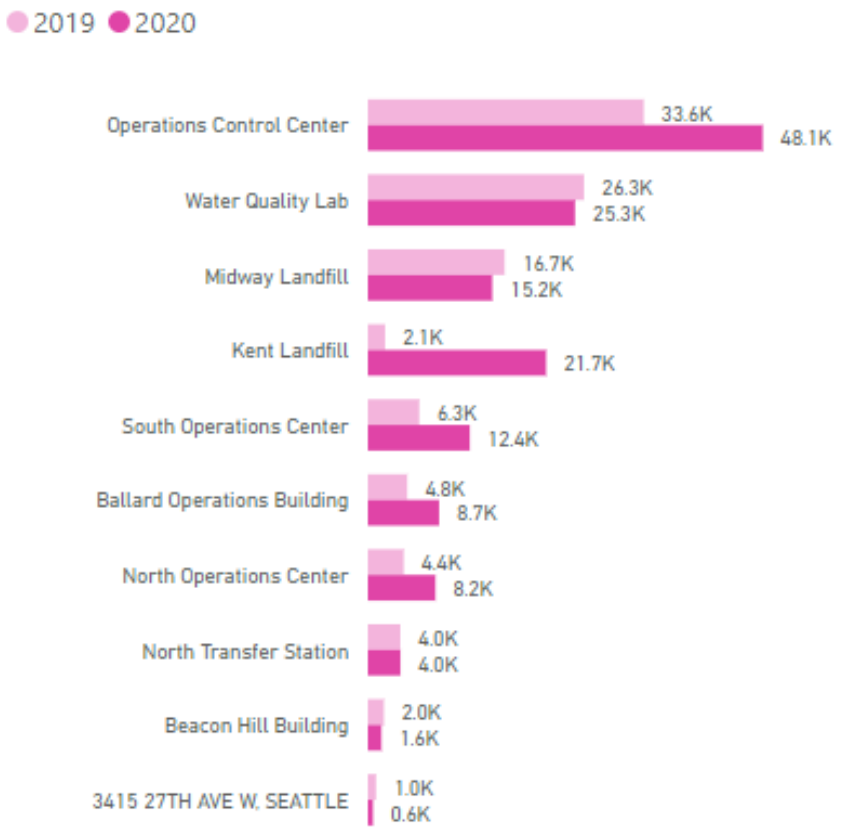


Fig 10: Facilities with Largest Fossil Gas



Key Takeaways

- **Carbon intensity of purchased electricity varies significantly between PSE- and SCL-supplied electricity:** Emissions related to our purchased emissions show the difference in emissions intensity between the two energy utilities that power our infrastructure or workforce facilities. While PSE generated 42-43% of our electricity, PSE power is responsible for 95-97% of emissions related to our electricity consumption. The comparatively small emissions related to SCL power provide tangible benefits to SPU's carbon neutrality goal. It's important to note, however, that efforts to remove fossil fuel assets from Puget Sound Energy's energy portfolio led to benefits to SPU's carbon reduction goals. While SPU had no significant changes to our energy consumption habits between 2019 and 2020, the utility's overall emissions related to purchased emissions declined between the two years due to improvements that PSE undertook to retire polluting assets. As PSE pursues its own carbon neutrality goals, emissions related to purchased electricity are expected to decline in the coming years.
- **Long-term emissions from purchased electricity are expected to decline as PSE implements improvements:** Puget Sound Energy has already committed to reducing the emissions profile from its energy generation portfolio, with a projected benchmark to reach carbon neutrality of 2030. SPU is already benefiting from this work, as evident in the year-to-year decrease in emissions in purchased electricity.
- **Seattle's historic landfills are significant sources of GHG emissions**: SPU is responsible for monitoring and managing methane emissions from three historic landfills at South Park, Midway, and Kent-Highlands. These historic landfills generate potent emissions through the decomposition of organic waste stored underground. While SPU has already installed methane destruction technologies at both the Midway and Kent-Highlands, the remaining emissions could be challenging to abate with existing technologies.

3.2 Fleet and Equipment

SPU operates a fleet of 800 vehicles and equipment, including 600 vehicles with internal combustion engines. This inventory also includes fuel consumption from rental vehicles that SPU used to supplement its fleet during the COVID-19 pandemic.

Emissions from SPU's fleet and equipment are from the combustion of fossil fuels as well as the escape of CFCs and HFCs from vehicle air conditioning systems.

These emissions are divided into two categories:

- **Fleet Fuel:** Emissions are generated when hydrocarbon-based fuels are combusted in an internal combustion engine.

Example: Using gasoline to power an SUV or diesel fuel to power a water service truck.

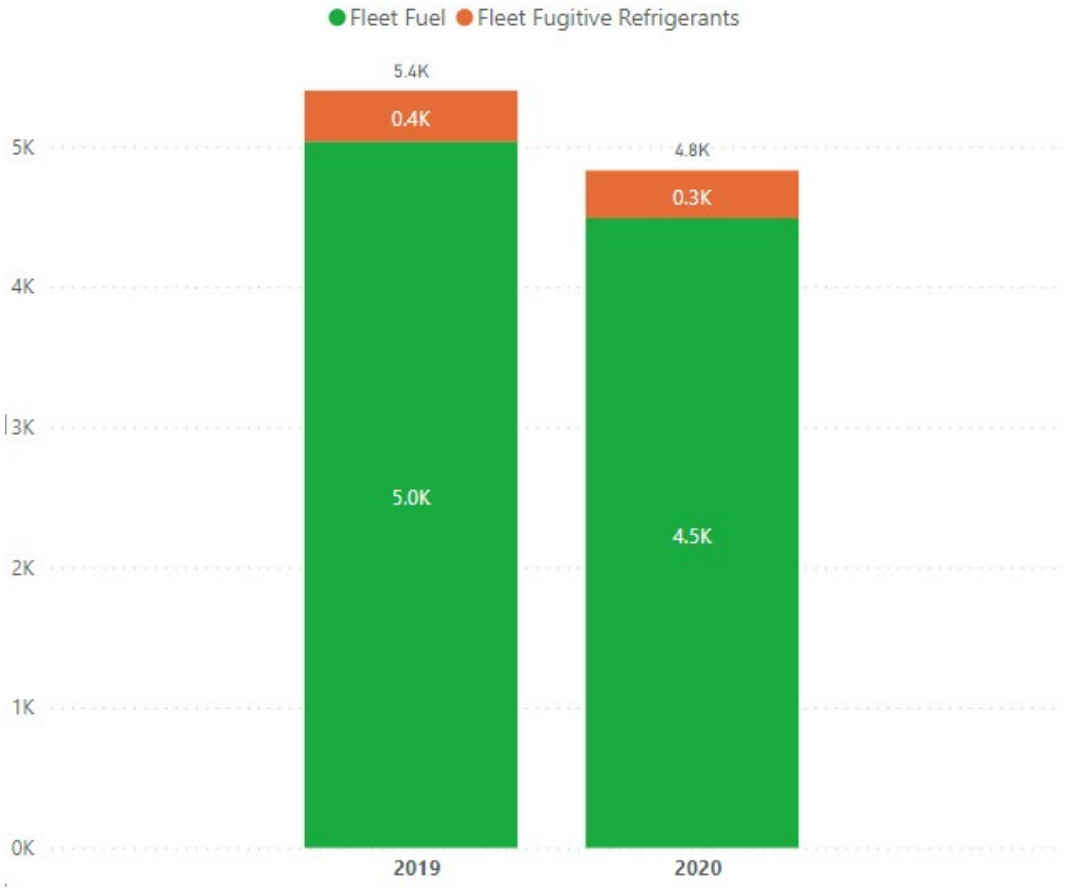
- **Mobile Fugitive Emissions**: Like HVAC units in buildings, air conditioning units in vehicles will leak refrigerants like HFCs and CFCs through normal use.

  Example: Leaking of refrigerant from normal wear and tear of an F-150 truck.

SPU utilizes several different types of fuels to operate the fleet, including a variety of diesel blends, biodiesel, and renewable fuels, as well as traditional unleaded gasoline and propane. All types of fuels are captured within this inventory.

Additionally, SPU's fleet includes several electric powered vehicles used primarily for light-duty personnel movement. However, options for heavy vehicles are coming onto the market including forklifts, yard goats, and short-run drayage trucks. Electric power used to charge most of SPU's electric vehicles is captured as part of the "purchased electricity" element for workforce facilities and are in turn included in the total calculation of SPU's warming emissions.

Fig. 11: Total Fleet Emissions per Year, by Emissions Type



In 2019, SPU's vehicle fleet generated 5.4 ktCO2e, with 93% from combustion sources, and 7% from fugitive emissions. In 2020, these emissions declined to 4.8 ktCO2e but the ratio stayed the same with 93% from combustion sources and 7% from fugitive sources (see Fig. 11).

SPU operates its fleet by utilizing a variety of fuel blends. These fuels include traditional diesel (referred to in the charts below as DSL), as well as diesel blends, including biodiesel (BIO) and 20% biodiesel (B20), and mixes of renewable diesel and biodiesel (R8B and R9B). SPU also uses traditional unleaded (UNL) and higher octane (SPR) gasoline blends, as well as a mixture of 20% renewable gasoline with 80% unleaded (R2U), as well as propane in certain select vehicles. These fuels have slightly varying carbon intensities, but all release warming emissions when combusted. Fig. 12 and Fig. 13 outline the carbon emissions associated with each type of fuel used by the utility.

Fig 12: Emissions by Fuel Type, 2019

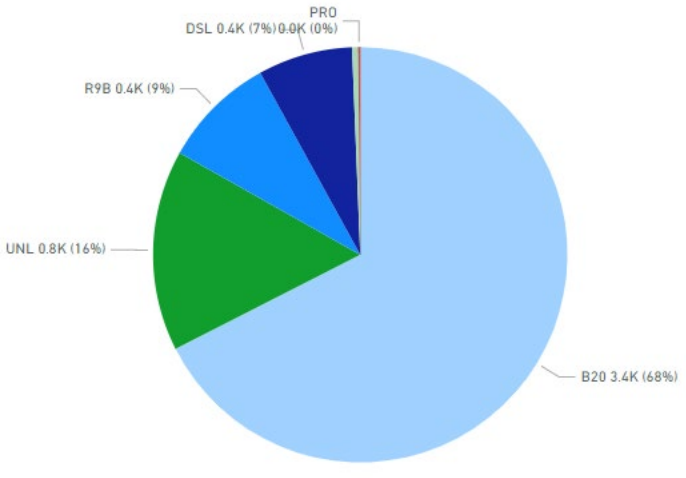
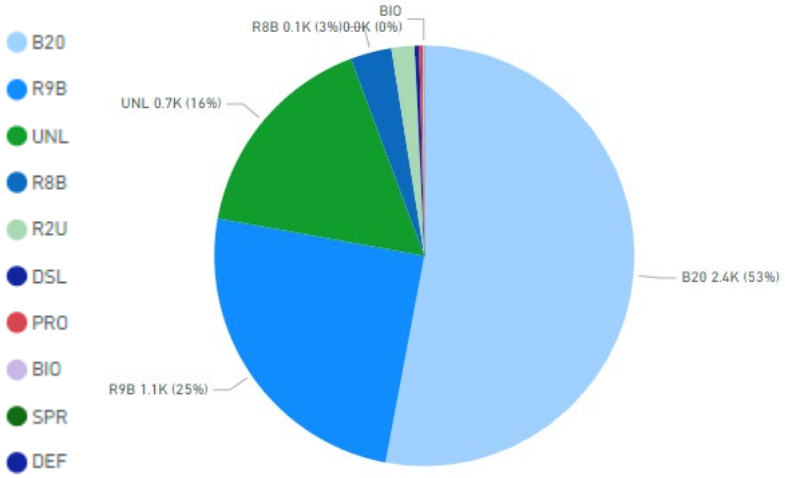


Fig 13: Emissions by Fuel Type, 2020



The composition of fuel types used shifted depending on market availability. Throughout both 2019 and 2020, B20 – a blend of 80% traditional diesel and 20% biodiesel – was the primary fuel type. However, in 2020, the city expanded the use of R9B – a blend of 90% renewable diesel and 10% biodiesel – which has lower lifetime emissions compared to traditional diesel. After these blends of diesel, the most utilized fuel was traditional unleaded gasoline, followed by several other blends of fuels as well as traditional diesel fuel.

While furthering the use of renewable fuels and biofuels can reduce lifetime emissions modestly, they had limited impact on SPU's emissions profile. Instead, the decline of fuel emissions can be largely attributed to changes in fuel consumption patterns related to the COVID-19 pandemic.

Fig. 14: Vehicle Fuel Consumption Month-Over-Month, by Fuel Type, in Gallons

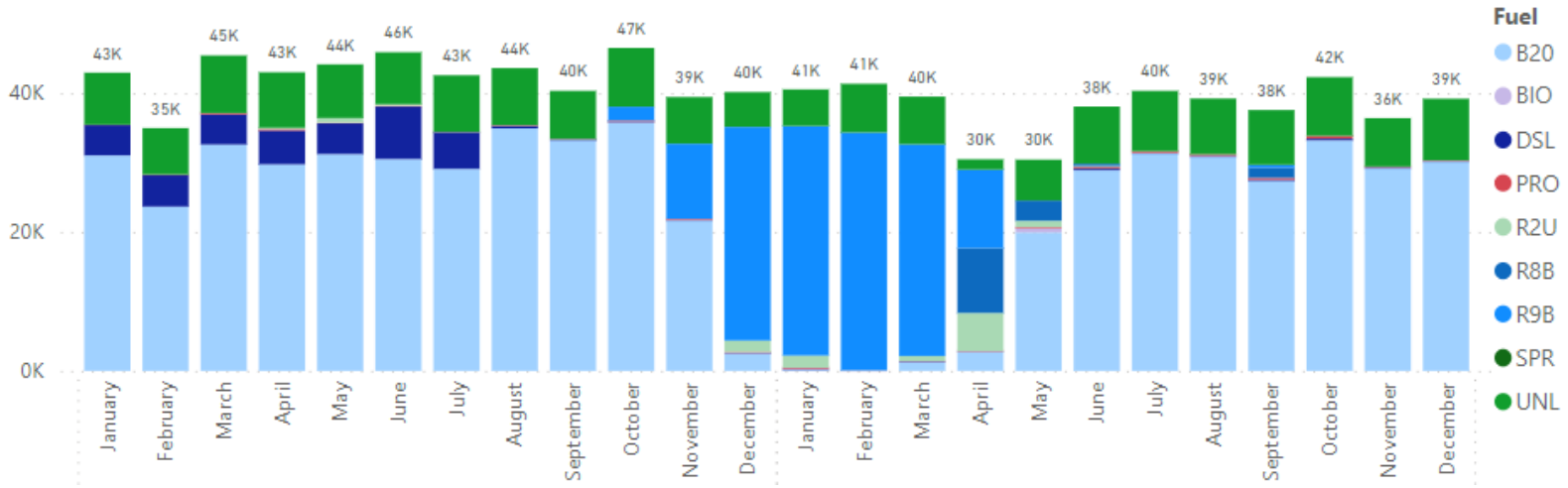
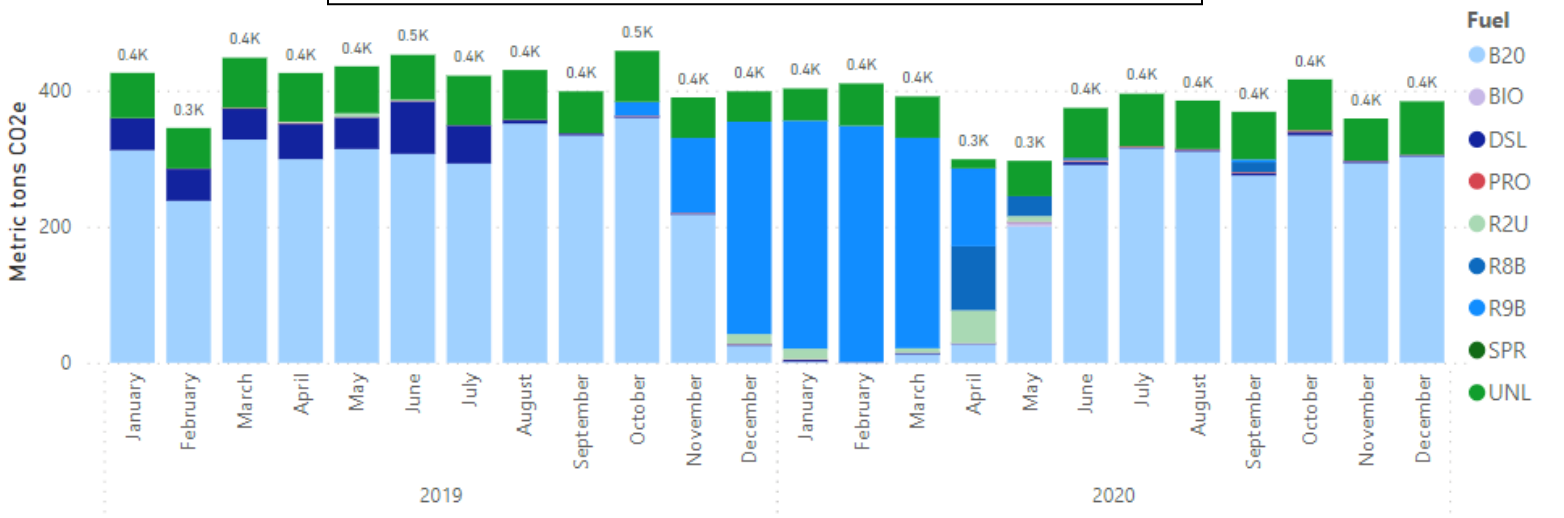


Fig. 14 outlines the total amount of fuel consumed each month by SPU's fleet in Gallons, with each color representing a different fuel blend. COVID-19 had two noteworthy effects on SPU's vehicle operations. Firstly, the supply of R9B stopped due to cost and supply chain issues, prompting a shift back to B20. Secondly, fuel consumption dropped significantly in April and May, before rebounding back to baseline levels in July.

Fig 15: Vehicle Fuel Emissions Month-Over-Month, by Fuel Type, in mtCO2e



When fuel consumption is translated into emissions equivalents, it becomes apparent that SPU's rates of emissions are closely tied to overall fuel consumption, as seen in fig. 15. SPU saw a 10.5% decline in total fuel

consumed between 2019 and 2020, which correlated with a 10.8% decline in emissions, despite transitioning to cleaner fuels. The decline in emissions from 2019 to 2020 can be most clearly explained as an effect of the COVID-19 pandemic, as SPU utilized less fuel as a response to stay-at-home mandates. As fuel consumption resumed to pre-pandemic levels, we expect that emissions associated with vehicle fuels will similarly rebound as well in 2021.

It's important to note here that these fleet emissions are analyzed based on the tailpipe emissions that each liquid fuel generates when combusted, as per the GHG inventory protocol used in this analysis. However, fuels including renewable gasoline, renewable diesel, or biodiesel as part of their blends would likely generate significantly lower emissions if they were to be analyzed based on the fuel's entire supply chain. Analysis regarding the total supply chain emissions of these lower-carbon fuels is ongoing.

Key Takeaways

- **Fleet electrification is SPU's biggest opportunity area:** As SPU transitions to electric vehicles, emissions from fleets are expected to decline as fuel-consuming vehicles are replaced. This is expected to be true regardless of which electric utility (SCL or PSE) provides the power for vehicle charging due to PSE's plans to reduce its carbon intensity.
- **Reducing fuel consumption can generate interim emissions reductions:** As SPU works to transition to an electric fleet, additional GHG emissions reductions could be achieved by continuing to implement and explore ideas to reduce fuel consumption, when feasible.

3.3 Additional Emissions Analyzed

While the focus of this inventory is around the emissions that SPU generates in day-to-day operation and service delivery, several additional categories of emissions associated with SPU were determined necessary to measure and include in this inventory. These emissions include contracted Solid Waste Collection, business travel, and employee commuting.

These emissions are not considered to be under SPU's direct purview, and therefore not included as part of SPU's day-to-day operations. However, the emissions sources outlined in this section are often visible by SPU employee and ratepayers alike; ratepayers are likely to see collection trucks operating throughout the city, and employees have previously identified their commute as a day-to-day source of warming emissions. Additionally, data regarding the distributions and trends of these emissions are likely to be relevant to future policy conversations at SPU.

It is important for SPU to track these emissions and address them appropriately.

Contracted Solid Waste Collection

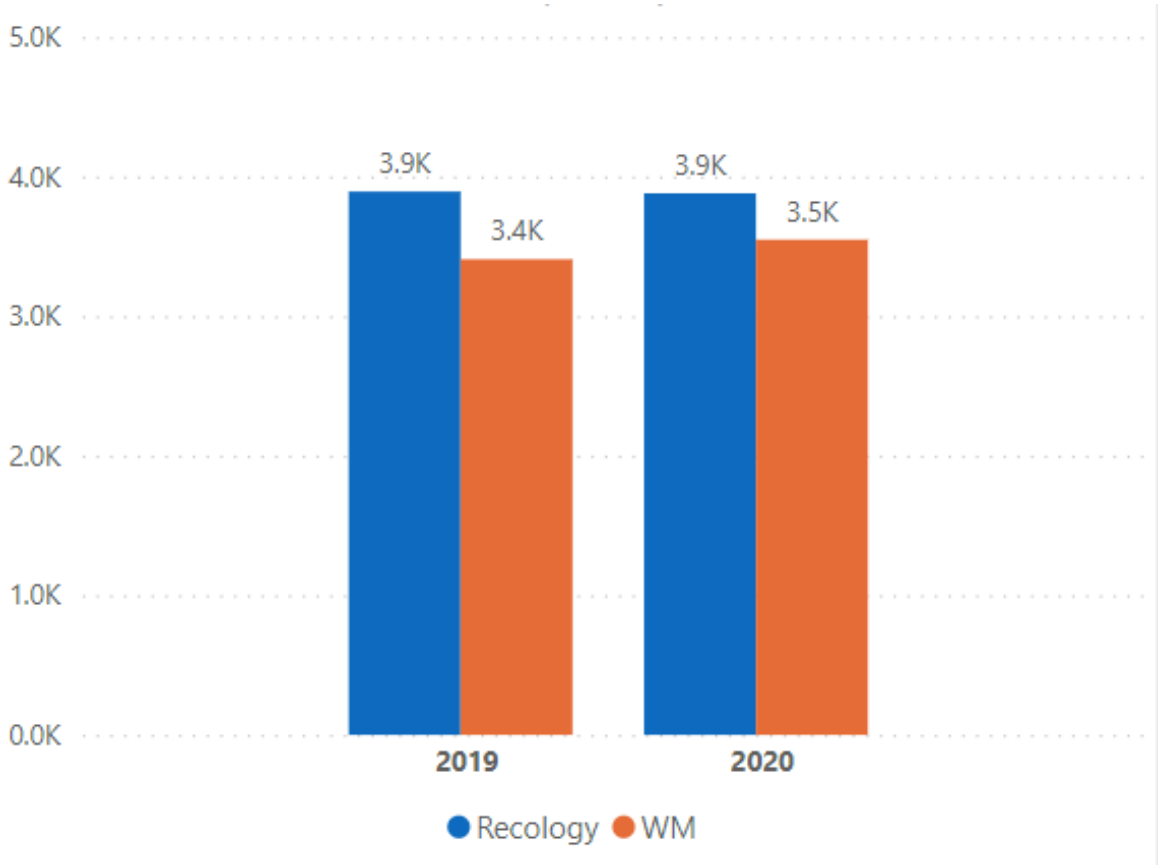
SPU collects Solid waste in Seattle through contracts with WM and Recology. While the contracted nature of these trucks would technically put the emissions generated by their operation outside of this inventory's purview, the essential services that these trucks provide are linked to SPU's operation.

Each company operates their own fleet in different regions of the city, and often utilizes different fuels. WM operates a fleet that includes vehicles powered by fossil gas, while Recology uses a mix of diesel, biodiesel, renewable diesel, and electricity for their fleet.

Despite these differences, the respective emissions for each company are similar, with WM emitting slightly fewer emissions. WM fleets generated the equivalent of 3.4 ktCO2e in 2019, and 3.5 ktCO2e in 2020, compared to Recology's 3.9 ktCO2e in 2019 and 3.9 ktCO2e in 2020. Despite WM's further vehicle miles traveled compared to Recology, WM's use of fossil gas in their fleet led to fewer overall emissions. Additionally, Recology's rollout of electric collection trucks demonstrates a viable path to decarbonization for this sector. More information on Recology and WM's service profile and opportunities for emissions reductions can be found on page 42.

The use of these emissions mitigating fuels can be traced, in part, to the language established in the previous collection contracts. Part of SPU's current contract requires both WM and Recology to take steps to switch their fleets to cleaner-burning fuels, including fossil gas and renewable diesel. SPU's next solid waste collection contract will be in 2029, presenting a new opportunity to evaluate the effectiveness of emissions reductions policies.

Fig. 16: Emissions generated by Solid Waste Collection Trucks, by year and contractor.



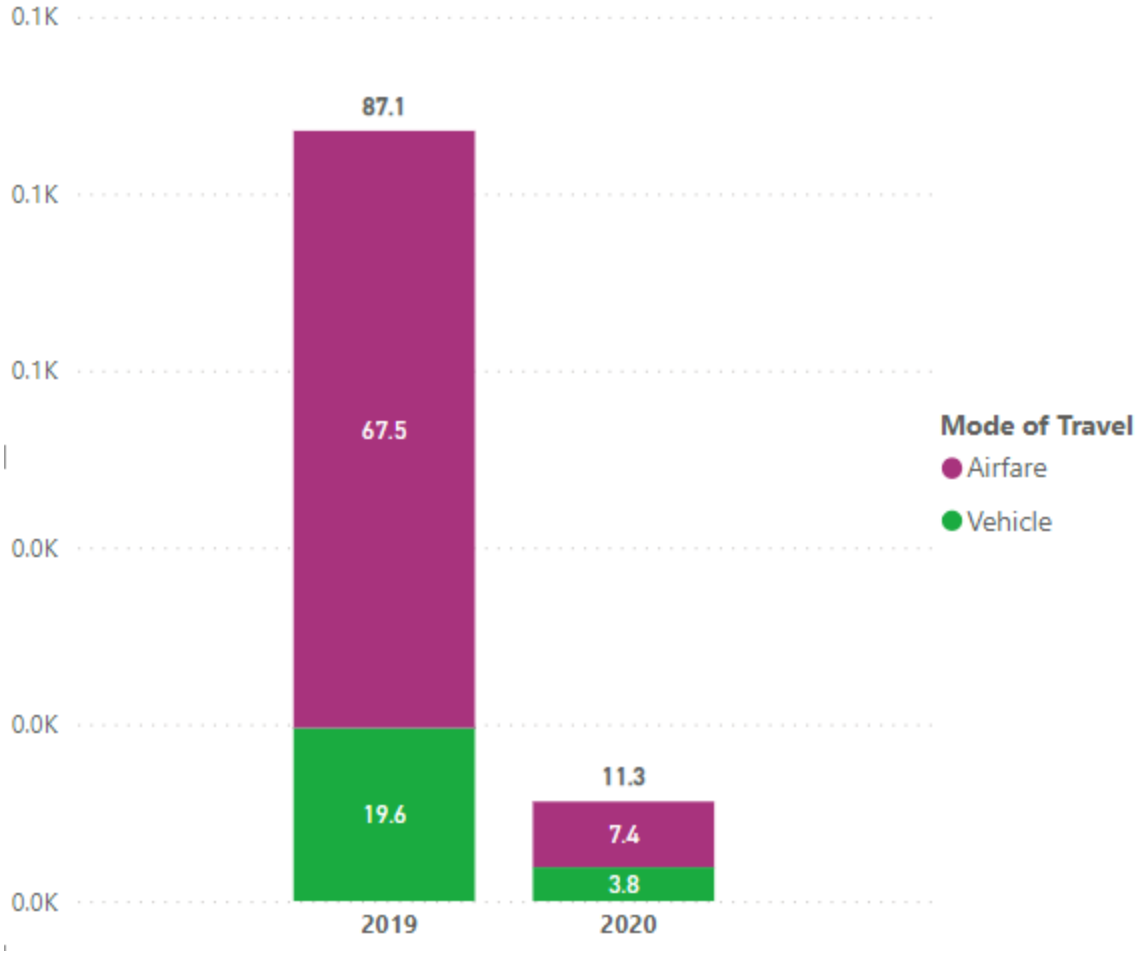
Key Takeaways:

- **Solid waste collection emissions represent a significant Scope 3 emissions source**: While both Recology and WM utilize different technologies to abate emissions, they still collectively emit more warming emissions than SPU generates through our fleet operations.
- **Contracting represents an opportunity for emissions reductions**: Language in our Solid Waste collection contracts can incentivize each vendor to improve and decarbonize their collection trucks.

Employee Business Travel

Emissions generated by business travel were estimated based on distance traveled, and if the trip was by air travel or car. Emissions were estimated based on travel records obtained from SPU's travel desk, which manages and monitors all travel taken by SPU employees on behalf of the utility. Emissions were estimated utilizing fuel efficiency standards for vehicle travel, and the ICAO carbon emissions calculator for air travel.

Fig. 17: Emissions from Business Travel



In 2019, business travel undertaken by SPU employees released 87.1 MTCO2e, and 11.3 MTCO2e in 2020.

The tremendous reduction of business travel emissions from 2019 to 2020 can be attributed to the COVID-19 pandemic, during which SPU halted all business travel in March 2020 as part of a utility-wide shift to remote work to prioritize health and safety. However, business travel was already attributed to a very small amount of warming emissions compared to SPU's overall operations.

Most business travel emissions can be traced to air travel, with 64 MTCO2e generated from flying to meetings compared to 18 MTCO2e generated from car travel in 2019. However, while air travel generated more emissions, it was also a far more efficient form of travel for SPU's employees. SPU employees flew over 508,000 miles in 2019, compared to slightly more than 45,000 miles driven.

The drastic reductions in emissions due to cancelled trips as a result of the COVID-19 pandemic also demonstrated that much travel can be converted to virtual meetings. While the pandemic represented an

extraordinary disruption in day-to-day business, SPU was able to nearly eliminate emissions from business travel after the transition to remote work in 2020.

Key Takeaways:

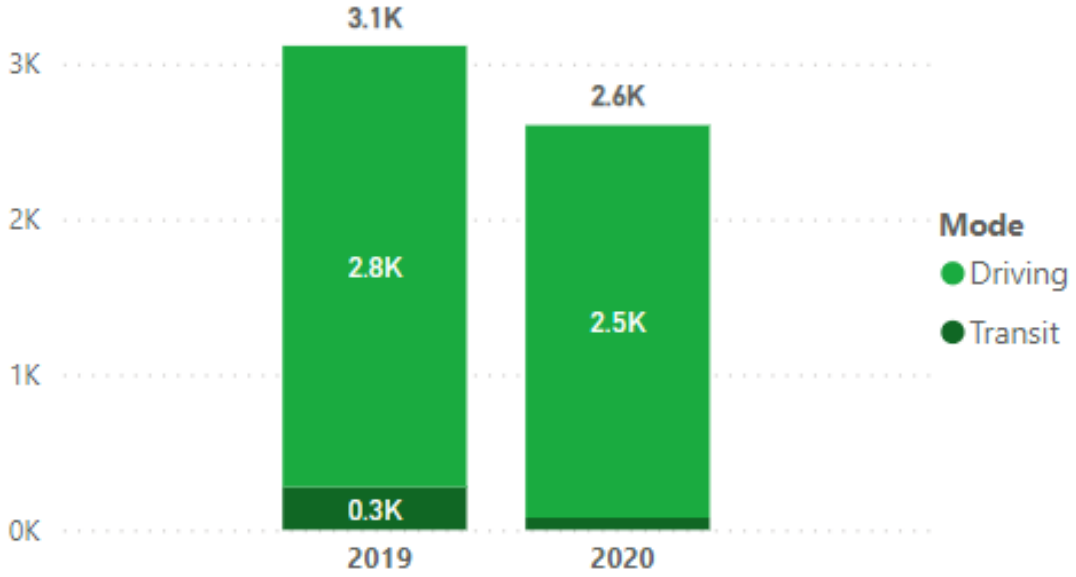
- **Business travel makes up a very small part of SPU's emissions profile:** Compared to SPU's operations and service delivery, the emissions related to business travel are extremely small.
- **Business travel emissions were heavily affected by the COVID-19 pandemic:** The drastic year-to-year decline demonstrated the impact of the shift to remote work, demonstrating how effective virtual meetings can be towards reducing travel emissions.

Employee Commutes

While emissions generated by employees commuting are not considered to be part of SPU's operations, the trip to and from work represents a very visible and obvious instance of emissions generation for employees. Additionally, the City of Seattle has made commute trip reduction a key facet of city-wide sustainability and emissions reductions goals. As such, we believe it's warranted to ensure that an estimation of these emissions is included in this inventory assessment.

The data needed to accurately calculate emissions related to employee commutes was not available for this inventory. As such, these results are estimates with significant assumptions were made to calculate an approximate number. For more information about the methodology utilized to estimate these emissions, see Appendix 2.

Fig. 18: Estimate of emissions generated by Employee Commuting, in mtCO2e.



In 2019, we estimate that SPU's approximately 1,400 employees generated 3.1 ktCO2e, and 2.6 ktCO2e in 2020, as shown in Fig. 18. While these emissions show a decline in 2020, these declines are mostly associated with the transition of workers based at Seattle Municipal Tower to remote working status after Washington State issued a Stay-at-Home order.

Passenger vehicle emissions made up 91.1% of commuting emissions in 2019 and 97% of commuting emissions in 2020. We also estimate that passenger vehicle modalities comprised only 59% of all commuting vehicle miles traveled in 2019, which emphasizes the significantly higher carbon intensity of passenger vehicle transportation compared to transit and other active transportation modalities.

As SPU shifted to remote work during the COVID-19 pandemic, the share of transit vehicle miles traveled dropped from 41% in 2019 to 18% in 2020, corresponding with an increase in share of passenger vehicle miles traveled to 82%. Total commuting vehicle miles traveled declined from 11.9 thousand in 2019 to 7.6 thousand in 2020. While such a decline is notable, it's worth emphasizing that SPU's essential service provision required the majority of SPU's workforce to continue to commute to work throughout the pandemic. Additionally, many of SPU's workforce facilities – including the Cedar River Watershed, the South Transfer Center, and the Tolt River Watershed – are poorly served by transit operations, requiring SPU employees to commute to work via passenger vehicle.

Key Takeaways:

- **SPU's Workforce Relies on Passenger Vehicle Commuting Modalities:** Commute Trip Reduction surveys performed by the city show that the majority of SPU's workforce commutes by car. Rates of car commuting varies between workforce facilities – with very few commuting by car to SMT and

nearly every employee commuting by car to rural workplaces like the Cedar River Watershed. As such, SPU's commuting requirements have a relatively high carbon intensity. While remote work is an option to reduce commuting emissions for some employees, much of SPU's workforce operates in roles that require employees to be present at their job sites each day, limiting opportunities for carbon emissions reductions through the expansion of a remote work policy.

GHG Implications of SPU's Natural Assets

SPU owns and maintains watersheds, reservoirs, and green infrastructure as part of its assets. These natural assets make up a part of SPU's carbon story. While SPU's watersheds likely sequester carbon as part of its natural services, the reservoirs that capture SPU's water supply likely emit GHGs through the decay of plant matter and the activity of microorganisms within the reservoir.

Methodology to measure the emissions stories from these natural assets are evolving over time. While there has been more literature devoted to understanding carbon sequestration in forests – urban or otherwise – there remains some ambiguity about how to best apply those methodologies to SPU's watersheds. Analysis of the sequestration potential of SPU's watersheds has been conducted in the past. The methodology for measuring emissions from reservoirs, green stormwater infrastructure, or urban forests, is far less developed, as this topic is still relatively nascent in scientific literature.

We aim to incorporate the carbon emissions implications of SPU's natural assets into future inventories.

3.4 Emissions by Line of Business

Each of SPU's three main lines of businesses operate with different structures, functions, facilities, infrastructure, and equipment, contributing to notably different emissions profiles. While the two largest overall emissions categories remain fleet fuel combustion and purchased electricity, the distribution of these emissions varies widely between each line of business.

Fig. 19: 2019 Emissions by LOB

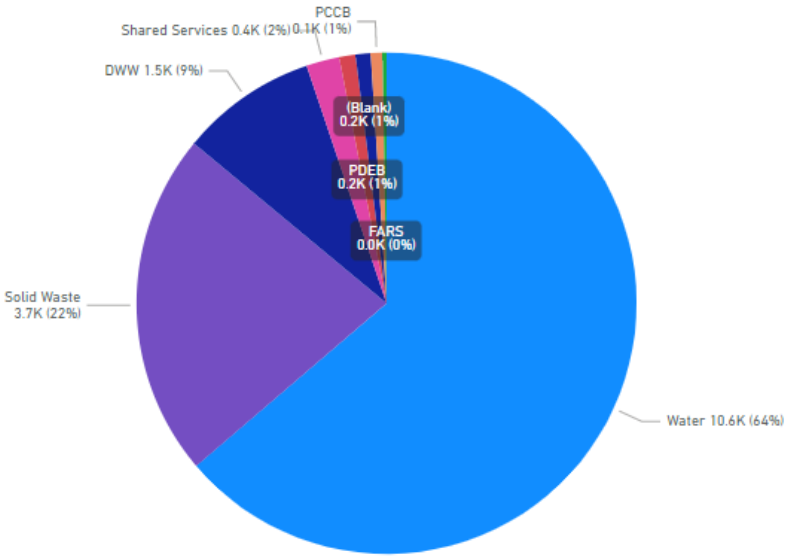
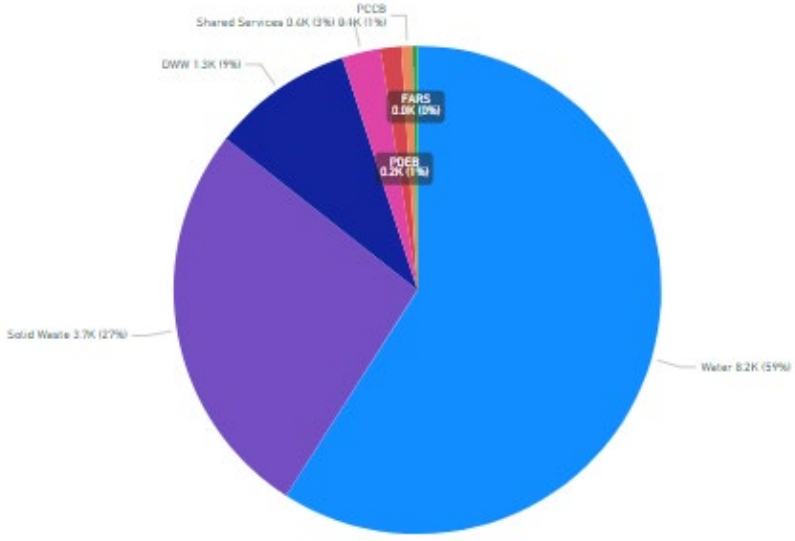


Fig. 20: 2020 Emissions by LOB



The Water Line of Business (LOB) generated 10.6 ktCO2e in 2019 and 8.2 ktCO2e in 2020. Due to the Water LOB's treatment and distribution infrastructure throughout the Puget Sound Energy's electrical service area, purchased electricity emissions represent a strong majority of total emissions for the Water line of business, followed by emissions from the combustion of fossil fuel for vehicle use.

Fig 21: 2019 Emissions by Type - Water

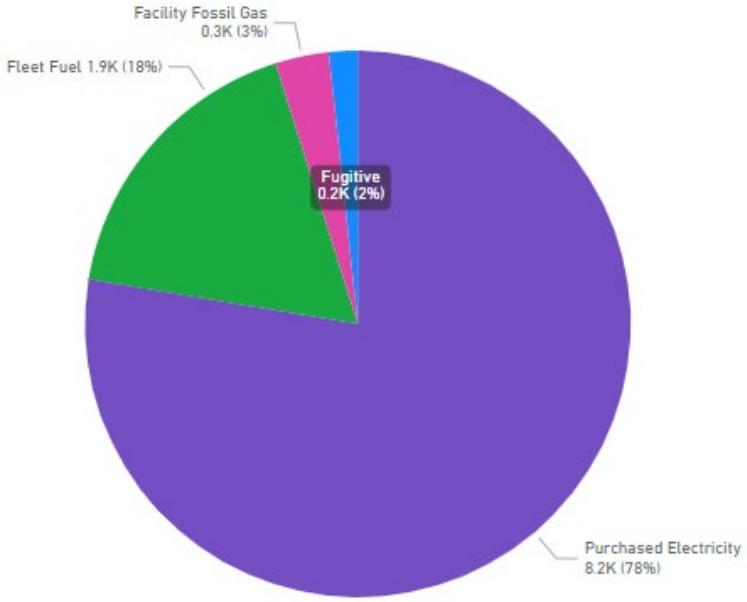
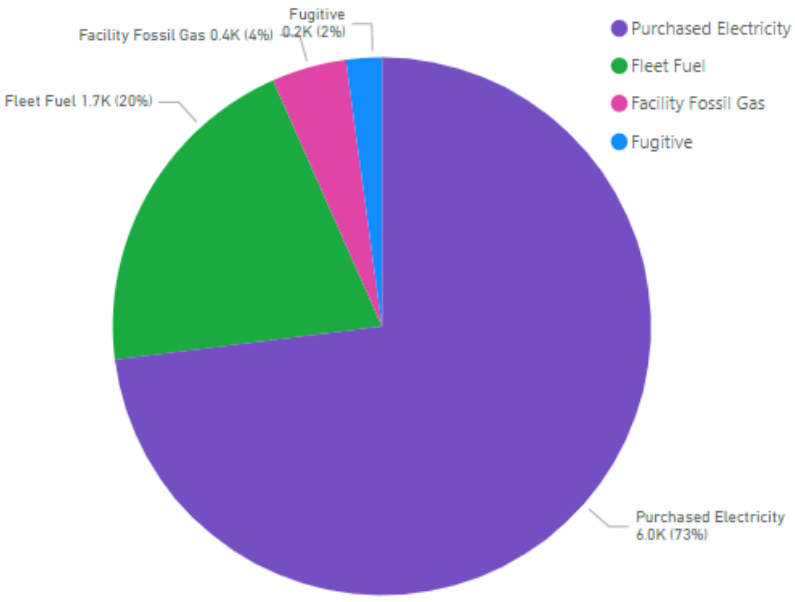


Fig 22: 2020 Emissions by Type - Water



While fleet fuel emissions declined modestly between 2019 and 2020, the corresponding decline in emissions from purchased electricity meant that the overall share of emissions from fleet fuel combustion increased year-over-year. This decline in purchased emissions can be contributed to success reducing the carbon intensity of electricity generation by Puget Sound Energy and Seattle City Light.

The Drainage and Wastewater (DWW) LOB generated 1.5 ktCO2e in 2019, and 1.3 ktCO2e in 2020. As the Drainage and Wastewater (DWW) Line of Business operates almost entirely within Seattle City Light's service area, the overall emissions from purchased electricity for DWW is very small. This is emphasized by the small number of facilities compared to other lines of business. DWW also benefits from contracting out many services that other wastewater utilities might include within their own operations, including wastewater treatment plants. As SPU collects and transports wastewater to treatment facilities operated by King County, many significant sources of purchased and fugitive emissions in the wastewater treatment process are not included as part of SPU's emissions profile.

In turn, fuel combustion emissions make up most of the emissions that Drainage and Wastewater generates each year. These emissions can be traced to the maintenance and supply trucks that DWW operates to maintain the pipes and pump stations they operate.

Fig 23: 2019 Emissions by Type – Drainage/Wastewater

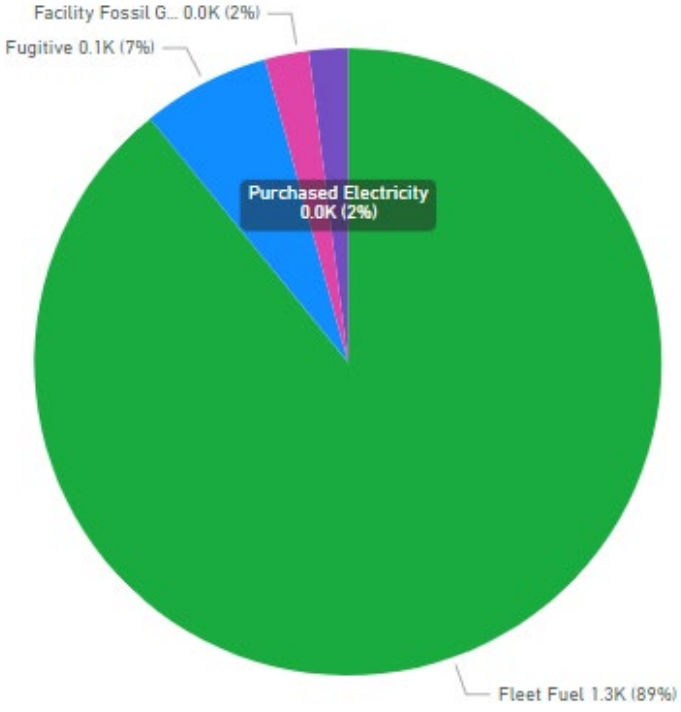
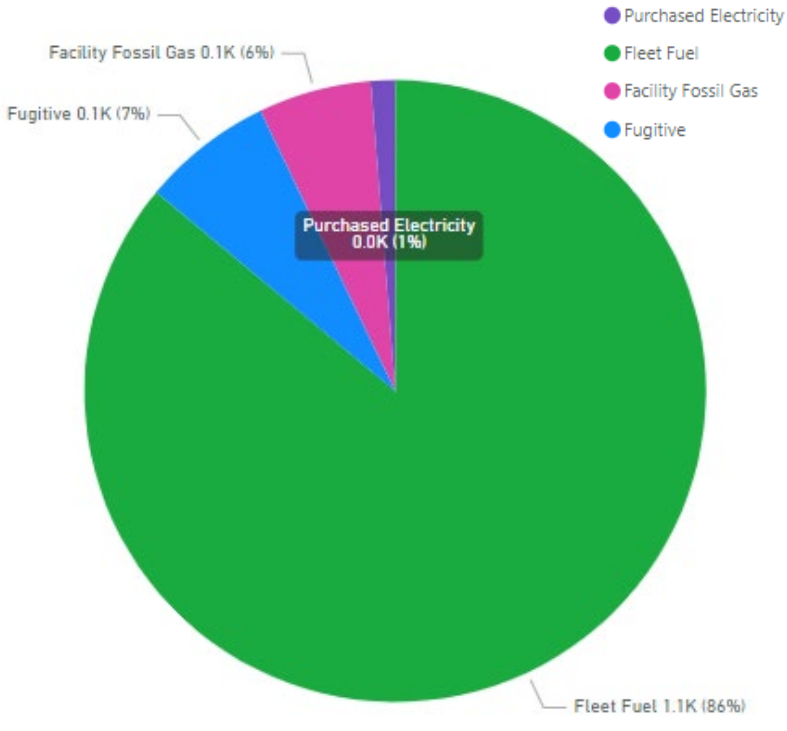


Fig 24: 2020 Emissions by Type – Drainage/Wastewater



The Solid Waste LOB generated 3.7 ktCO2e in 2019, and 3.7 ktCO2e in 2020. Similarly to Drainage and Wastewater, the Solid Waste line of business generates most of its warming emissions through the combustion of vehicle fuels. It's important to note that these emissions do not include solid waste collection trucks – rather, the vehicles in question are used to operate and move waste within transfer stations, move containers to shipping points, and ensure smooth operations from collection drop off to shipping. Solid waste collection trucks are included as part of the Scope 3 emissions analysis in Section 3.3.

Fig. 24: 2019 Emissions by Type - Solid Waste

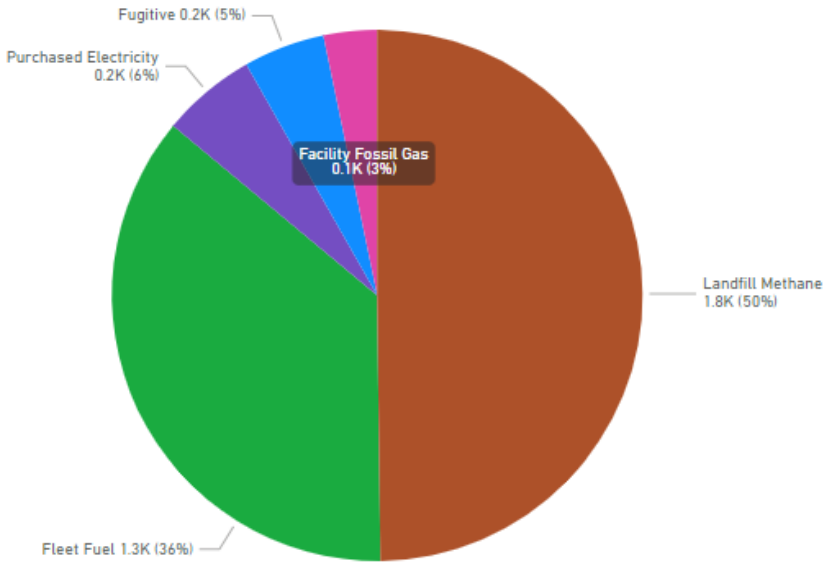
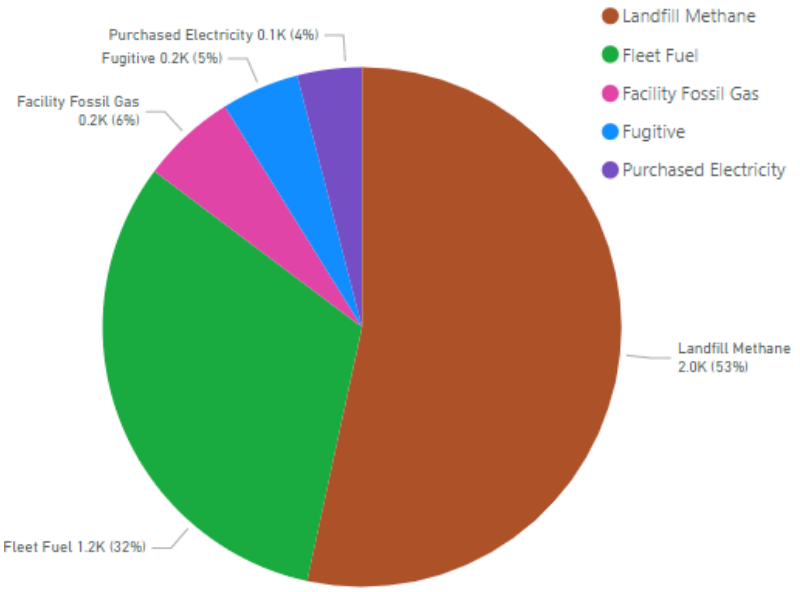


Fig. 25: 2020 Emissions by Type – Solid Waste



Solid Waste's infrastructure and workforce facilities emissions are driven by comparatively high refrigerant emissions. The entirety of the Solid Waste LOB infrastructure network is within SCL's service area, which leads to very few emissions from purchased electricity for these assets. However, the North Transfer Station utilizes a large number of heat pumps, which use large amounts of refrigerants which are many times more powerful GHGs than CO2. While still a minor percentage of Solid Waste's total emissions profile, the warming intensity of the refrigerants released from these heat pumps leads to larger shares of fugitive emissions than any other line of business.

The largest source of emissions within the Solid Waste line of business are the three historic landfills. As described previously, these historic landfills emit large amounts of methane gas, which is 28x as powerful a warming emission as carbon dioxide. SPU has already taken steps to mitigate the impact of these historic landfills by installing methane destruction technologies at Kent-Highlands and Midway which will help to abate these emissions in the future.

4. Recommended Action Items

This 2019-2020 GHG Emissions Inventory report and baseline is a first step in understanding our emissions footprint. To achieve our goal of carbon neutrality/net zero emissions by 2030, there are several actions Seattle Public Utilities will need to take. These recommended actions are not listed in order of priority, but rather are grouped together according to each relevant sector.

Summary of Recommended Actions

#	Area	Action
1	Infrastructure and Workforce Facilities	Deliver SPU's building electrification strategy
2	Infrastructure and Workforce Facilities	Partner with PSE towards decarbonization
3	Infrastructure and Workforce Facilities	Generate renewable energy throughout existing SPU infrastructure
4	Infrastructure and Workforce Facilities	Improve energy efficiency practices at SPU workforce facilities and infrastructure
5	Infrastructure and Workforce Facilities	Improve maintenance records and monitoring practices to address fugitive emissions
6	Infrastructure and Workforce Facilities	Replace building system refrigerants with high warming potentials
7	Fleets	Continue to transition light-duty and medium-duty fleet to electric vehicles
8	Fleets	Continue development of vehicle charging infrastructure
9	Fleets	Develop a plan to prioritize fuel efficiency practices to reduce fuel consumption
10	Fleets	Continue efforts to reduce fugitive emissions throughout fleet
11	Historic Landfills	Monitor improved methane destruction technologies
12	Historic Landfills	Explore ways to leverage historic landfill properties to expand GHG emissions reductions
13	Collection	Require additional emissions reductions in solid waste collection truck contracts
14	Business Travel	Replace business travel with virtual meetings whenever possible
15	Carbon Offsets	Establish standards and protocols for purchasing carbon offsets

Infrastructure and Workforce Facilities

SPU's existing work to improve building efficiency and reduce facility emissions has already paid dividends; SPU is in a strong position to work towards building electrification and improve efficiency. Past efforts to improve the Operations Control Center through building tune ups, as well as the city's overall directive to create building performance standards and support energy benchmarking, has already catalyzed conversations and work to electrify SPU's infrastructure and workforce facilities and ensure sustainability in the future. Ongoing partnerships between SPU, Seattle City Light, and Puget Sound Energy have also been established to improve energy efficiency at some of our key sites, including the North and South Transfer Stations.

Action 1: Deliver SPU's building electrification strategy.

SPU is on track to eliminate fossil gas emissions by 2035 in our buildings. Per the City's Green New Deal Executive Order, SPU developed a strategy to electrify building systems including HVAC, hot water heaters and cooking equipment. However, the emissions from the building equipment using fossil gases is a comparatively small part of SPU's overall emissions profile.

Action 2: Partner with PSE towards decarbonization.

Electricity consumption makes up the vast majority of emissions that can be traced to SPU infrastructure and workforce facilities, as well as the single largest category of emissions across the entire utility. However, 96% of emissions from electricity can be traced back to Puget Sound Energy. While Seattle City Light produces a little more than half of the electricity that SPU consumes, SCL's carbon-neutral energy generation portfolio nearly eliminates warming emissions from electricity supplied by SCL.

The effect of this difference in emissions intensity is particularly apparent when comparing emissions related to each specific facility. The water treatment plants, as part of the Cedar River and Tolt watersheds, already consume the most amount of energy of any facility that SPU operates, followed by the North and South transfer stations. When examining the amount of emissions created, the two water treatment plants represent 66.2% of the emissions generated by SPU's electrical consumption in 2019 and 60.3% in 2020. Additionally, eight of the ten highest emitting sites that SPU operates have electricity supplied by PSE – emphasizing PSE's disproportionate contribution to SPU's overall emissions profile.

As such, encouraging PSE to decarbonize their energy profile will be essential to achieving SPU's carbon neutrality goals. As SCL's service area roughly correlates to Seattle's boundaries, there is no room to negotiate new contracts with PSE or convert existing infrastructure or facilities over to SCL power. However, when PSE reduces the carbon intensity of its electricity, SPU experiences tangible benefits. Emissions from electricity consumption, for example, declined year over year between 2019 and 2020. While there was little change in energy consumption patterns, the volume of warming emissions per KWH supplied by PSE declined, eliminating 2.3 MTCO2e from SPU's electricity consumption.

Puget Sound Energy has already declared its intent to be carbon neutral by 2030 and be entirely free of carbon emissions in their electrical generation by 2045[7], which is in line with SPU's targets and presents a clear pathway to carbon neutral facility operations within the utility's declared timelines. However, until realized, these goals remain uncertain, and SPU should work with PSE as a partner to fulfil its stated decarbonization goals.

Action 3: Generate renewable energy throughout the existing SPU infrastructure.

Beyond decarbonizing the existing energy profile that SPU purchases and increasing energy efficiency, SPU can also explore ways to generate its own renewable energy. SPU has already explored some of these options through creative pilot projects. The North Transfer Station, for example, was the first SPU facility to install solar panels on its roof, with the potential to generate enough electricity to power up to 130 homes. SPU is also exploring the installation of its first in-line hydropower generation station at the Lake Forest Park Reservoir, which would take advantage of excess pressure in our water distribution network to generate as much as 700,000 kwh of electricity annually.

These carbon-free sources of electricity not only can help offset operating costs, but also could provide a pathway to help offset some of the most carbon-intensive electricity in our emissions profile. SPU can build off the results of these early pilot projects to prioritize new renewable energy generation opportunities throughout the utility's infrastructure.

Action 4: Improve energy efficiency practices at SPU workforce facilities and infrastructure.

SPU should continue to reduce energy consumption across all our infrastructure and facilities regardless of the source of the power (PSE vs SCL). Opportunities to increase energy efficiency include energy benchmarking and analysis, as well as investing in new, more efficient equipment whenever possible.

Action 5: Improve maintenance records and monitoring practices to address fugitive emissions.

A small portion of emissions from SPU's facilities are released as fugitive emissions, primarily refrigerant escaping from our facility HVAC systems. While these emissions represent a miniscule volume of material released, the extremely high warming potential of these refrigerants make them potent GHGs and warrant SPU's attention. Efforts should be made to improve maintenance records and monitoring practices to ensure that these emissions are tracked effectively.

Action 6: Replace building system refrigerants with high warming potential.

SPU should, whenever possible, try to replace refrigerants with high warming potential with refrigerants that are less likely to cause warming. These refrigerants are utilized in heat pumps and HVAC systems in SPU workforce facilities.

[7] https://www.pse.com/en/pages/together

Fleet & Equipment

SPU has already recognized the importance of reducing fossil fuel consumption in its fleet, as exemplified by the existing electric vehicles that make up 12% of SPU's fleet presently. SPU has also pioneered and normalized the use of liquid fuels – like biodiesel and renewable diesel – that can reduce the amount of warming emissions released from existing fossil fuel-powered vehicles.

SPU's fleet represents the emissions source that the Utility has the most direct control. As vehicle electrification technology develops into a wider share of the automotive market, SPU is expected to have additional opportunities to purchase more electric vehicles.

Some of these vehicles are already obtainable today, especially for light fleet (sedans, SUVs, vans). SPU recently purchased its first electric pick-up truck and electric van. The potential for electrified work vehicles to both deliver crews and material to job sites, as well as act as a power source for small equipment, continues to grow and provides an opportunity to eliminate both vehicles and stationary equipment alike in the coming years.

SPU is also starting to purchase heavy electric fleet vehicles. For example, in 2023 two electric "yard goats" - small tractors used at the transfer stations to move large solid waste containers within the station – replaced diesel yard goats. Employees who tested the electric vehicles have reported that they meet their needs and are easier to navigate.

However, due to the nature of some heavy-duty vehicles utilized by SPU, it's unlikely that the entire vehicle fleet will be transitioned to electric propulsion by 2030. Certain heavy-duty vehicles are not expected to have suitable electric options available in the near future. As a result, will need to offset some fleet related emissions to meet the 2030 goal.

Action 7: Continue to transition light-duty and medium-duty fleet to electric vehicles.

SPU is aligned with the City's electrification strategy including the 2018 Green Fleet Executive Order, which requires the city to accelerate its electrification efforts and phase out fossil-fuel use by 2030. To date, SPU has:

- Transitioned 12% of our leased and owned fleet to electric or hybrid electric vehicles
- Installed 70 electric vehicle chargers across 11 SPU workforce facilities
- Tested emerging electric vehicles and electric vehicle charging technology through pilot programs (e.g., plug-in electric battery packs for auxiliary power on water service trucks, shared charging technology to minimize power needs, and use of electric bikes)

Electric vehicles are expected to make up more of the automotive market in the coming years. Already, California has established plans to eliminate the sale of light-duty fossil fuel-powered vehicles by 2035 – a policy Washington state has agreed to follow[8]. SPU should continue to proactively align fleet procurement strategies to take advantage of the expected availability of electric vehicles. These strategies include identifying vehicle user

[8] https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/

needs to better understand how electric vehicle transition meet job requirements. Some of these needs - particularly related to heavy machinery – are not yet available in the current electric vehicle markets. SPU should continue to identify standards of performance for these heavy equipment – including vactors and heavy trucks – that can recognize when nascent technology has developed enough to warrant replacing fossil-fuel powered vehicles.

Action 8: Continue development of vehicle charging infrastructure.

Electric vehicle charging infrastructure improvements are needed to support an electric fleet. SPU has already installed electric chargers at workforce facilities, including OCC, SOC, NOC, South Transfer Station, and Lake Youngs. In addition, SPU staff can utilize electric charging infrastructure installed by FAS at the Seattle Municipal Tower Garage, SeaPark Garage, and Charles Street, as well as at Haller Lake starting in 2023. However, this charging network best supports light fleet vehicles. The build out of fast charging hubs across SPU's workforce facilities will be necessary to support heavy fleet electrification and will require significant power upgrades.

Action 9: Develop a plan to prioritize fuel efficiency practices to reduce fuel consumption.

The stay-at-home orders in response to the COVID-19 pandemic in 2020 required SPU to reduce operations to essential services, which in turn temporarily reduced the vehicle activity and the amount of fuel SPU consumed. This reduction in fuel use led to a notable reduction in GHG emissions between 2019 and 2020. While electrification will be key to eliminating mobile combustion emissions from SPU's emissions profile, interim reductions can be achieved by prioritizing fleet management practices that decrease fuel consumption, when feasible, and have the added benefit of a reduction in fuel costs. Providing the support and resources required to design an actionable efficiency improvement plan can help support short-term progress towards emissions reductions.

Action 10: Continue efforts to reduce fugitive emissions throughout fleet.

SPU's fleet also generates fugitive emissions that escape from vehicle air conditioning systems. While these emissions represent a very small fraction of the fleet-related emissions, they are many times more potent than CO2 at warming the atmosphere. Presently most fleet vehicles use HFC-134a, which has a warming potential that is 1,300 times more powerful than CO2. SPU has already started a transition to R1234yf – a refrigerant that warms the planet roughly equally to CO2 in its emissions. SPU could dramatically reduce fugitive emissions by transitioning all vehicles to R1234yf in the coming months.

Historic Landfills

SPU is charged by the city with managing and maintaining the waste collected in three historic landfills including measuring and accounting for the warming emissions generated by these sources.

SPU is not the only department managing historic landfills – Seattle Department of Parks and Recreation manages several historic landfills that emit much larger quantities of landfill gas than the historic landfills overseen by SPU. As Seattle will have to mitigate these emissions in the near future to fulfill the city's larger climate goals, these historic landfills could represent opportunities for interdepartmental collaboration.

With this context in mind, SPU can take several actions to address the emissions of the historic landfills we manage.

Action 11: Monitor methane destruction technologies.

Firstly, SPU can take a proactive approach to monitoring emerging methane capture, abatement, and destruction technologies. Present technology is likely too expensive to justify its installation and use at SPU's historic landfills that do not already have flares installed. However, new funding from Congress through the Inflation Reduction Act has focused on methane capture and destruction and could lead to new innovations or financing mechanisms that lower the cost of action. SPU should proactively monitor if these technologies and opportunities evolve in a way to align with SPU's interests.

Action 12: Explore ways to leverage historic landfill properties to expand GHG emissions reductions.

Historic landfills can be repurposed into multi-use developments with tangible co-benefits for the public. Most notably, Seattle Parks and Recreation operates a golf course and driving range on the site of the Interbay historic landfill. While historic landfills are certainly not suitable for large developments that would disturb the waste buried at these sites, they do represent opportunities for brownfield renewable energy and carbon reduction improvements. SPU should prioritize feasibility studies and analysis on the construction of solar panels, carbon sequestering landscapes, and other emissions reduction opportunities on the historic landfills under the Utility's operations.

Solid Waste Contracted Trucks

The contracted relationship between SPU and the two vendors who own and operate solid waste collection trucks, as well as available technology, limits the kind of emissions reductions efforts that SPU can pursue from solid waste collection. However, SPU isn't without options to eliminate these emissions, and can start laying the groundwork for these changes by understanding available vehicle technology and preparing contract language to require Contractors provide collection vehicles that emit fewer warming gases.

WM and Recology utilize slightly different equipment and fuel sources for their collection sources, but they generate roughly similar quantities of warming emissions each year. Solid waste collection trucks are notoriously challenging to decarbonize – trucks are estimated to operate with a fuel efficiency of 3 miles per gallon, and the stop/start nature of their use makes further efficiency improvements challenging.

Despite those operational challenges, SPU has taken steps to incentivize both WM and Recology to improve their operations through contracting. In our most recent 10-year solid waste contract (2019-2029) with Recology and WM, SPU has required that all solid waste collection vehicles under the contract be run with cleaner engines and 100% renewable fuels. The fleet consists of:

- 50% renewable fossil gas (with gas produced by capturing landfill emissions)
- 40% renewable diesel (from animal fats and other waste grease)
- 10% electric (including small route trucks, box trucks, and 2 full size route trucks)

WM, for example, has shifted their entire fleet to run on compressed fossil gas, while Recology has worked to incorporate renewable fuels, compressed fossil gas, and even early use of electric vehicles into their fleets alongside diesel fuels.

While these efforts are encouraging, their climate impact can be limited. While the lower carbon intensities of renewable fuels and compressed fossil gas are modest improvements compared to burning diesel fuels – and in the case of fossil gas, produce far fewer particulate emissions compared to diesel – they still release significant amounts of GHG emissions. As an example, WM trucks traveled an estimated 408,000 more miles than Recology did in 2019, and generated 452 fewer MTCO2e for that distance, demonstrating that CNG trucks can lead to modest emissions reductions. While notable, both WM and Recology trucks are still generating far more warming emissions than is compatible with SPU's climate goals.

Solutions to these issues are emerging. In 2020, Recology started using two electric trucks as part of their collection fleets in Seattle, logging a total of 5,234 miles throughout Seattle. Electric heavy vehicles are still nascent technology, and Recology has reported some maintenance issues related to these first few trucks. Additionally, electric vehicle technology is currently nascent, with operational limitations to range and power that can be influenced by the topography of a vehicle's expected route. New government funding enacted in the Inflation Reduction Act is likely to boost development and manufacturing of electric heavy trucks in the coming years.

Action 13: Require additional emissions reductions in solid waste collection truck contracts.

SPU has already required environmental standards and emissions reductions as part of their solid waste collection contracts to both WM and Recology. As these contracts are due to be renegotiated in 2029, SPU can take a proactive approach to reducing emissions from these sources by outlining emissions requirements that will need to be achieved by collection partners, in line with the expected technology available. This could include a requirement for zero-emissions vehicles by a certain date during the contract period and could incentivize a transition to electric vehicles that align with the expected evolution of Seattle's transportation network. Going forward, SPU will aim to continue to report on the emissions associated with our solid waste collection trucks as Recology and WM will provide quarterly and annual mileage and fuel usage data to SPU.

Business Travel

Action 14: Replace business travel with virtual meetings whenever possible.

As the COVID-19 pandemic demonstrated, SPU employees can conduct most of their business remotely, if necessary. While there will inevitably be a requirement for some select employees to travel for conferences, networking, or for particularly important initiatives, SPU can further reduce emissions by taking additional steps to examine if a proposed trip can be accomplished with remote communication.

Other

Action 15: Establish standards and protocols for purchasing carbon offsets.

SPU's goal to be carbon neutral by 2030 will require speedy action. Many of the solutions suggested above will take time to implement and transition, and no solution can be allowed to compromise the essential services that SPU provides to ratepayers. This is particularly true with regards to our fleet. Some heavy duty vehicles have power demands and roles that are unlikely to be feasibly transitioned to electricity by 2030. Additionally, ensuring prompt emergency responses will likely require fossil fuel vehicles past 2030,

As a result, SPU will need to begin offsetting the emissions of hard-to-abate sectors of our operation. Emissions offsets, while important, can also suffer from a lack of transparency, and additionality, and reliability, all of which undermine their efficacy as a climate solution. As a result, SPU should start codifying standards to verify and authenticate emissions offsets.

Seattle City Light could act as a model for offsetting policies. SCL has received explicit authority from Seattle City Council to purchase offsets, and has outlined a series of minimum requirements to verify, purchase, and retire offsets in a way that ensures reliability. SPU can begin conversations exploring similar legislation and standards that can be used to purchase offsets for our own emissions.

Appendices

Appendix 1: Results in Context

This inventory finds that SPU's GHG emissions linked to the utility's service provision are most closely tied to electrical purchasing from Puget Sound Energy and to vehicle fuel emissions. While these emissions categories will require targeted infrastructure and equipment investment, as well as broader mitigation investments, to achieve carbon neutrality by 2030, there are clear policy options available that the utility can implement to quickly reduce its emissions.

While this report focuses on SPU's responsibility to address its own operational emissions, it is critical to place these results in context with other emissions tracking and reduction efforts throughout the city and across King County.

Related Inventories

SPU, SPR, and SCL Purchasing & Contracting Inventory: As acknowledged earlier in this report, SPU's actions also result in "Scope 3" emissions. These emissions can be indirectly traced to SPU's activities through the organization's supply chains as well as through the activities that SPU employees undertake. These emissions are generated through SPU's purchases, contracts, employee commuting, and business travel, and are more completely analyzed in the Purchasing & Contracting Inventory that SPU is completing in conjunction with Seattle Parks and Recreation and Seattle City Light. The emissions in SPU's supply chain are roughly 3x the emissions associated with SPU's operations, indicating a need to develop a robust sustainable procurement strategy to address purchasing & contracting related emissions.

Seattle's Consumption Based Emissions Inventory: The City of Seattle has developed a consumption-based emissions inventory (CBEI) which estimates the greenhouse gas (GHG) emissions associated with all the goods and services consumed within the community, no matter where they are produced (including the extraction of raw materials, manufacturing, and global transportation). This inventory looks at all the emissions associated with the food we eat, the things we buy, how we travel, and the homes we live in. SPU's efforts in both waste diversion (recycling & composting) and waste prevention (food waste prevention, food rescue, repair and reuse etc.) represent powerful levers towards addressing consumption-based emissions. SPU's work to advance Seattle's vision of zero waste and move towards an inclusive circular economy further emphasizes SPU's opportunity to lead on climate mitigation.

Ultimately, SPU has a responsibility to address the emissions in our operations, supply chain, and across our communities. This inventory provides an empirical foundation for SPU's decarbonization work in our operations and is a critical part of our journey towards climate mitigation.

Peer Utilities Comparison

Compared to peer utilities, SPU has numerous structural advantages that provide a clear pathway to eliminating its contributions to climate change by 2030. Thanks to Seattle City Light's carbon-neutral electricity, SPU's electricity profile is a significantly smaller proportion of its emissions compared to peer utilities. In turn, electric vehicles that are charged within Seattle City Light's service area will nearly eliminate the emissions associated with their operation. SPU can take advantage of the existing progress accomplished by Seattle City Light to significantly reduce emissions from its fleet by aggressively pursuing vehicle electrification.

This is complemented by Puget Sound Energy's existing emissions reductions goals, which aim to be carbon neutral by 2030 and entirely renewable by 2045. Movement towards these goals will result in emissions reductions at SPU sites powered by Puget Sound Energy.

Additionally, SPU does not operate either an active landfill or a wastewater treatment facility. While Seattle still generates emissions from solid waste, sewer, and wastewater, those emission are "passed on" to the organizations that handle and maintain those facilities – namely, King County for wastewater treatment and WM for solid waste collection emissions. As such, SPU has a much smaller emissions profile compared to other peer wastewater, water, and solid waste utilities.

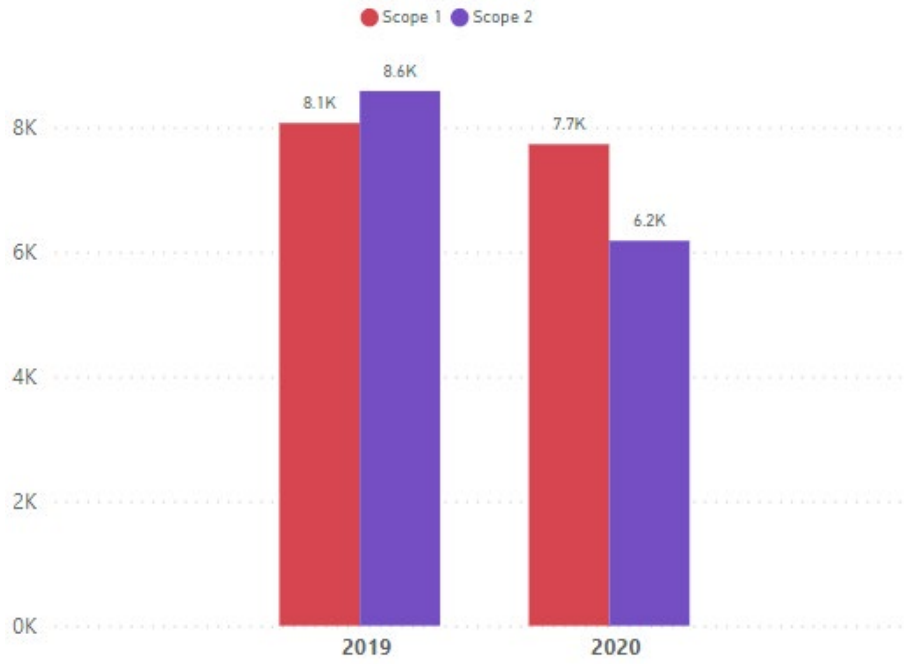
Appendix 2: Emissions by Scope

In GHG inventory protocols, emissions are categorized by one of three "Scopes", referring to how the emissions are generated.

- **Scope 1:** Emissions generated through "direct combustion" of fossil fuels.
- **Scope 2**: Emissions generated to create electricity that is purchased by SPU to power our buildings, infrastructure, and equipment.
- **Scope 3**: Emissions associated with SPU's business activities but generated by assets not directly controlled by SPU.

SPU's emissions, categorized by scope, are listed below. The inventory focuses primarily on emissions related to operations, but the recommendations are primarily focused on Scope 1 and Scope 2 emissions. While some emissions sources are examined as Scope 3 emissions, this report is limited in its analysis for emissions outside of Scopes 1 and 2.

Fig. 26: Scope 1 and Scope 2 emissions



Scope 1 Emissions

Our Scope 1 emissions are primarily dominated by fuel use. While we have some small quantities of emissions related to fugitive gases, the vast majority of Scope 1 emissions stem from the burning of fossil fuels.

Fuel combustion can be broken down into two categories: stationary combustion and mobile combustion.

Mobile combustion refers to emissions generated by equipment that uses fuel to move itself. This category includes SPU's fleet and equipment that uses gasoline, diesel or propane.

Stationary Combustion refers to emissions that arise through the ignition and use of fossil fuels in equipment that does not use its fuel to move itself are referred to as stationary combustion emissions. These include building emissions associated with heating our working spaces or warming our water with fossil gas in our buildings, as well as electricity from generators. Importantly, while some equipment – like generators, leaf blowers, and some machinery - might be frequently towed in trailers, these pieces of equipment are considered "stationary" for the purposes of this report.

Scope 1 also includes **Fugitive Emissions** - GHGs that escape from air conditioning systems, refrigerators, or fire extinguishers, as well as emissions from our historic landfills. These emissions are often in the form of CFCs and HFCs, which have extremely large warming potentials compared to CO2.

In 2019, SPU generated 8.1 ktCO2e in 2019 related to Scope 1 emissions, and 7.8 ktCO2e in 2020.

Scope 2 Emissions

Scope 2 emissions are almost entirely sourced from the electricity that SPU purchases from Puget Sound Energy and Seattle City Light to power the infrastructure and workforce facilities the utility operates. While most sites are located within Seattle City Light's service area, several of our largest consumers of electricity - especially water treatment plants - are located within Puget Sound Energy's service area. As such, roughly 57% of our total electricity consumption is provided by PSE.

Scope 2 emissions also include electricity purchased to power electric vehicles (EVs). While there is no "mobile consumption" category in Scope 2 emissions categories, a small percentage of our electricity is used to charge EVs. We expect that this percentage will climb in the coming years, as fleet electrification efforts lead to increased adoption of electric vehicles.

In 2019, SPU generated 8.6 ktCO2e related to scope 2 emissions, and 6.2 ktCO2e in 2020.

Akin to the conclusions related to our facilities, most emissions related to purchased electricity comes from electricity provided by Puget Sound Energy. When examining Scope 2 emissions, 95-97% of emissions are sourced from Puget Sound Energy.

Scope 3 Emissions

Scope 3 emissions are defined by the utility's boundary of control; emissions that SPU are not able to directly influence through business operation, including through partner organizations, are considered beyond the purview of Scope 1 and Scope 2 emissions.

These emissions include emissions generated through solid waste collection, employee commuting and employee business travel. In 2019, SPU generated the equivalent of 10.5 ktCO2e, compared to 10.0 ktCO2e generated in 2020.

Scope 3 emissions would also include many of the emissions that are being examined through the Purchasing & Contracting inventory project and will include a more complete analysis of this emissions category.

Appendix 3: Methodology

Protocol

This inventory's methodology is derived from the Local Government Operations Protocol (LGOP) formulated by The Climate Registry (TCR). The LGOP outlines a methodology for local governments to build consistent, rigorous, and sound greenhouse gas inventories in a manner that can be replicated with fidelity.

SPU adapted this methodology in consultation with Cascadia Consulting Group, to ensure that the needs of our inventory aligned most closely with our operations.

Scopes and Boundaries

SPU prioritized emissions from Scope 1 and Scope 2 sources within this inventory. While most Scope 3 emissions are analyzed in the concurrent Purchasing & Contracting Inventory conducted alongside Parks and Recreation and Seattle City Light, several relevant Scope 3 emissions were included in an informatory basis. These emissions were determined to be relevant to SPU's policy goals and analysis, and included employee commutes, business travel, solid waste collection trucks, and some select historic landfills.

We took care to specify which emissions would be considered part of SPU's direct responsibility to reduce warming emissions. We termed these emissions "Operational Emissions", while we termed emissions outside of SPU's direct responsibility for action "Non-Operational Emissions" for additional analysis.

Data Collection

Data collection began in September of 2021.

Data collection started by collecting billing records for vehicle and facility consumption in 2019 and 2020, which was provided by SPU's accounts payable team. Scope 1 datasets were collected in consultation and partnership with representatives throughout Seattle Public Utilities and the broader City of Seattle. Information regarding fleet combustion was provided by SPU's fleets and facilities team, in conjunction with FAS. Stationary combustion data was provided by Puget Sound Energy. Fugitive emissions data for historic landfills was provided by representatives of SPU's Solid Waste Line of Business, while fugitive emissions regarding vehicles and workforce facilities were provided by SPU's Fleets and Facilities teams. Emissions factors for fuels, fossil gas combustion, landfill gas, and fugitive emissions were provided by the EPA. In the case of unique fuel blends that did not have established emissions factors, SPU and Cascadia calculated emissions factors based on the proportion of the component fuels.

Scope 2 datasets were provided by Seattle City Light and Puget Sound Energy for electricity consumption. Emissions factors to convert consumption into emissions equivalents was provided by Seattle City Light and Puget Sound Energy.

Scope 3 datasets related to business travel were provided by SPU's travel desks, which consisted of the transportation modalities utilized and the destinations traveled. Miles traveled was estimated utilizing Google Maps for vehicle travel, and ICAO's flight calculator for aviation trips. Emissions were estimated utilizing EPA's standards for vehicle travel per mile, as well as estimates for short-, medium-, and long-haul flights.

Data for employee commutes were provided – in an anonymized format to ensure confidentiality – by SPU's HR team. Miles traveled was estimated using Google Maps, outlining expected commutes from employee zip codes of residence to place of work. Commute Trip Reduction (CTR) surveys supplied by Seattle Department of Transportation were used to estimate the modalities of transportation for facilities when available. When CTR surveys were not available for a given facility, we utilized the CTR survey of the most closely located facility that had data available. For some select locations that are poorly served by transit, we assumed that the entirety of

the workforce operating at that facility utilize passenger vehicles to commute. For records where there is no data available for a given commuting records, we assumed an average of the data set's miles traveled. Emissions per vehicle miles traveled for each modality were calculated utilizing EPA averages.

Information related to solid waste collection trucks was provided by WM and Recology, limited to examine vehicles utilized within SPU's solid waste collection area. Emissions were calculated utilizing emissions factors provided by the EPA.

Data was verified for accuracy and controlled for quality by comparing datasets to other files within the city, including fleets and fuel consumption databases and energy consumption records. In some select cases, data was manually cross-referenced with other departments throughout the city to ensure quality and fidelity.

Inventory results were compiled by Cascadia Consulting Group, as outlined in the LGOP. Results were packaged into a PowerBI dashboard. This report was written by Brooks Bolsinger and Ashima Sukhdev from SPU.