Metro

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Metro Greenhouse Gas Emissions Inventory

FY 2016-17

For Metro Internal and Business Operations

June 2018

ACKNOWLEDGEMENTS

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Good Company, a sustainability consulting firm based in Eugene, OR supported Metro's work on this project. Aaron Toneys of Good Company provided training and data gathering assistance to Metro staff and facilitated the use of Good Company's Carbon Calculator (G3C), a proprietary GHG inventory tool. He is the primary author of this report. Andree Phelps provided data collection support and analysis and supported development of the final report.

About Metro:

If you picnic at Blue Lake or take your kids to the Oregon Zoo, enjoy symphonies at the Schnitz or auto shows at the convention center, put out your trash or drive your car – we've already crossed paths.

So, hello. We're Metro – nice to meet you.

In a metropolitan area as big as Portland, we can do a lot of things better together. Join us to help the region prepare for a happy, healthy future.

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For more information on Metro's internal sustainability program, visit: www.oregonmetro.gov/greenmetro

For more information on Metro's regional climate work, visit: www.oregonmetro.gov/climate-smart-strategy

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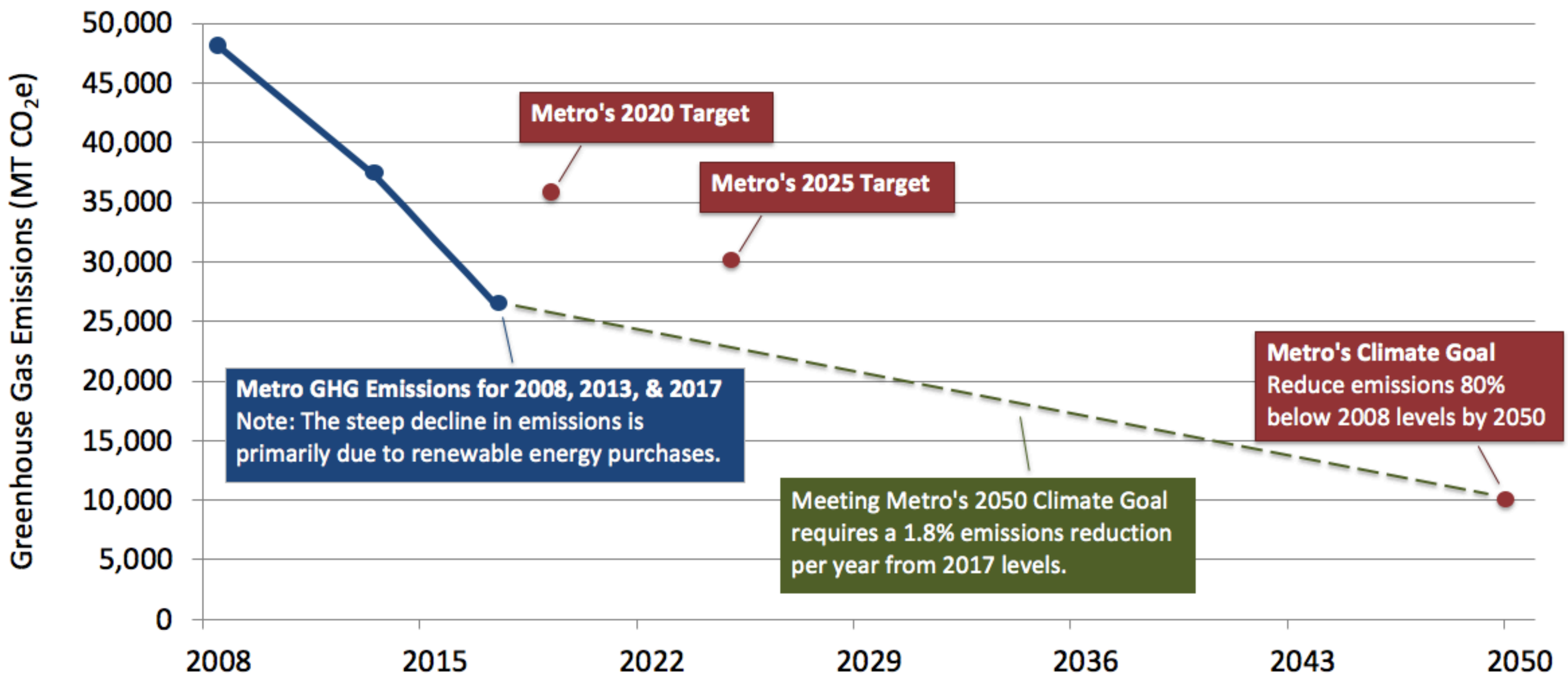
1. EXECUTIVE SUMMARY

METRO'S PROGRESS TOWARD CLIMATE GOAL

Metro's climate goal for its internal operations is to reduce greenhouse gas (GHG) emissions to 80% below 2008 levels, equivalent to 10,000 metric tons carbon dioxide equivalent (MT CO_2e), by 2050. Figure ES-1 shows that Metro's actual 2017 (fiscal year 2016-17) emissions reductions are ahead of the 2020 target. This accelerated progress was primarily due to purchase of renewable electricity – an action that resulted in significant emissions reductions, but is almost complete, as well as energy efficiency initiatives. The additional reductions necessary for Metro to reach its goal will require strategic efforts across all sources of greenhouse gas emissions.

Figure ES-1: Metro's progress toward climate goal (excluding supply chain emissions)



2017 GREENHOUSE GAS (GHG) EMISSIONS

In 2017, Metro operations generated **26,418 MT CO_2e** from GHG sources included in Metro's quantitative climate reduction target (non-supply chain emissions). The largest source in 2017 was the fuel used by Metro-contracted vehicles to transport solid waste from transfer stations to landfills (Regional Waste Hauling). Other significant sources of emissions included: building electricity and natural gas use (Stationary Fuels), employee commute, fugitive methane from St. Johns Landfill, and Metro's owned vehicles.

Supply chain emissions add 29,700 MT CO_2e[1] to the non-supply chain emissions for a total of **56,118 MT CO_2e** Metro-wide emissions. With supply chain emissions included, three functional areas generate 87% of Metro-wide total emissions: Solid Waste, MERC, and the Oregon Zoo.

Figure ES-2: Functional area share of Metro-wide emissions (including supply chain)

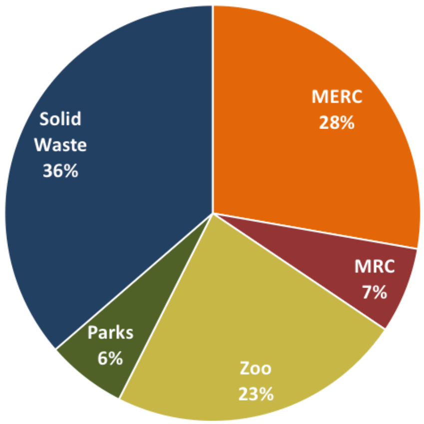
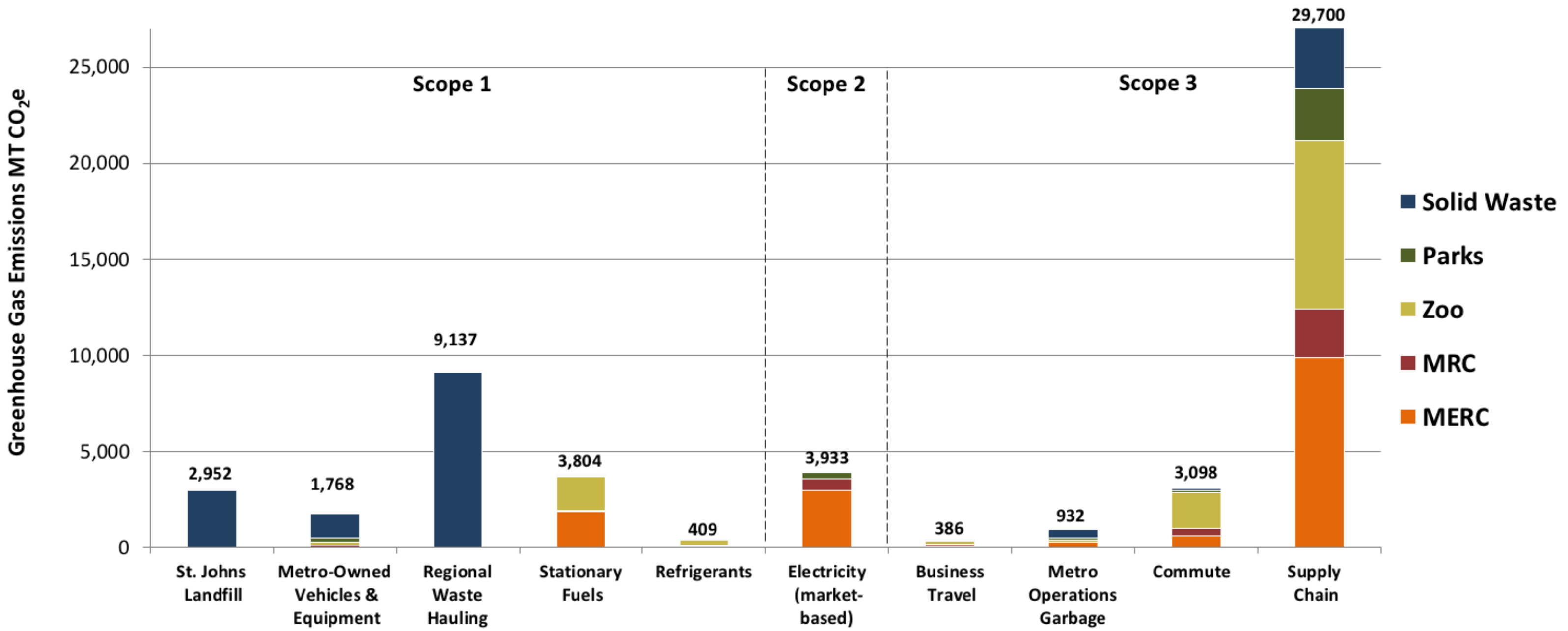


Figure ES-3: Metro-wide emissions by source and functional area

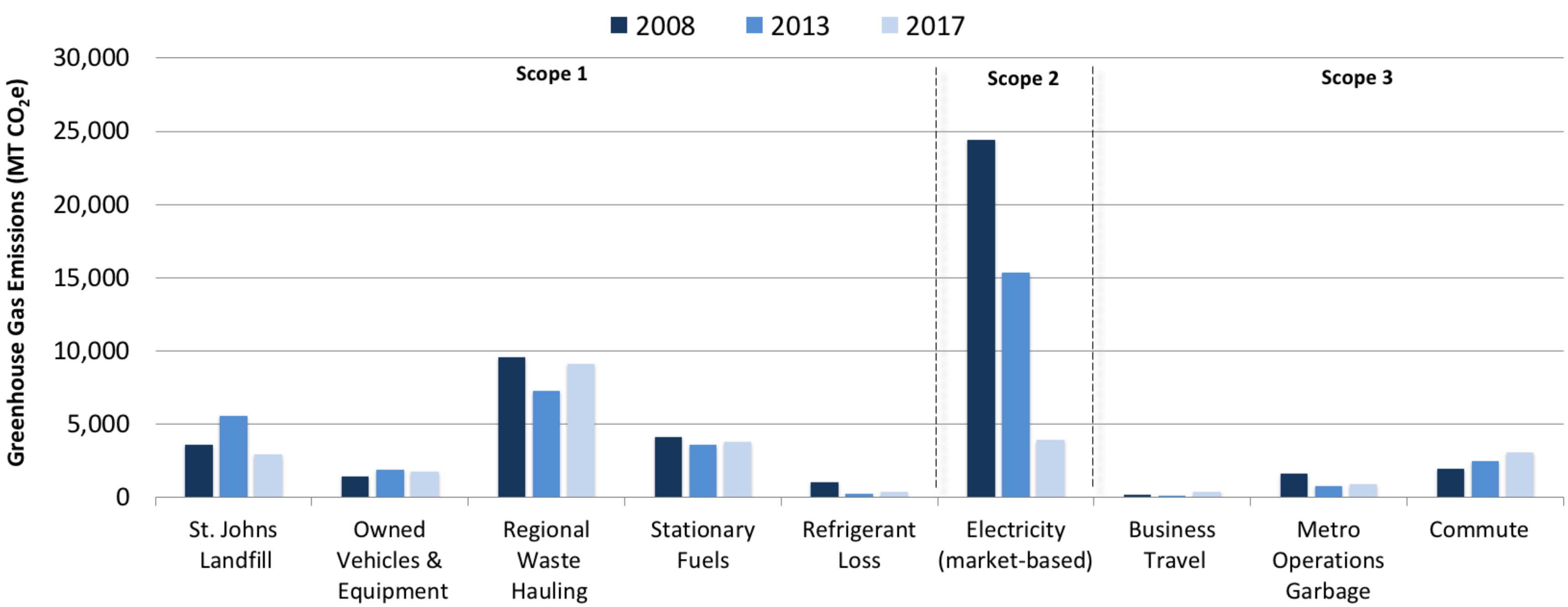


[1] Supply chain emissions are rounded to demonstrate the level of uncertainty for this emissions source.

COMPARISON OF INVENTORY RESULTS – 2008, 2013, AND 2017

- Overall, non-supply chain emissions decreased nearly 45% from 2008 emissions, and nearly 29% from 2013 emissions.
- St. Johns Landfill methane emissions decreased by 19% from 2008 due to declining decomposition of landfilled material over time. Purchase of landfill gas by Ash Grove cement contributed to the 32% decrease in emissions from 2013 to 2017.
- Owned vehicles and equipment emissions decreased by 6% since 2013, but 2017 emissions remain higher than baseline.
- Regional waste hauling emerged as Metro's largest source of non-supply chain emissions. Emissions decreased 4% since 2008. The dip in emissions in 2013 was due to reduced generation of solid waste during the recession.
- Stationary fuel use (primarily natural gas) emissions have decreased by 8% since baseline.
- Electricity emissions are down 84% from 2008 due to renewable electricity purchases and energy efficiency upgrades.
- Commute emissions increased by 48% from 2008. Trips by solo drivers at many facilities have decreased, which reduces emissions, but this gain was outdone by increases in the number of Metro employees and trips.

Figure ES-4: Year-over-year emissions comparison by source and scope



2. INTRODUCTION

In 2003, the Metro Council set an ambitious target for business operations to be sustainable within one generation. To this end, the Council adopted goals in five key categories: climate, waste, toxics, water and habitat. Metro's Sustainability Plan[2], adopted in 2010, identifies strategies and actions to achieve the goals and sets a baseline, indicators, and interim targets to measure progress over time.

METRO'S CLIMATE GOAL

Metro conducts periodic greenhouse gas inventories to track progress over time toward Metro's climate goal and to understand trends and manage emissions from specific sources and activities. A GHG inventory quantifies the GHG emissions associated with a specific boundary, such as internal operations, for a specific period of time. This report presents data and emissions for 2017 (fiscal year 2016-17) and follows on Metro's 2008 (baseline) and 2013 GHG inventories. GHG emissions are reported in metric tons of carbon-dioxide equivalent (MT CO_2e).

Based on the results of the baseline greenhouse gas (GHG) inventory conducted for 2008 emissions[3], Metro adopted a sustainability goal to reduce direct and indirect GHG emissions from internal operations 80% below 2008 levels by 2050. Due to the challenges of quantifying supply chain emissions, Metro set a quantitative target for non-supply chain emissions and identified a need to develop process targets for supply chain emissions. Table 1 below provides a summary of the indicators and targets for Metro's climate goal.

Table 1: Indicators and interim targets for tracking progress toward Metro's climate goal

SCOPES 1, 2 and 3 EMISSIONS (excluding supply chain)	
Year	**Reduction Target**
2013	0% increase
2015	15% reduction
2020	25% reduction
2025	40% reduction
2050	80% reduction

[2] Metro Council resolution No. 10-4198, "For the Purpose of Adopting Metro's Sustainability Plan and Authorizing the Metro Chief Operating Officer to Implement the Plan."

[3] GHG Emissions Baseline Inventory, 2008, for Metro internal and business operations, August 2010. http://library.oregonmetro.gov/files//metro_internal_ghg_inventory_8-10.pdf

3. METRO CLIMATE ACTION

Three guiding principles frame Metro's work in the area of reducing GHG emissions from operations: reduce energy demand first, address emissions from all three scopes, and use most current climate science to guide actions.

Guiding Principles for Greenhouse Gas Emissions Reduction at Metro

- **Reduce Energy Demand First**. Metro's top priority should be to improve facility energy efficiency. Purchase and/or on-site generation of renewable energy should be a second priority. Procurement of high-quality carbon offsets (that meet certain criteria) should not be considered until these avenues have been fully pursued.
- **Address Emissions from All Three Scopes.** Metro should address all GHG emissions sources: energy, transport, and materials from all three emissions scopes.
- **Use Most Current Climate Science to Guide Actions.** Metro has chosen to use the findings from the Intergovernmental Panel on Climate Change (IPCC), which outline what is necessary in terms of the scale of emissions reductions needed to avoid catastrophic climate change (change beyond the point that we can't adapt) to guide its actions.

Since the Metro Sustainability Plan was adopted in 2010, the organization's efforts to reduce GHG emissions have focused on energy efficiency and renewable energy.

Recent Climate Action

In 2017 Metro completed 18 energy efficiency projects with Energy Trust of Oregon support, which are expected to save 3.5 million kWh of electricity annually. These projects include LED lighting, heating and cooling system upgrades, solar arrays, solar ready design and participation in the Strategic Energy Management Program. To date, Metro has received over $3 million in incentives from Energy Trust of Oregon.

Metro's newest buildings, Elephant Lands and the Education Center, both at the Oregon Zoo, include solar arrays. The Education Center was also designed for net zero energy — to produce as much energy as it uses on an annual basis. A two-megawatt solar array was installed at the Oregon Convention Center in 2016. This solar array generates one quarter of the building's electricity use. In addition, Metro's purchase of renewable energy through Renewable Energy Certificates has significantly reduced emissions and helps to drive development of new, additional renewable electricity generation.

Next Steps

Metro has initiated work to create an updated climate action plan for internal operations, informed by the results of this inventory, the latest climate science and best practices, technological advances and cost reductions for solar energy and electric vehicles, and new funding mechanisms.

4. METHODOLOGY

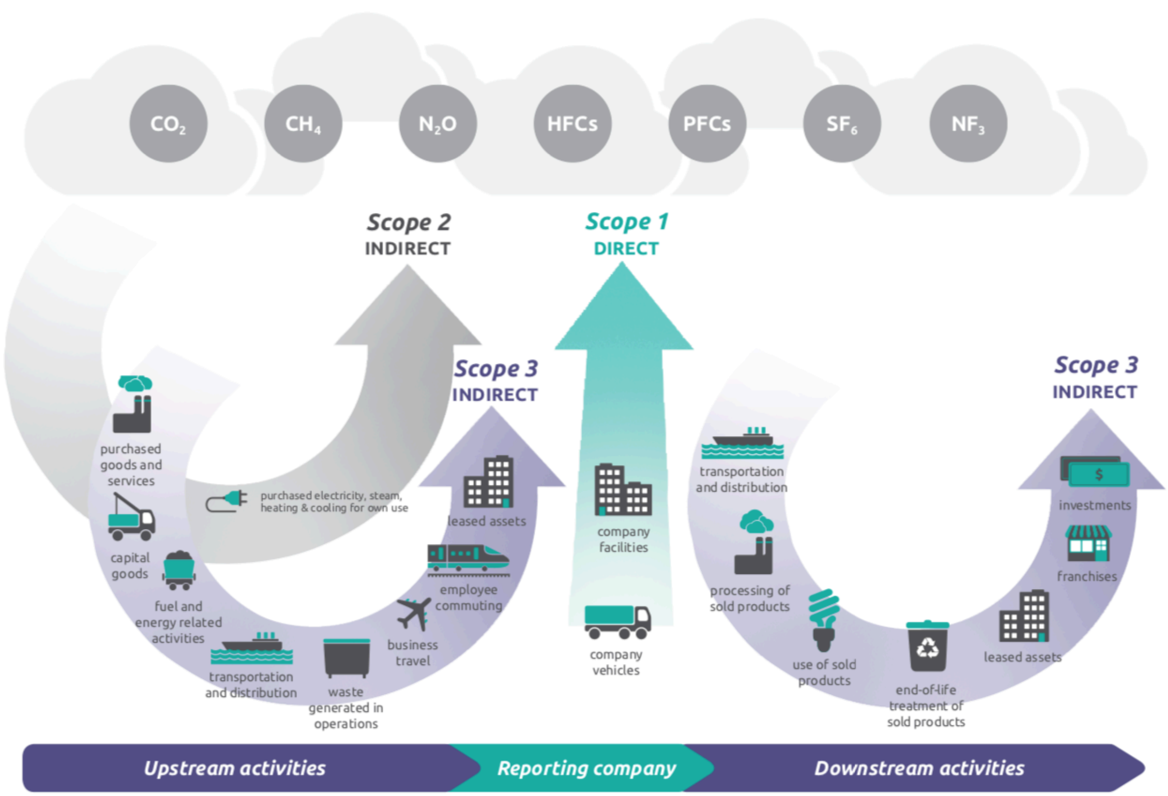
INVENTORY BOUNDARIES

Metro sought to include the widest possible boundaries (emissions sources and facilities) in this inventory, while following standard GHG inventory protocols and providing consistency with the baseline inventory. GHG inventory protocols define emissions as either direct (owned) or indirect (shared). This inventory captures nearly all direct and indirect emissions associated with Metro's operations.

Direct emissions are those that stem from sources owned or controlled by a particular organization. Indirect emissions occur because of the organization's actions, but the direct source of emissions is controlled by a separate entity. Organizations can influence these emissions through their purchasing power. To distinguish direct from indirect emissions sources, three "scopes" are defined for GHG accounting and reporting.[4] Figure 1 illustrates the three emissions scopes.

- **Scope 1:** All direct GHG emissions from equipment and facilities owned and/or operated by Metro.
- **Scope 2:** Indirect GHG emissions from purchased electricity.
- **Scope 3:** All other indirect emissions sources that result from Metro activities but occur from sources owned or controlled by another company or entity, including: business travel, embodied emissions in material goods purchased and services contracted by Metro, emissions from landfilled solid waste, and emissions associated with Metro employee commute patterns.

Figure 1: Greenhouse gases and accounting and reporting scopes[5,6]



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[4] Source: WRI/WBSCD Greenhouse Gas Protocol, Corporate Accounting and Reporting Standard (Revised Edition), Chapter 4.
[5] Source: WRI/WBSCD Greenhouse Gas Protocol, Corporate Value Chain (Scope 3) Accounting and Reporting Standard
[6] Explanation of Greenhouse Gas chemical formulas: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluouride (NF_3), and sulfur hexafluoride (SF_6).

In an effort to organize the emissions from Metro's diverse operations portfolio, all facilities are grouped by type and referred to as functional areas. Table 2 includes the name of each of the five functional areas and the types of facilities included within each. Table 3 describes the emissions sources included in the inventory.

Table 2: GHG inventory facility boundaries

METRO FUNCTIONAL AREA	FACILITIES INCLUDED IN INVENTORY	FACILITIES EXCLUDED FROM INVENTORY
Solid Waste	Metro South Transfer Station Metro South Hazardous Waste Facility Metro Central Transfer Station Metro Central Hazardous Waste Facility MetroPaint St. Johns Landfill	Killingsworth Fast Disposal Landfill
Metropolitan Exposition Recreation Commission (MERC)	Oregon Convention Center Portland Expo Center Portland'5[7] - Keller Auditorium Portland'5 - Arlene Schnitzer Concert Hall Portland'5 - Antoinette Hatfield Hall/Admin	
Oregon Zoo	Oregon Zoo Condor breeding facility	
Metro Regional Center (MRC)	Office building (includes parking lot)	
Regional Parks	Blue Lake Regional Park Borland Field Station Chinook Landing Marine Park M. James Gleason Memorial Boat Ramp Oxbow Regional Park Scouters Mountain (new park in 2014) Smith and Bybee Lakes Glendoveer Golf and Tennis (excluding driving range)	Beggars Tick Wildlife Refuge Cemeteries Cooper Mountain Nature Park Mount Talbert Nature Park Metro Natural Area Properties Rental Properties

[7] Portland'5 refers to Portland'5 Centers for the Arts, formerly Portland Center for the Performing Arts.

Table 3: Description of Metro's operational GHG emissions sources

	EMISSIONS SOURCE	EMISSIONS SOURCE DESCRIPTION
Scope 1	**St. Johns Landfill**	St. Johns Landfill is a 238-acre closed landfill, located on the North Portland Peninsula near the confluence of the Columbia and Willamette rivers, which generates landfill gas (LFG) from decaying solid waste. Ash Grove Cement purchased some landfill gas in 2017. The remaining LFG was captured and flared. Fugitive methane releases are calculated and included in this inventory, as well as trace methane and nitrous oxide emissions from the flaring process. CO_2 emissions from the flaring process are considered biogenic, are reported separately, and therefore are not included in this inventory. As a Title V air pollution permit holder, Metro must meet DEQ reporting requirements related to the methane management practices at this landfill.
	Owned Vehicles & Mobile Equipment	Metro owns 120 on-road vehicles and 160 pieces of off-road equipment that consume gasoline and diesel fuels. It was assumed all fuel meets the state guidelines for biofuel blends (E10 for gasoline and B5 for on-road diesel). Upstream emissions from the extraction and transportation of fuels to the point of purchase are outside the boundary of this inventory.
	Regional Waste Hauling	Metro contracts with a trucking company to transfer community-generated solid waste from Metro's transfer stations to various landfills (primarily Columbia Ridge Landfill in Arlington, OR). This emissions source is included under Scope 1 because Metro purchases the fuel for these contracted vehicles directly and because the vehicle fleet was designed to Metro specifications.
	Stationary Fuels	Metro consumes natural gas for space and water heating and propane in equipment used by the Solid Waste and Parks functional areas. Additionally, Metro consumes a small quantity of diesel fuel in back-up electricity generators at many facilities; however, in most cases this data cannot be separated from diesel used in mobile fuels and is included in the owned vehicle results. Also, where heating oil was reported, it was included as a stationary diesel equivalent.
	Refrigerants	Refrigerants are used in heating, ventilation, air conditioning and commercial food refrigeration systems at Metro facilities.
Scope 2	**Electricity**	Metro calculated emissions from electricity consumption from all facilities included in the inventory boundary. Following Greenhouse Gas Protocol's Scope 2 Guidance, emissions from electricity were calculated using both the market-based and location-based methodologies.
Scope 3 (Indirect Emissions)	**Business Travel**	Business travel includes employees' use of airlines, rental cars, and personal vehicles for travel associated with training, conferences, and meetings. Data for business travel by light rail or bus was unavailable and therefore excluded from this inventory.
	Metro Operations Garbage	This category includes landfilled solid waste from Metro operations. Waste volumes do not include recyclables, yard debris or food scraps to compost from Metro operations. Community-generated solid waste from Metro residences and businesses that is processed at Metro-run transfer stations is also not included.
	Commute	In 2017, Metro employed 1,658 full-time, part-time and temporary employees (straight headcount). Commute survey information provided data on the percentage of trips by mode and average one-way trip mileage.
	Supply Chain	This category provides an estimate of the embodied GHG emissions in the manufacture of goods, food, energy and fuel products, and services purchased by Metro.

5. AGENCY-WIDE RESULTS

Metro's 2017 emissions (non-supply chain) are equivalent to any one of the following:

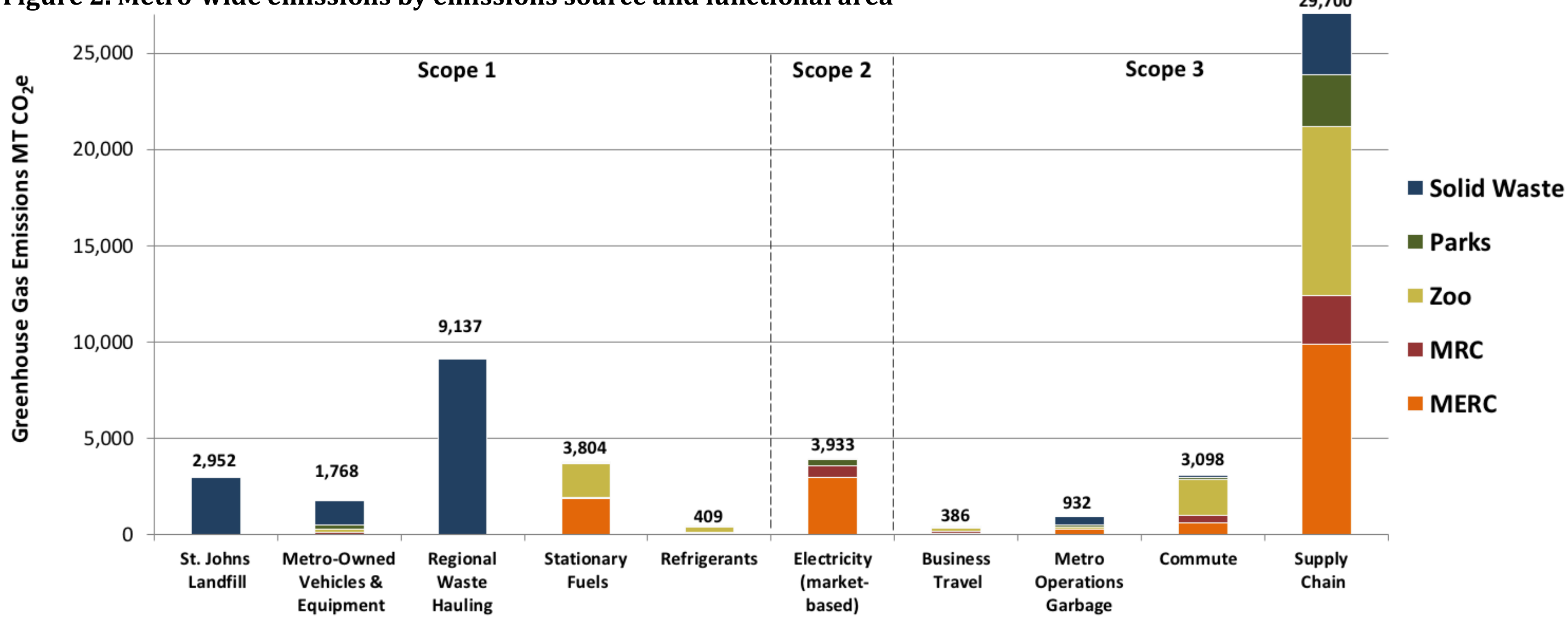
- energy use of 2,800 homes in one year
- driving 5,600 cars for one year

Calculated with https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

In 2017, Metro operations generated **26,418 MT CO_2e** from sources included in Metro's quantitative emissions reduction target (excluding supply chain). The largest source within the goal was the fuel used to transport solid waste from transfer stations to landfills (Regional Waste Hauling). Other significant sources of emissions included building electricity and natural gas use (Stationary Fuels), employee commute, fugitive methane from St. Johns Landfill, and Metro's owned vehicles.

Supply chain emissions add 29,700 MT CO_2e[8] to the non-supply chain emissions for a total of **56,118 MT CO_2e** Metro-wide total emissions. With supply chain emissions included, three functional areas generate over 87% of total emissions: Solid Waste, MERC, and Oregon Zoo.

Figure 2. Metro-wide emissions by emissions source and functional area



[8] Supply chain emissions are rounded to demonstrate the level of uncertainty for this emission source.

Table 4: Comparison of Metro's operational GHG emissions (MT CO_2e) for 2008, 2013, and 2017

Emissions Category	2008	2013	2017	% Change 2008 to 2017	Description of Changes, 2008 - 2017
Scope 1 Emissions					
Regional Waste Hauling	9,553	7,259	9,137	-4%	Changes in economic activity and corresponding solid waste generation and use of higher efficiency freight vehicles
Stationary Fuels	4,126	3,788	3,804	-8%	Metro implemented energy efficiency projects
St. Johns Landfill	3,637	5,561	2,952	-19%	Anaerobic digestion of landfilled material declined over time
Owned Vehicles & Equipment	1,464	1,888	1,768	+21%	Metro has significantly increased the number of part-time and temporary employees
Refrigerant Loss	1,058	228	409	-61%	
Scope 2 Emissions					
Electricity (Market-Based Accounting)	24,405	15,338	3,933	-84%	Metro began purchasing Renewable Energy Certificates (RECs) and implemented energy efficiency projects
Electricity (Location-Based Accounting)	12,774	8,526	8,418	-34%	The average carbon intensity of the regional power grid is decreasing and Metro implemented energy efficiency projects
Scope 3 Emissions					
Supply Chain (**not included in Metro's quantitative goal*)	35,900	3,500	29,700	-17%	Purchase of RECs reduced supply chain emissions
Commute	2,100	2,128	3,098	+48%	Metro has significantly increased the number of part-time and temporary employees
Solid Waste	1,742	801	932	-47%	
Business Travel	217	156	386	+78%	
Metro Climate Goal Emissions (w/Market-Based Electric Emissions):	**48,301**	**37,147**	**26,418**	**-45%**	
Metro Climate Goal Emissions (w/Location-Based Electric Emissions):	36,670	30,335	30,902	-16%	
Total Emissions including Supply Chain (w/Market-Based Electric Emissions):	84,201	40,647	56,118	-33%	
Total Emissions including Supply Chain (w/Location-Based Electric Emissions):	72,570	33,835	60,602	-16%	

Note 1: Electricity Market-based and location-based emissions are not additive. They represent two distinct methodologies in GHG inventory guidance; therefore, emissions totals at the bottom of the Table 4 are provided for each method.
Note 2: Differences in emissions results between the 2013 and 2017 inventories are due to updates to emissions factors for 2013.
Note 3: Emission subtotal amounts are rounded and will not add up exactly in the Climate Goal and Total Emissions.

The most notable change in Metro's emissions for 2017 compared to baseline was an 84% reduction in electricity related emissions from Metro's purchase of renewable energy and implementation of energy efficiency projects. Other notable emissions reductions include an 8% reduction in stationary fuel use, a 4% reduction in regional waste hauling, and a 47% decline in emissions from landfilled solid waste from Metro's facilities.

Metro's emissions sources that increased compared to baseline include employee commute, Metro's owned vehicles and equipment, and business travel. These increases were all in some way impacted by the significant increase in the number of Metro employees (full-time, part-time and temporary), which almost doubled between 2008 and 2017. Figure 3 compares the emissions included in Metro's Climate Goal between 2008 and 2017.

Figure 3: Comparison of Metro goal emissions by source over time

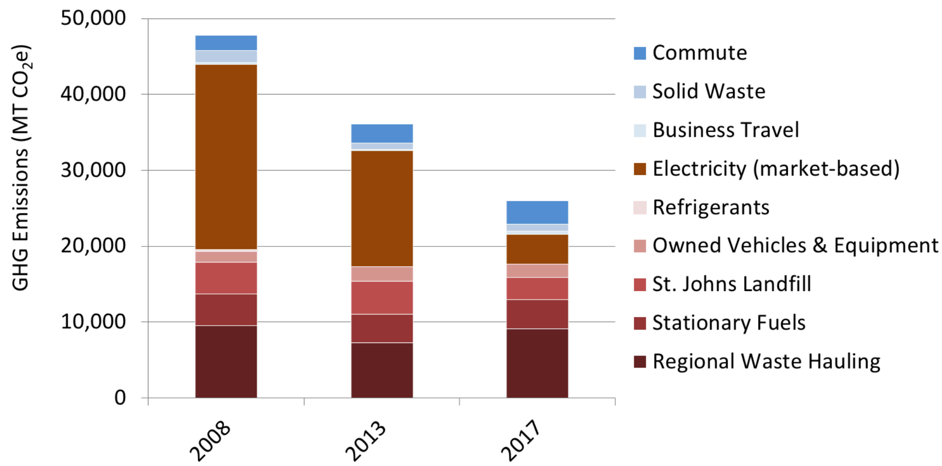
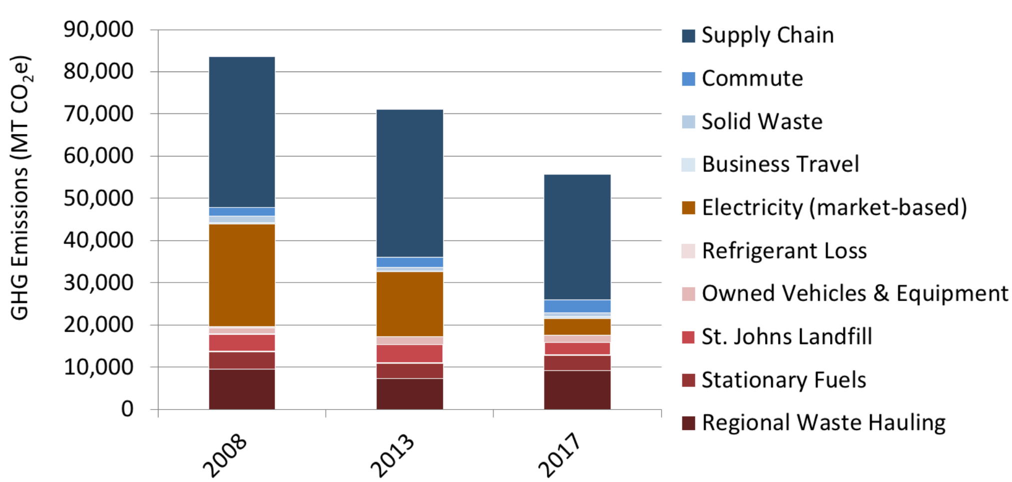


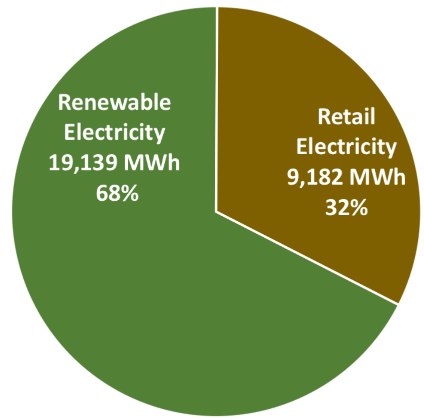
Figure 4 adds supply chain emissions to those included in Figure 3. Supply chain emissions have decreased over the time period. These decreases are primarily attributed to a reduction in upstream energy emissions associated with Metro's renewable energy purchases.

Figure 4: Comparison of total emissions by source over time



INVENTORY HIGHLIGHT — ELECTRICITY

Figure 5: Comparison of Metro-wide renewable versus retail electricity use



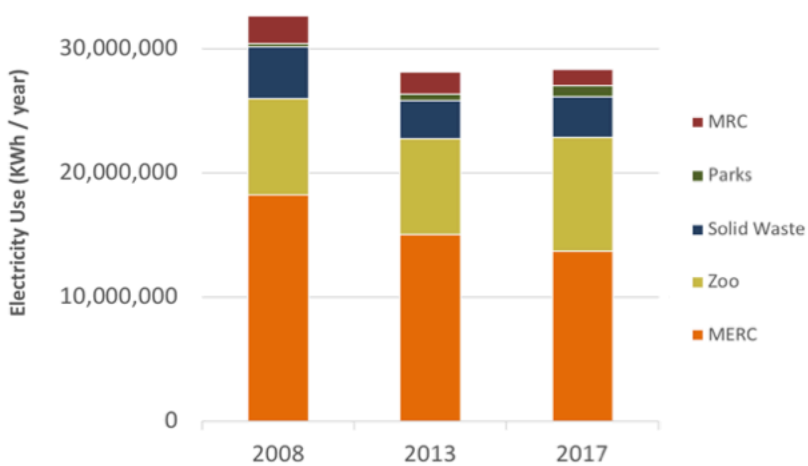
Metro's market-based electricity emissions have decreased by 84% between 2008 and 2017. This dramatic reduction was the result of two factors: the purchase of renewable electricity and implementation of energy efficiency projects.

Renewable Electricity

The most significant factor was Metro's commitment to the purchase of renewable electricity in the form of Renewable Energy Certificates (REC) from Portland General Electric (PGE) and PacifiCorp (PAC). Several Metro facilities had been purchasing RECs; in 2017, the Oregon Zoo began purchasing RECs for 100% of their electricity use, which substantially reduced Metro's emissions. In 2017, Metro consumed about 28 million kilowatt-hours (kWh). Figure 5 shows that, of this total, 68% was renewable and 32% was PAC's and PGE's average retail electricity product. According to Oregon Department of Environmental Quality reporting, the emissions intensity[9] of PAC's average retail electricity is 0.65 kg CO_2e / kWh, compared to 0.37 kg CO_2e / kWh for PGE. To maximize emissions reductions from future REC purchases, Metro should focus on purchasing RECs from PAC before purchasing from PGE. Specifically, REC purchases for Portland'5 venues and Metro Regional Center would have the greatest emissions reduction benefits.

Energy Efficiency

Figure 6: Metro-wide electricity use, by functional area for 2008, 2013, and 2017



The second factor contributing to the emissions decrease was Metro's reduction in the quantity of electricity consumed. Between 2008 and 2017, Metro reduced its organization-wide electricity use by 13%. Figure 6 shows that two functional areas represent 80% of Metro-wide electricity use: MERC and the Oregon Zoo. The majority of Metro's functional areas have decreased their electricity use by more than 20%. The two exceptions are the Oregon Zoo and Parks. Of these two, the Oregon Zoo had the largest increase, about 1.4 million kWh between 2008 and 2017, primarily due to the addition of new facilities. Parks electricity use increased by about 600,000 kWh between 2008 and 2017.

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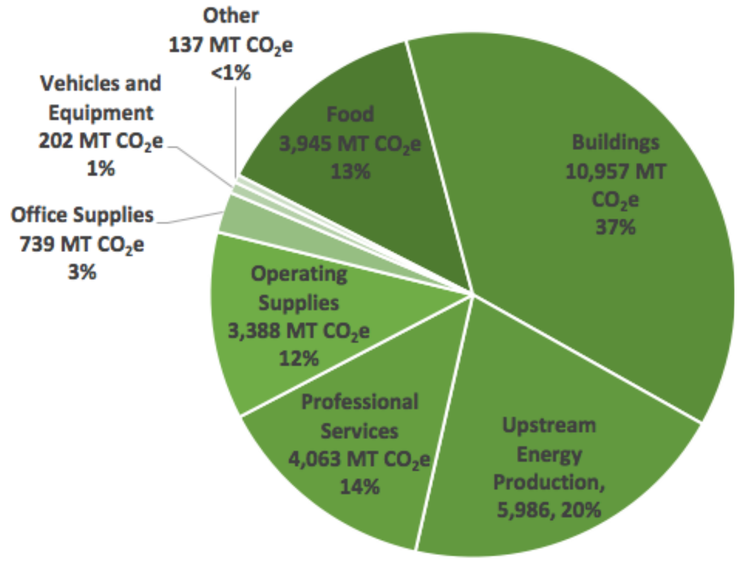
[9] A utility's emissions intensity (or emissions factor) is the quantity of GHG emissions produced to generate each unit of retail electricity (i.e., per kilowatt hour)

INVENTORY HIGHLIGHT – SUPPLY CHAIN

Metro's 2017 supply chain emissions were estimated at **29,700 MT CO_2e**, an amount greater than the rest of Metro's emissions combined. These emissions represent the upstream GHG impacts generated during raw material extraction, production, and transportation of purchased goods, energy, food, services, and waste disposal. While supply chain emissions are large in scale, they are very difficult to accurately track over time due to factors associated with accounting systems and data, as well as limitations related to the models used to estimate emissions. In addition, while Metro has choice in purchasing and can leverage its purchasing power to influence vendor practices, Metro's ultimate control over its vendors' emissions is limited. Due to these challenges, supply chain emissions are not included in Metro's quantitative emissions reduction target.

Metro acknowledges the scale of these emissions and is committed to continuing to include supply chain emissions in its GHG inventory and to establish specific supply chain targets. These targets will be informed by the findings from this GHG inventory, guidance from Oregon Department of Environmental Quality (DEQ), and best practices.

Figure 7: Metro-wide supply chain emissions by purchasing category



- **Building Construction (37%):** Includes the labor and materials in building construction, renovation and maintenance services.
- **Upstream Energy Production (20%):** Includes fuel extraction, refinement, and transport.
- **Professional Services (14%):** Includes various professional services such as accounting, advertising, legal, management consulting, employment, education, architecture and engineering, real estate, insurance, etc.
- **Food (13%):** Includes food purchased for resale (Oregon Zoo, MERC visitor venues), animal feed (Oregon Zoo), and, to a lesser extent, food served.
- **Operating Supplies (12%):** Includes general operating supplies as well as postage and delivery.
- **Office Supplies (3%):** Includes paper and printing, all other supplies commonly found in office settings, as well as information technology hardware, software, and services.
- **Vehicles and Equipment (1%):** Includes the purchase, rental, and maintenance of vehicles and equipment.
- **Other Goods and Services (<1%):** Includes "all other" goods and services not included in the first six categories that are not large enough to be grouped into a separate category. Examples of purchases in this category include: art, exhibits, permitting services, meetings, animal care, parking operations, grants, staff development, and education.

6. FUNCTIONAL AREA RESULTS

With supply chain emissions included, three functional areas generated 87% of Metro-wide total emissions: Solid Waste, MERC, and the Oregon Zoo. The emissions attributed to each of Metro's five functional areas are described below.

SOLID WASTE

In 2017, Solid Waste generated 14,107 MT CO_2e of non-supply chain emissions and a total of 20,607 MT CO_2e including supply chain, or roughly **36% of Metro's total operational emissions**. As can be seen in Figure 8, the majority of the Solid Waste functional area emissions came from Scope 1, those direct emissions over which Metro has the most control. This is in contrast to all the other functional areas where the majority of emissions came from indirect emissions sources (Scopes 2 and 3). Figure 9 shows that the largest sources of Solid Waste Scope 1 emissions were regional waste hauling, fugitive methane releases from St. Johns Landfill, and use of Metro-owned vehicles and equipment.

Figure 8: Solid Waste emissions as a share of total Metro operational emissions

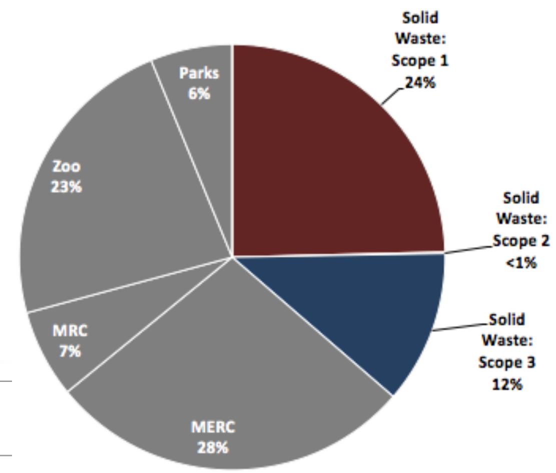
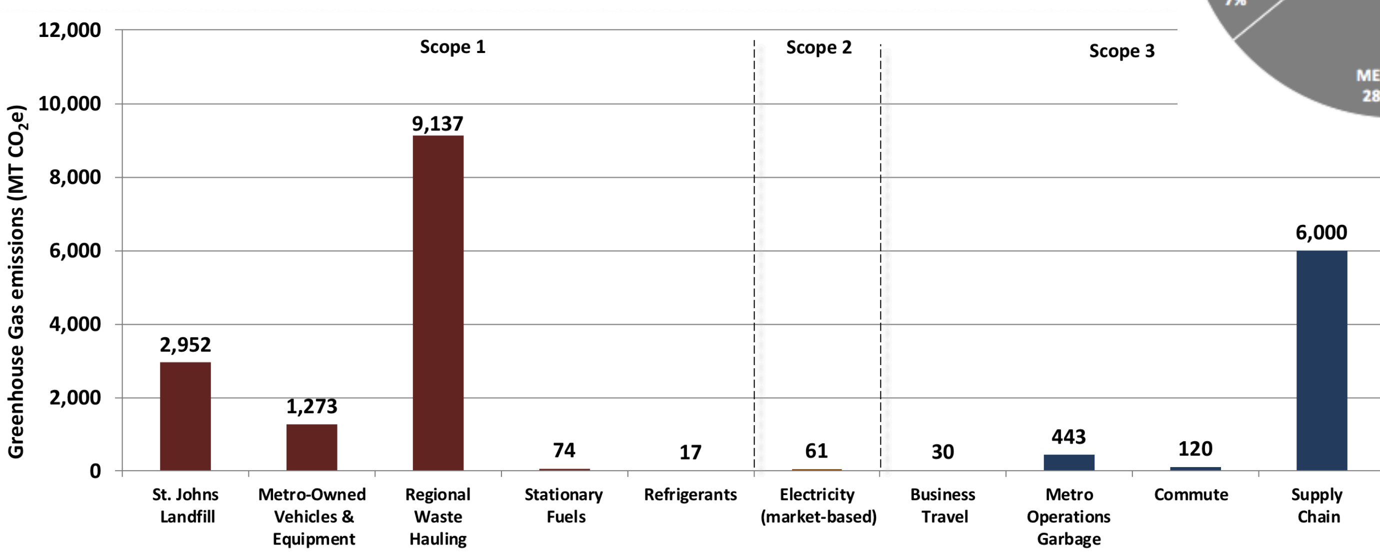
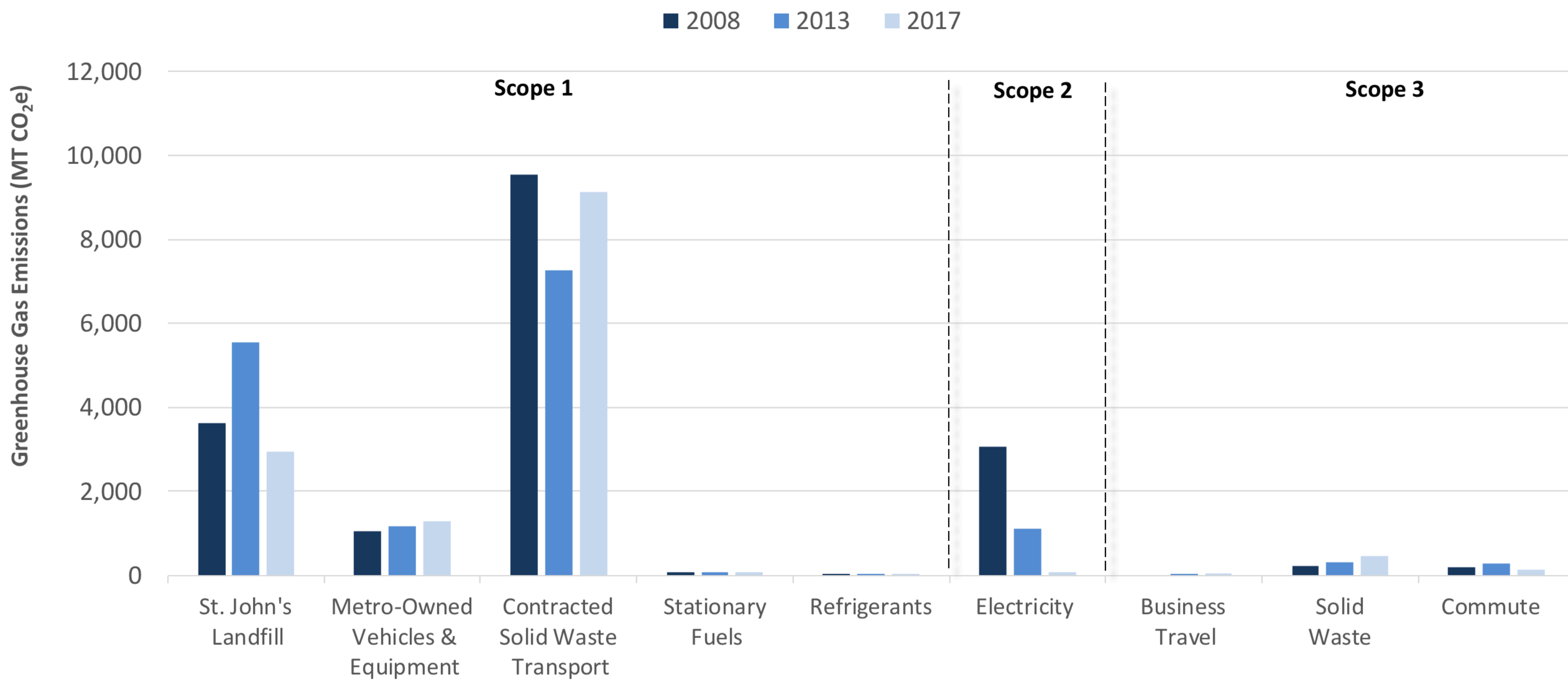


Figure 9: Solid Waste GHG emissions results by source and scope (2017)



Non-supply chain emissions from Solid Waste decreased by 21% between 2008 and 2017. See Figure 10 for details. In 2017, Solid Waste facilities were supplied by almost 100% renewable electricity through PGE's Clean Wind Program, significantly reducing these emissions. Solid Waste's largest source of emissions, Regional Waste Hauling, increased by over 25% between 2013 and 2017. This increase was likely correlated with an increase in regional economic activity and associated generation of solid waste. Methane emissions from St. Johns Landfill decreased as a result of the decline in the decomposition of landfilled material over time. Ash Grove Cement also purchased some landfill gas in 2017. Fuel use from Solid Waste's owned vehicles and equipment also increased as a result of increased quantities of solid waste being managed in Metro's owned transfer stations and other facilities over the time period.

Figure 10: Comparison of Solid Waste emissions by GHG inventory year, emissions source, and scope



Metropolitan Exposition Recreation Commission (MERC)

In 2017, MERC generated 5,823 MT CO_2e of non-supply chain emissions and a total of 15,723 MT CO_2e including supply chain, or roughly **28% of Metro's total operational emissions**.

The majority of MERC emissions came from indirect Scope 2 and Scope 3 emissions as shown in Figure 11. The three largest emissions sources for MERC were embodied emissions within purchased goods and services in the supply chain, electricity, and stationary fuels (primarily natural gas). Within supply chain the largest sources of emissions were associated with purchases related to building construction/maintenance and food.

Figure 11: MERC emissions as a share of total Metro operational

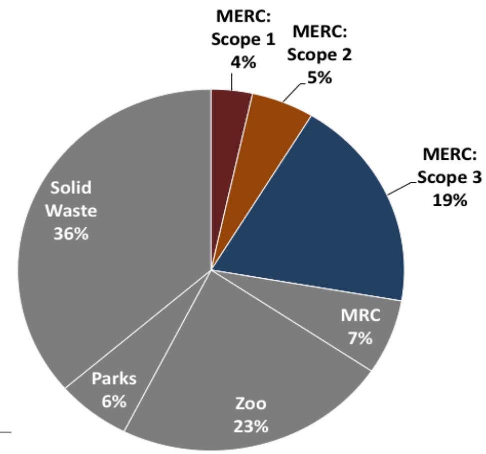
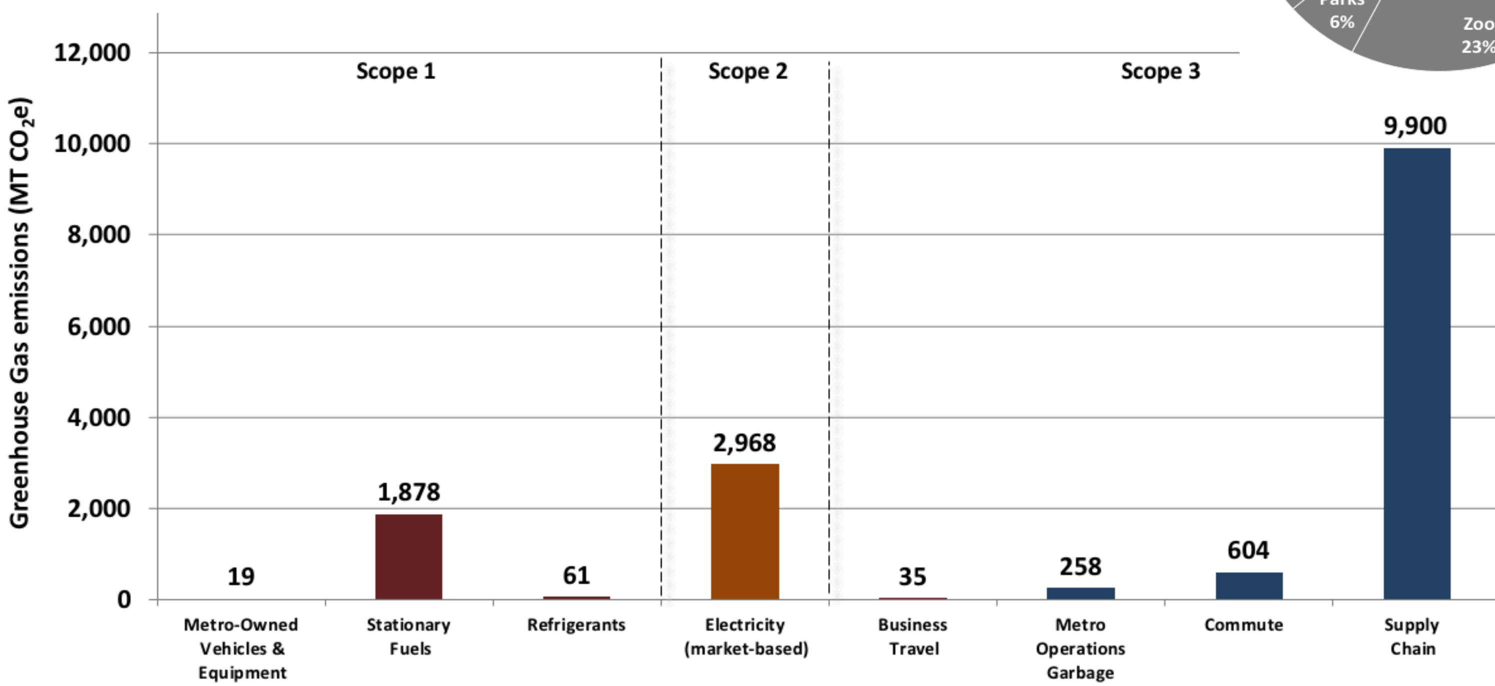
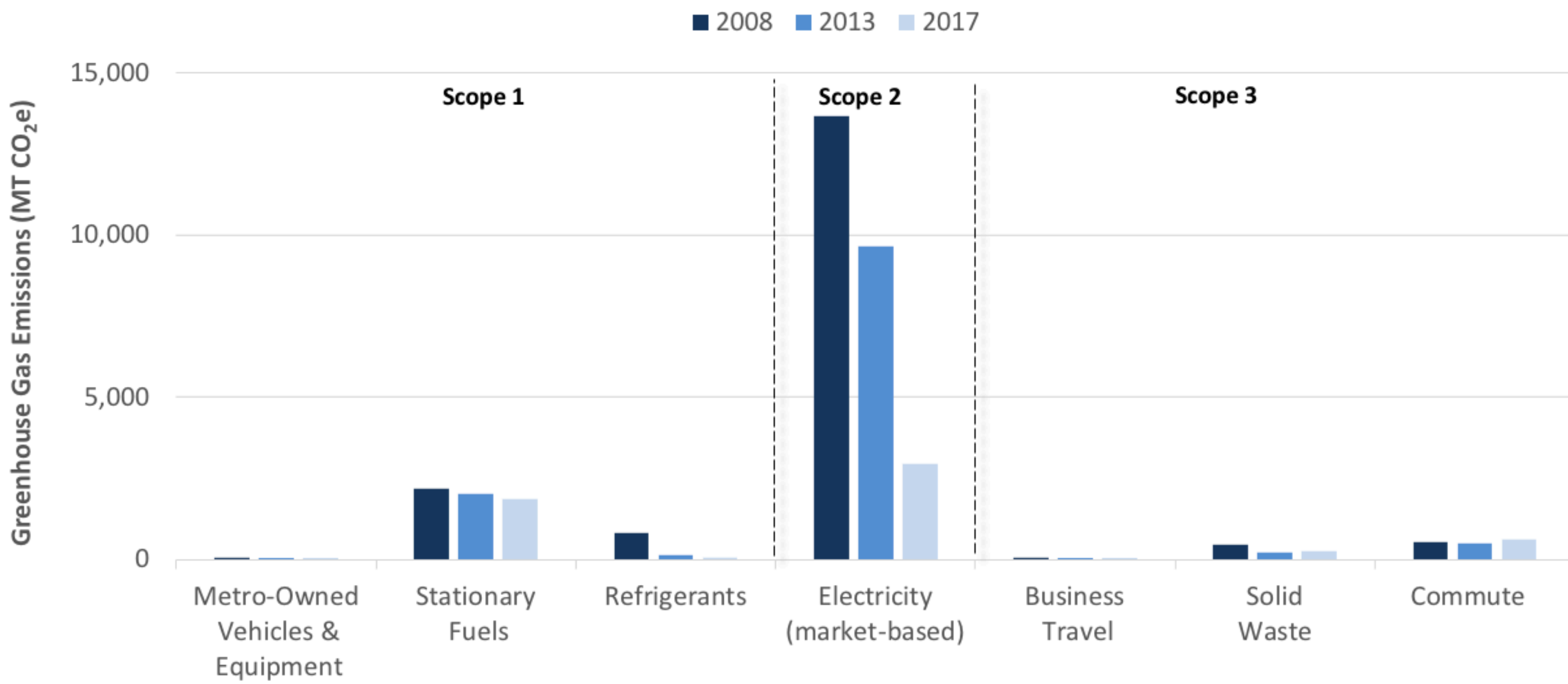


Figure 12: MERC greenhouse gas emissions results by source and scope (2017)



Overall, Metro's non-supply chain emissions from MERC venues decreased by 67% from 2008 to 2017. MERC's largest emissions source has been, and continues to be, electricity, but MERC facilities have made great strides in reducing electricity emissions with a combination of efficiency projects, such as LED lighting upgrades and HVAC upgrades, and purchasing renewable energy. In 2017, MERC facilities sourced 47% of total electricity from renewable electricity generation, including generation from the 2MW solar photovoltaic system installed at the Oregon Convention Center. Efficiency projects also reduced stationary energy use (i.e., natural gas) and emissions. Other sources of emissions for MERC were also reduced or steady compared to previous inventories, with the exception of employee commute.

Figure 13: Comparison of MERC emissions by GHG inventory year, emissions source, and scope



OREGON ZOO

In 2017, Oregon Zoo generated 4,376 MT CO_2e of non-supply chain emissions and a total of 13,176 MT CO_2e including supply chain, or roughly **23% of Metro's total operational emissions**.

The majority of Oregon Zoo emissions came from Scope 1 and Scope 3 sources, as shown in Figure 14. The three largest emissions sources for the Oregon Zoo were embodied emissions within purchased goods and services in the supply chain, employee commute, and stationary fuels (primarily natural gas). Historically, electricity emissions have been the Oregon Zoo's largest source, but in 2017, 100% of the Oregon Zoo's electricity was sourced from owned or contracted renewable energy generation. Within supply chain, the largest sources of emissions were associated with purchases related to building construction/maintenance and food.

Figure 14: Oregon Zoo emissions as a share of total Metro operational emissions

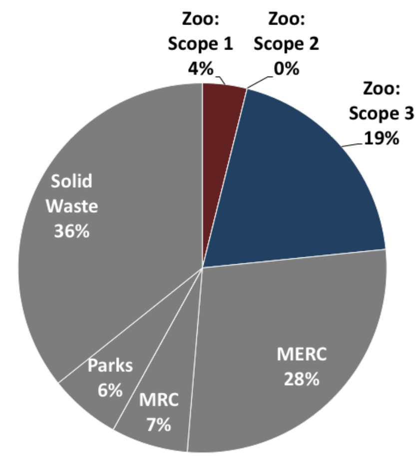
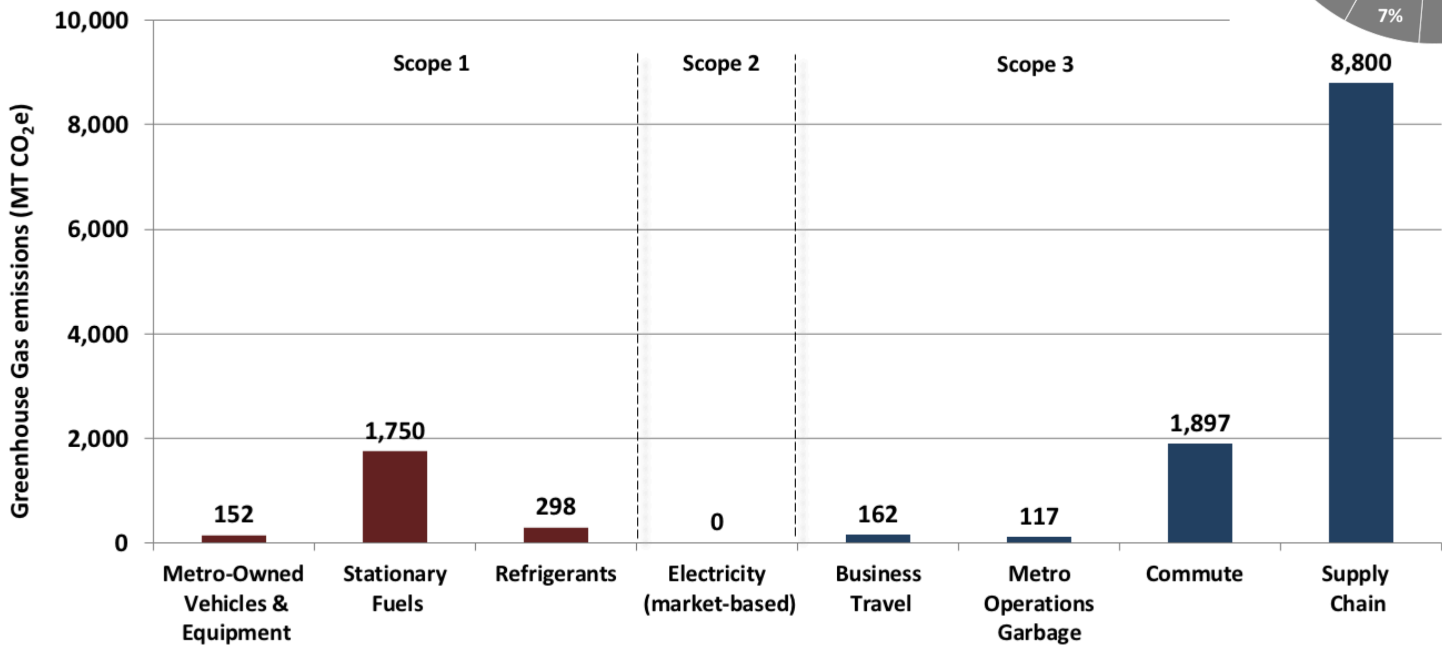
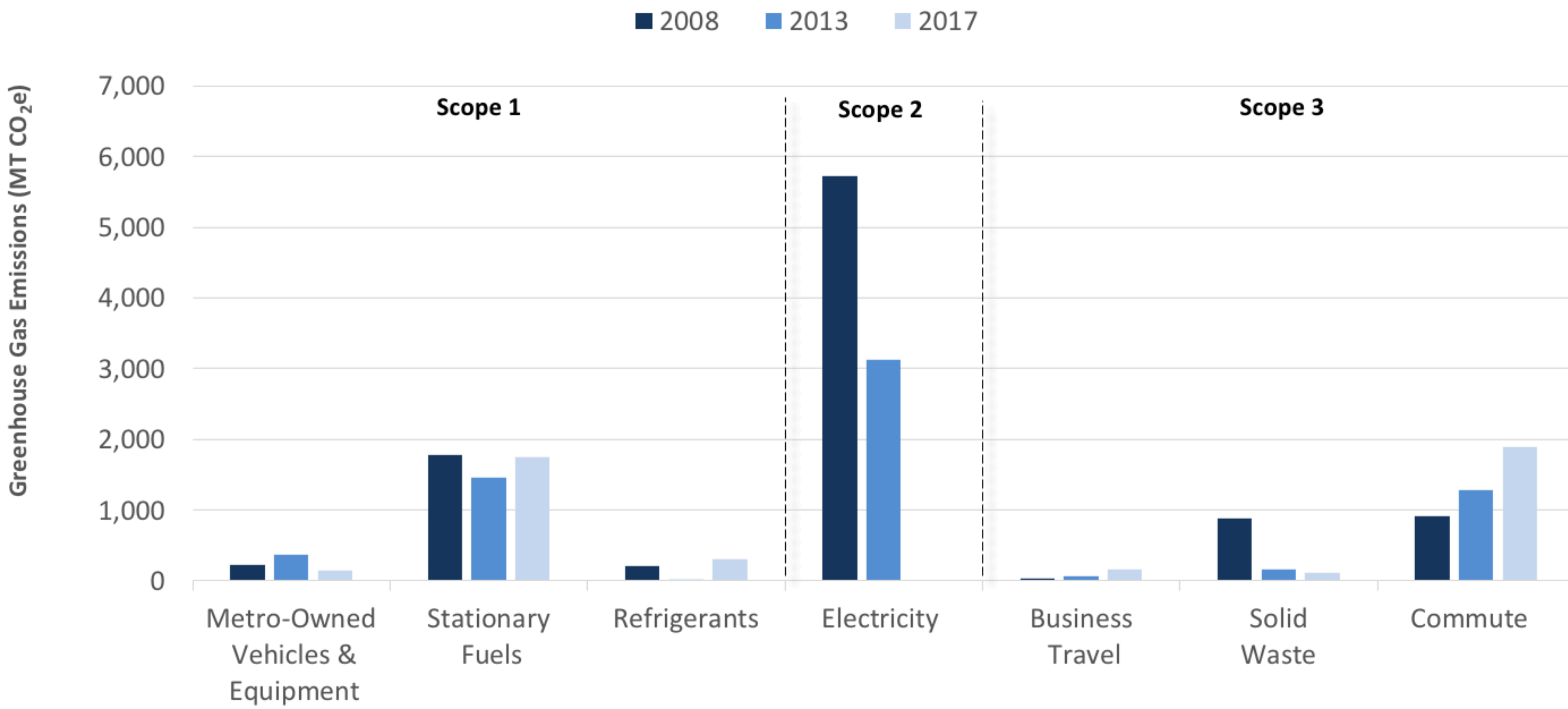


Figure 15: Oregon Zoo greenhouse gas emissions results by source and scope (2017)



Non-supply chain emissions from Oregon Zoo venues decreased by 57% between 2008 and 2017. See Figure 16 for details. All of the Oregon Zoo's electricity was supplied by renewable electricity. The majority of renewable energy was purchased through PGE's Clean Wind Program, with about 3% of the Oregon Zoo's electricity load generated by owned, onsite solar PV installations. Other sources of emissions for the Oregon Zoo were also reduced or steady, including owned vehicle and equipment fuel use and landfilled solid waste. The Oregon Zoo also had two sources of emissions that significantly increased between 2013 and 2017: employee commute and stationary fuel use. Employee commute emissions have steadily grown with the number of full-time, part-time and temporary Oregon Zoo employees.

Figure 16: Comparison of Oregon Zoo emissions by GHG inventory year, emissions source, and scope



METRO REGIONAL CENTER (MRC)

In FY 2017, Metro Regional Center generated 1,291 MT CO_2e of non-supply chain emissions and a total of 3,791 MT CO_2e including supply chain, or roughly **7% of Metro's total operational emissions**.

The majority of MRC emissions came from indirect sources (Scopes 2 and 3). The largest emissions sources for MRC were embodied emissions within purchased goods and services in the supply chain, electricity, and employee commute. Supply chain emissions were dominated by purchase of professional services, operating supplies, and building construction/maintenance. In 2017, MRC purchased 30% renewable electricity.

Figure 17: MRC emissions as a share of total Metro operational emissions

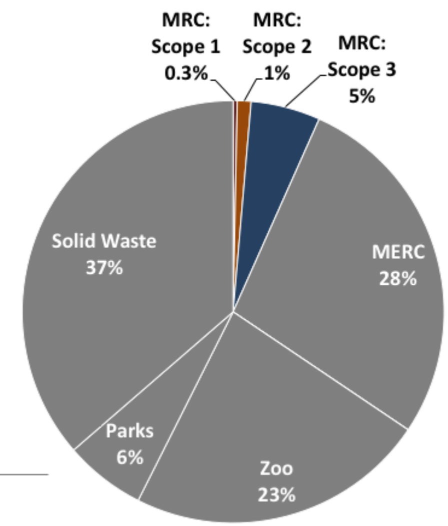
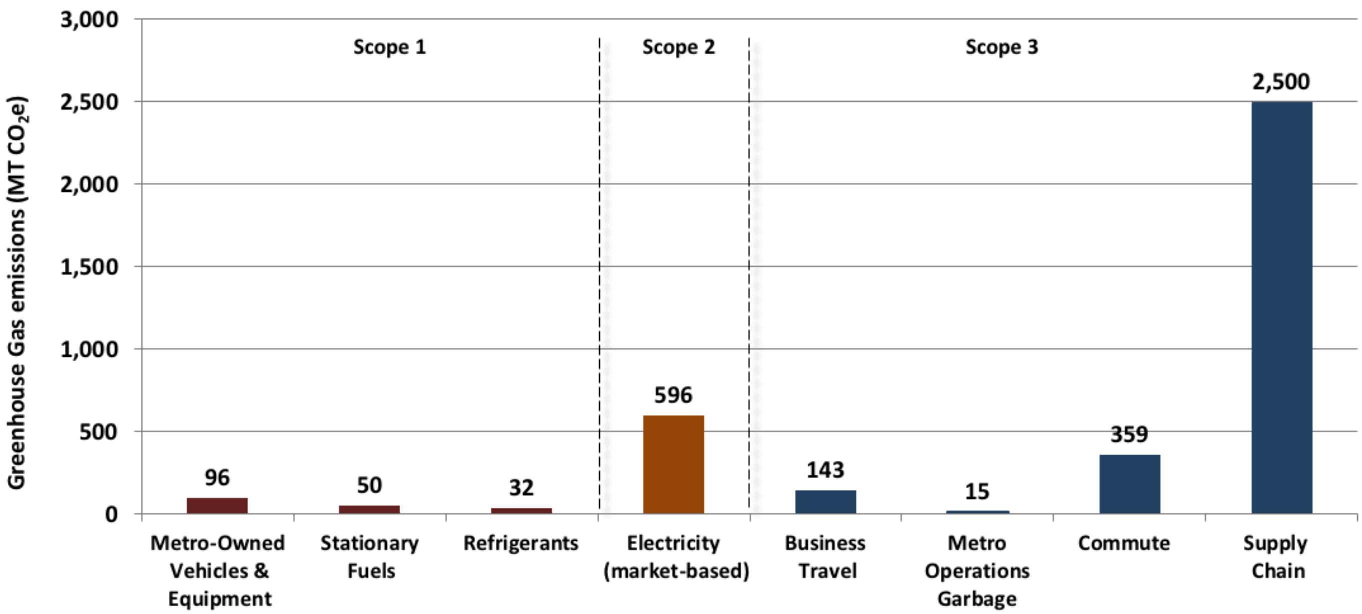
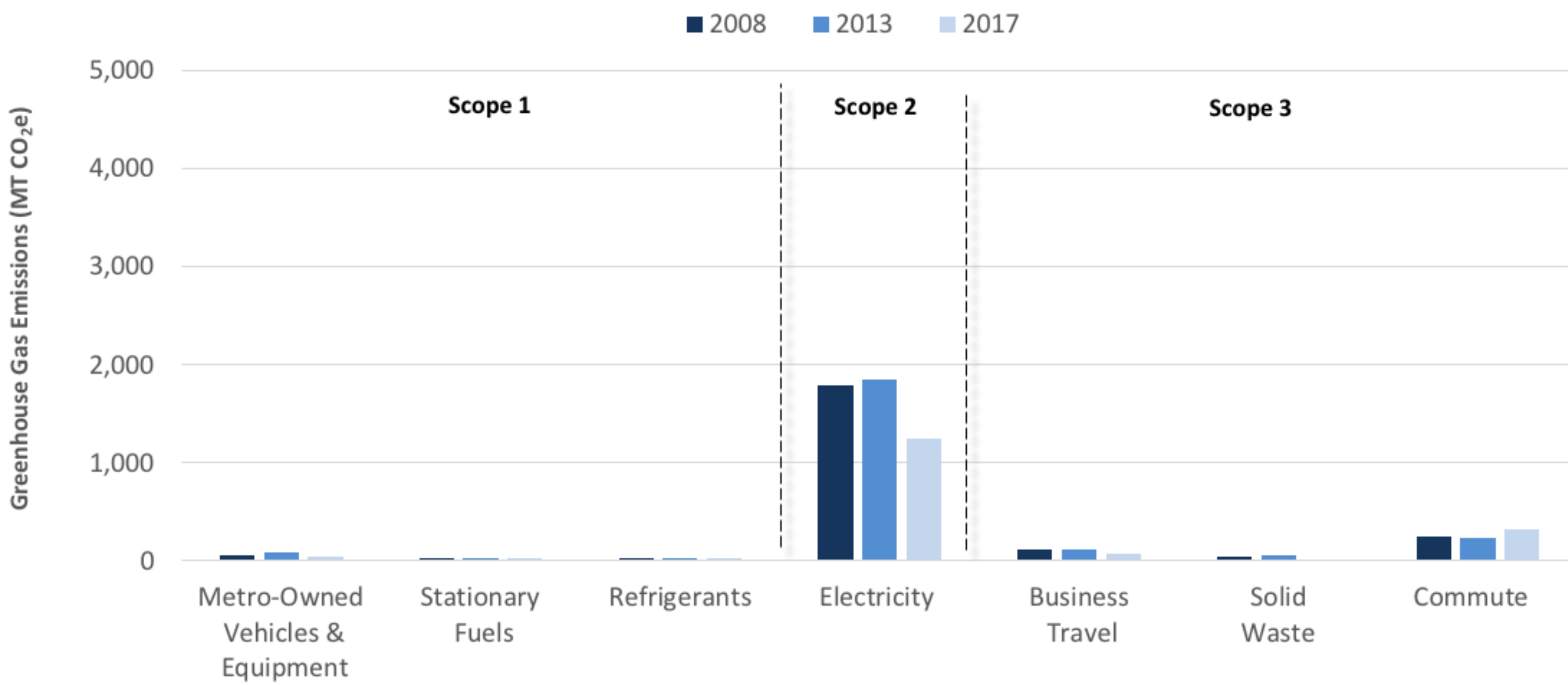


Figure 18: MRC greenhouse gas emissions results by source and scope (2017)



Non-supply chain emissions from MRC decreased by 43% between 2008 and 2017. See Figure 19 for details. In 2017, electricity continued to be MRC's largest source of emissions, surpassing Metro-owned vehicles and equipment. The other significant and growing source of emissions for MRC was commute.

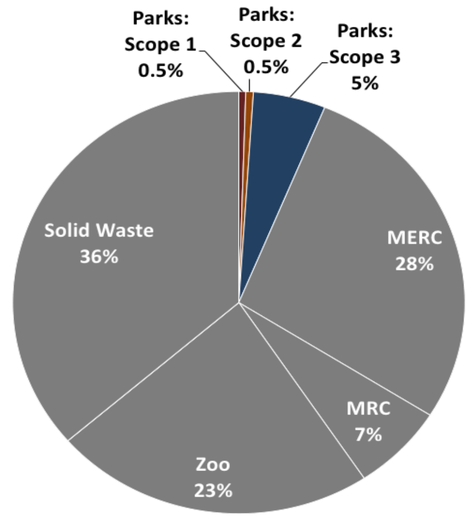
Figure 19: Comparison of MRC emissions by GHG inventory year, emissions source, and scope



Regional Parks

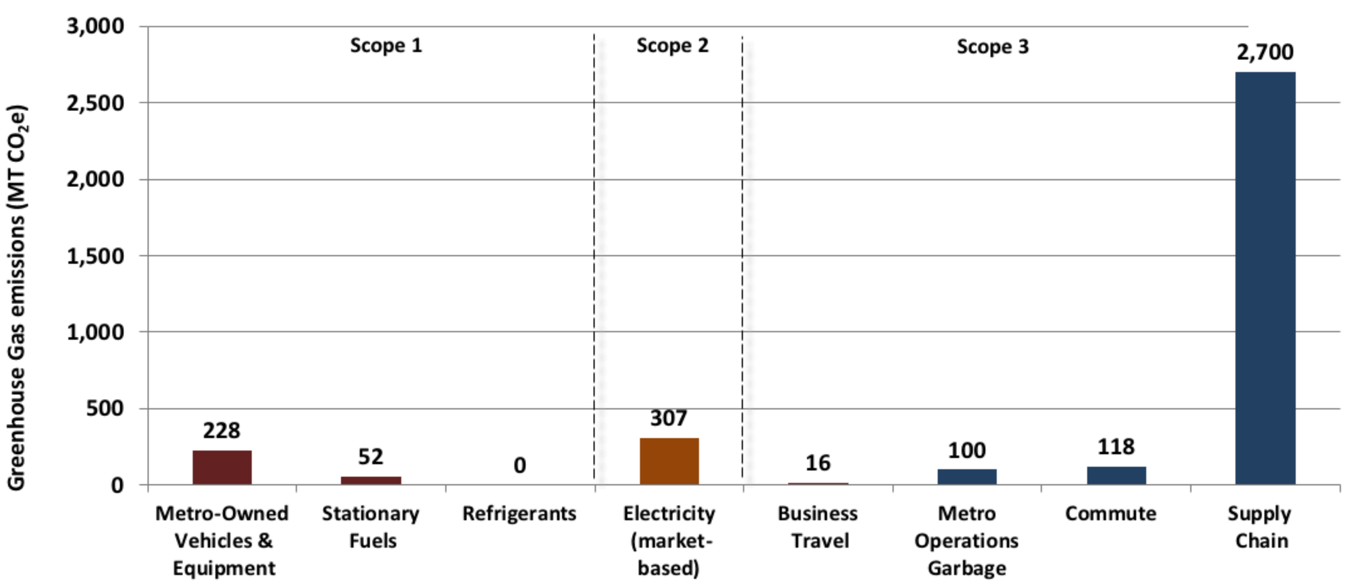
In 2017, Regional Parks generated 821 MT CO_2e of non-supply chain emissions and a total of 3,521 MT CO_2e including supply chain, or roughly **6% of Metro's total operational emissions**.

Figure 20: Parks emissions as a share of total Metro operational emissions



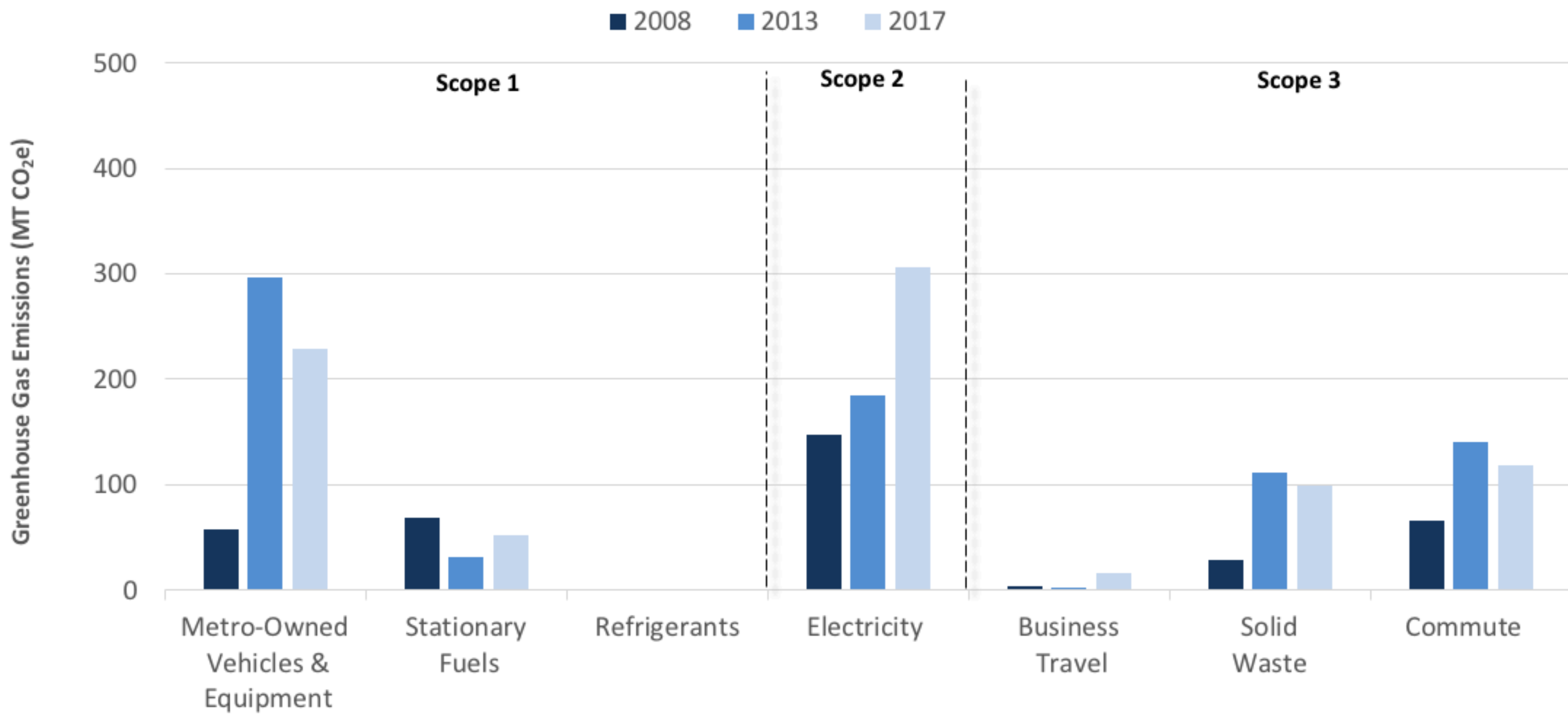
As can be seen in Figure 21, the majority of the Parks emissions were from supply chain, followed by electricity and owned vehicles and equipment. Within supply chain the largest category was building construction/maintenance.

Figure 21: Regional Parks greenhouse gas emissions results by source and scope (2017)



Non-supply chain emissions from Regional Parks increased by 20% between 2008 and 2017. See Figure 22 for details. In 2017, electricity became Park's largest source of emissions, surpassing Metro-owned vehicles and equipment. Vehicle and equipment fuel use by Parks decreased between 2013 and 2017. Note that the difference in Parks fuel use between 2008 and 2013 is attributable to data gaps in 2008 that were addressed in 2013, rather than a significant increase in fuel use. Other sources of Parks emissions were less or similar in 2017 compared to 2013.

Figure 22: Comparison of Regional Parks emissions by GHG inventory year, emissions source and scope



APPENDIX A: METHODS, DATA PROTOCOLS, AND SENSITIVITY ANALYSIS

Methods and data used in the inventory are documented in electronic files of Good Company's Carbon Calculator (G3C) and the 2017 Inventory Audit Trail. A version of G3C was created for each of Metro's functional areas, which contains detailed data and emissions results beyond what is included in the report. The Audit Trail is a cataloged folder containing all the raw data and related calculation files used in the inventory. Combined, these data sources provide detailed documentation for the inventory and provide guidance for conducting future inventories.

PROTOCOLS AND TOOLS

Metro's operational GHG inventory follows The Local Government Operations Protocol v1.1 (LGOP)[10] for Scope 1 and Scope 2 emissions sources, as well as guidance, best practices, tools and models from a variety of other sources including: World Resource Institute's (WRI) Scope 2 Guidance, EPA's Climate Leaders, EPA's Waste Reduction Model (WARM), and Oregon Department of Environmental Quality's (DEQ) Purchaser Price Model.

Good Company's Carbon Calculator v4.0 (G3C) was used to calculate all GHG emissions for Metro's operations. G3C follows the standards set by the LGOP Protocol in its methodology and calculation of emissions. Calculations in G3C are fully transparent and include an audit trail that includes all data and resources used in the inventory.

This inventory includes the "Kyoto gases:" carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3) and hydrofluorocarbons (HFCs). Metro does not use PFCs, NF_3 or SF_6; therefore, those gases are not included. In general, direct and indirect CO_2-equivalent (CO_2e) emissions consist of CO_2 from the combustion of fossil fuels. All operational GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). Quantities of individual GHGs are accounted for in the G3C file used to calculate emissions for this GHG inventory. The GHG calculations use the global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

METHODS

The methods used in this inventory follow previously stated GHG inventory protocol and guidance that was documented in Metro's 2013 GHG Inventory Report[11] with the exception of the items described below.

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[10] For details visit:
https://www.theclimateregistry.org/tools-resources/reporting-protocols/local-goverment-operations-protocol/

[11] For details visit:
https://www.oregonmetro.gov/sites/default/files/2014/04/18/12012013_greenhouse_gas_emissions_inventory_internal_2012-13.pdf

General Information

- For the 2017 report, square footage of some sites was revised to accurately reflect only conditioned building space. For example, square footage for the driving range at Glendoveer Golf Course driving range was excluded.
- Scouters Mountain was a new park opened by Metro in 2014.
- Oregon Department of Environmental Quality (ODEQ) has begun providing utility-specific emissions factors for Portland General Electric and PacifiCorp since the 2013 inventory. These factors were used in Market-based electricity accounting.
- Purchase of renewable energy certificates began after the 2013 inventory. These purchases were accounted for in Market-based electricity accounting.
- Renewable energy generation at Oregon Convention Center, Oregon Zoo, and Glendoveer Golf and Tennis came online after the 2013 inventory.

Stationary Fuels

Methodology for this emissions source was the same as in the 2013 report, with the following exceptions:

Propane

- Blue Lake Regional Park data for propane was available for this report.

Stationary Diesel

- Blue Lake Regional Park data for stationary diesel was available for this report.

Electricity

Since the 2013 GHG inventory, significant new guidance (Scope 2 Guidance[12]) was developed and adopted by all major GHG inventory protocols. This guidance recommends using two distinct accounting methodologies to calculate electricity-related emissions.

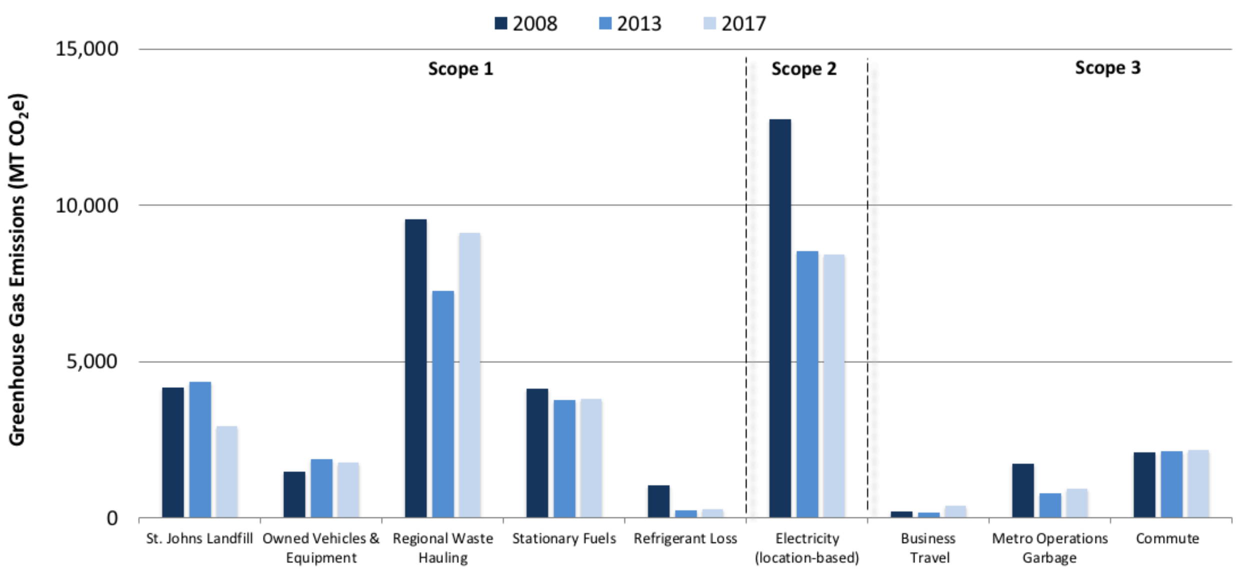
- **Location-based method** (or regional grid) multiplies an organization's electricity use by the average emissions intensity of a specific regional electricity grid that is published by the Environmental Protection Agency (eGRID 2016). Note that differences in 2013 emissions results between the 2013 and 2017 inventories are due to the use of an updated eGRID emissions factor for 2013.
- **Market-based method** (or utility-specific) represents emissions from the electricity procurement contracts that an organization has purposefully chosen. For many, these

[12] For details visit http://www.ghgprotocol.org/scope_2_guidance.

contracts are with the local electric utility that provides service. Other choices could include selection of a specific electricity utility (in markets with more than one); contracting with a specific supplier (in a Power Purchase Agreement); or the purchase of renewable energy certificates. This accounting method multiplies electric purchases by the emissions factors for specific "contractual instruments" that convey the "environmental attributes" from a specific electricity supplier to the purchaser. This method allows organizations to account for the benefit associated with renewable electricity purchases.

The Scope 2 Guidance recommends using the Market-based Method for goal tracking. For sensitivity analysis, Figure 23 is provided to compare location-based results to market-based results (Figure ES-4). This comparison is also presented in Table 4.

Figure 23: Year-over-year emissions comparison by source and scope (using location-based electricity accounting)



Business Travel

During the previous inventories, business travel data were challenging and disproportionately time consuming to collect. Because business travel has historically been Metro's smallest source of emissions in its quantitative target (about 1% depending on the year), a streamlined method was employed during this inventory. This method used readily available financial data for air travel-related expenses (air travel $ in 2017). These data ($/year) were multiplied by a conversion factor (passenger miles / $) to estimate passenger miles. Air travel emissions were calculated from passenger miles using the 2013 GHG inventory methodology.

Metro Operations Landfilled Solid Waste

Data collection was similar for this report as it was for prior reports, except data for Glendoveer Golf and Tennis and St. Johns Landfill were available for the entire year, as opposed to six months in previous inventories.

Commute

Following the methodology used in previous Metro inventories, commute emissions were calculated using a straight headcount, which consists of total Metro full-time, part-time, and temporary employees. Employee headcount almost doubled between 2008 and 2017. Metro Human Resources staff provided a weighted average number of work days, by functional area for the employee headcount. This weighted average accounted for the fact that part-time and temporary employees do not commute to work the same number of days as full-time staff. Miles traveled were calculated by multiplying the number of trips times the average commute distance by functional area that was calculated for the 2013 inventory. Modal split for employee commute was taken from available commute surveys already conducted by Metro. These surveys were not comprehensive – gaps exist for some facilities. These gaps were filled using 2013 modal split values as a proxy for 2017.

Supply Chain: Embodied Emissions in Purchased Goods and Services

A life-cycle GHG analysis using Metro 2017 financial data combined with emissions coefficients from ODEQ's *Purchaser Price Model* was conducted for all Metro purchases, including goods, food, and services. This analysis estimated the upstream GHG emissions generated by raw material extraction, production, and transportation of goods and services, and associated waste disposal, up to the point of product purchase.

The most significant methodological change to the supply change analysis was the substitution of Oregon's *Purchaser Price Model* for Carnegie Mellon's *Economic Input-Output Lifecycle Assessment Model* (EIO-LCA).[13] ODEQ's model was substituted for two reasons: 1) it is based on a more recent data set (2010 vs. 2002); and 2) emissions coefficients are specific to Oregon versus the U.S. averages contained in EIO-LCA.

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[13] Green Design's Economic Input-Output Life Cycle Assessment is a free online tool available online at www.eiolca.net.