Climate Action Plan 2.0

Appendix 6

Eugene Community Greenhouse Gas Inventory: Sector-Based Inventory for 2010 - 2017, Consumption-Based Inventory for 2013

Eugene, Oregon
Community Greenhouse Gas Inventory
Sector-Based Inventory for 2010 – 2017
Consumption-Based Inventory for 2013

Report prepared by Good Company, January 2019

INTRODUCTION

A greenhouse gas (GHG) inventory quantifies the GHG emissions associated with a specific boundary – such as operational control within an organization or the geographic boundary of a community – for a specific period of time. By conducting inventories at regular intervals, community stakeholders can understand trends and manage emissions from specific sources and activities. The results of Eugene's GHG inventories are being used to support a 2019 update of the Eugene community's Climate Action Plan (CAP2.0) and provides the foundation for a GHG emissions tracking and management system related to the City's Climate Recovery Ordinance (No. 20567).

FINDINGS IN BRIEF

- Fossil Fuel Use
    - Eugene's 2017 fossil fuel use totals 13.5 million British thermal units (MMBTU)[1]. The largest fossil fuel sources used in the community include gasoline/diesel use (55%) and natural gas (39%). Smaller sources include fossil fuels used to generate electricity (4%) and other fuels, including propane and fuel oil (2%).
    - Eugene's total community fossil fuel use has *decreased* by 6% since 2010.
    - On a per capita basis, emissions have *declined* by 13%, while total population has increased by 7%.
- Sector-based Greenhouse Gas Emissions (local emissions)
    - Eugene's 2017 sector-based GHG emissions total **1.01 million MT CO_2e** using market-based electricity emissions.[2]. The largest sources of community emissions include passenger and freight transportation (53%) followed by commercial energy (22%) and residential energy use (10%). See page 9 for more details.
    - Eugene's sector-based GHG emissions have *decreased* by 4% since 2010 using market-based electricity emissions.
    - On a per capita basis, emissions have *declined* by 11%, while total population has increased by 7%.
- Consumption-based GHG Emissions (local emissions + imported emissions)
    - Eugene's consumption-based emissions estimate, which includes production emissions for imported goods, foods and services consumed in Eugene, totals **2.75 million MT CO_2e** using market-based electricity accounting.[3]

[1] A British thermal unit (BTU) is the amount of heat needed to raise one pound of water one-degree Fahrenheit. Reporting in a common energy unit is required as fossil fuels come in various, incompatible volumetric units (gallons for gasoline, or cubic feet for natural gas).

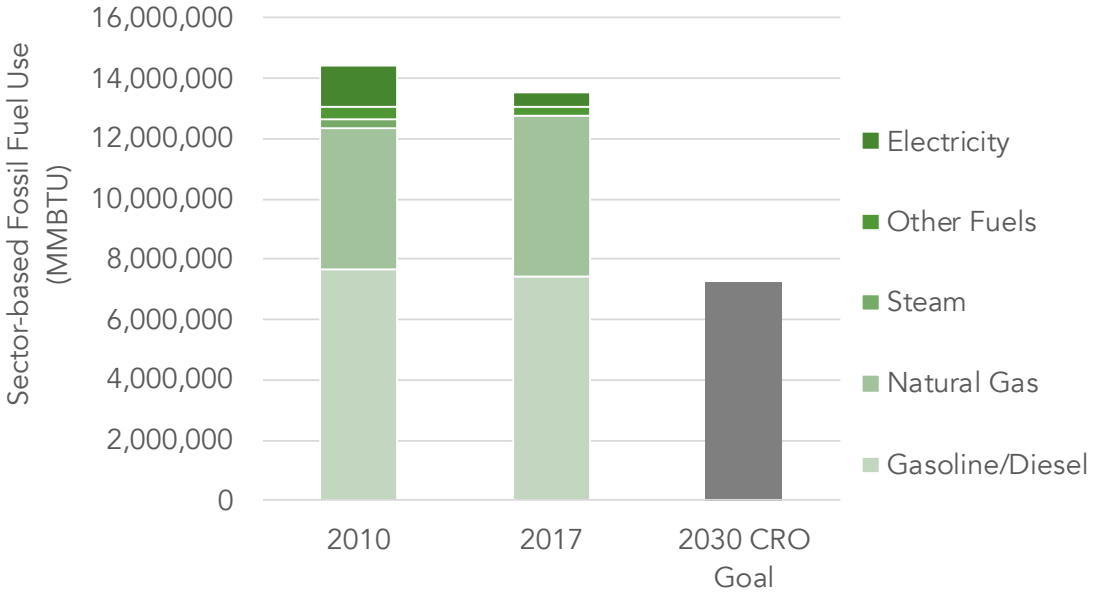
[2] Eugene's sector-based GHG emissions total **1.71 million MT CO_2e**. using location-based electricity accounting. The largest sources include commercial energy use (37%) followed by passenger and freight transportation (31%) and residential energy use (23%). See page 9 for more details about market- and location-based electricity accounting.

[3] Eugene's consumption-based emissions using location-based electricity accounting equal **3.45 million MT CO2e**.

PROGRESS TOWARDS FOSSIL FUEL CRO FOSSIL FUEL TARGET

Between 2010 and 2017, the Eugene community's fossil fuel use has *reduced* by 6%. This reduction from the 2010 baseline was achieved while population *increased* by 7% over the same period. *Per-capita* fossil fuel use has *reduced* by 13% between 2010 and 2017.

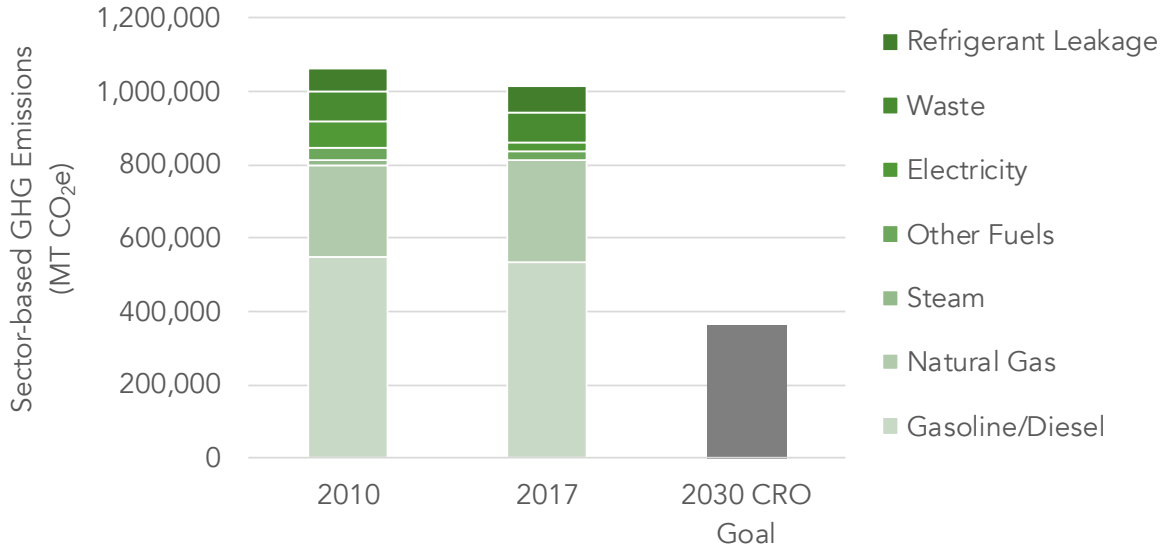
Figure 1: Comparison of 2010 (target baseline) and 2017 fossil fuel use to 203 0 CRO target.



PROGRESS TOWARDS CRO SECTOR-BASED GREENHOUSE GAS GOALS

Between 2010 and 2017, the Eugene community's GHGs have been *reduced* by 3% using market-based electricity accounting. This reduction from the 2010 baseline was achieved while population *increased* by 7% over the same period. *Per-capita* GHGs have *reduced* by 10% between 2010 and 2017.

Figure 2: Comparison of 2010 and 2017 GHGs to 2030 CRO GHG goal.

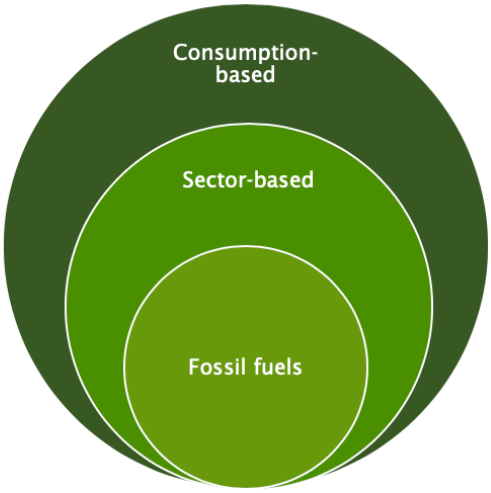


INVENTORY APPROACH

This inventory documents the community of Eugene, Oregon's greenhouse gas emissions (GHGs) for calendar year 2017, with historical data for 2010 through 2015. There was no inventory conducted for 2016. Inventory results are presented using two types of inventory methodologies: Sector-Based and Consumption-Based.

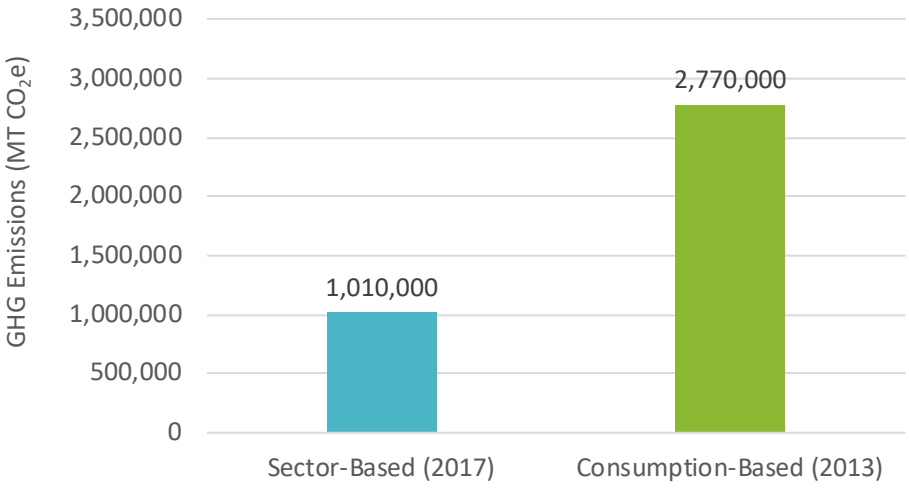
- *Sector-based emissions inventories* (local emissions) include emissions from energy use by homes, businesses, and vehicles as well as emissions from landfilling solid waste and wastewater treatment. GHG emissions from **fossil fuels** are the largest component of the community's Sector-based GHG emissions and have reduction targets in the CRO.
- *Consumption-based emissions inventories* include local, sector-based emissions and also include emissions that are generated during production and delivery of imported goods; energy and food consumed within the Eugene community; and exclude emissions from local production that are exported.

Figure 3: Nested relationship between CRO goals and related inventory work.



These two inventory types together offer a more comprehensive view of the Eugene community's GHG emissions. The community has greater control over sector-based emissions sources, as well as better data, which is why this accounting methodology is most often used to set emissions reduction goals. Consumption-based emissions from the production of imported goods, food, energy, and services are more difficult to measure and track, but when accounted for, make up a significant portion of the community's emissions. Figure 4 compares community emissions using sector-based and consumption based GHG accounting methodologies.

Figure 4: Comparison of 2017 Sector-Based and 2013 Consumption-Based Emissions.



SECTOR-BASED INVENTORY (LOCAL EMISSIONS)

Eugene's sector-based emissions inventory (SBEI) totaled ~**1.0 million metric tons** of carbon dioxide equivalent (MT CO_2e)[4] for calendar year 2017. These emissions are summarized on Figure 5 and use market-based electric emissions accounting. Figure 6 shows community sector-based emissions as calculated using location-based electricity accounting which total **1.7 million MT CO_2e**. *(See page 9 for discussion of electricity-related emissions including location-based and market-based accounting methods).*

Figure 8 (on page 7) details Eugene's Sector-Based emissions for 2017 showing a 10% *reduction* compared to 2010. Eugene's per capita emissions *declined* by 16% as population increased by 7%.

Emissions from the residential, commercial, and industrial (RCI) sectors are dominated by natural gas and electricity use. Electricity use (kilowatt-hours consumed) increased by 2.3% between 2010 and 2017, notably slower than population growth. Electricity emissions, however, *decreased* by 21% due to an increase in the share of low-carbon intensity electricity production on our regional electricity grid to hydroelectric and wind generation. During this period, total natural gas use and the associated emissions *increased* by 13%. The residential sector led the increase, which is attributed to population growth and a colder winter in 2017.

Figure 5: Eugene 2017 emissions by sector
(using market-based electricity accounting)

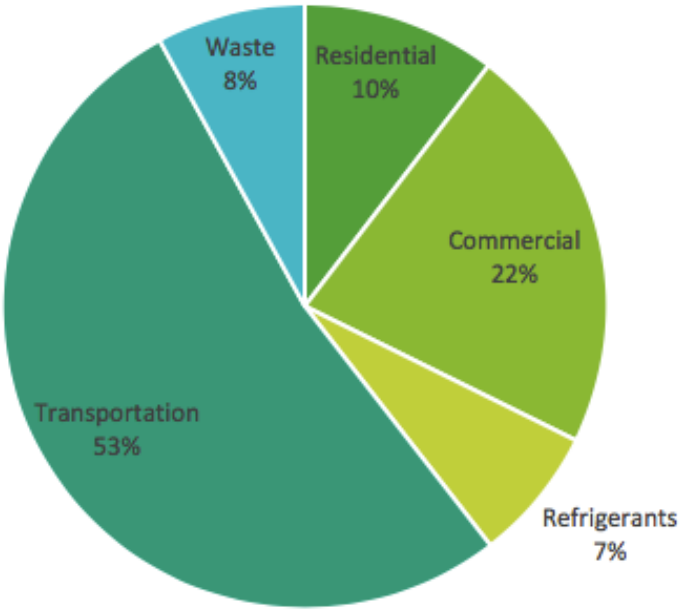
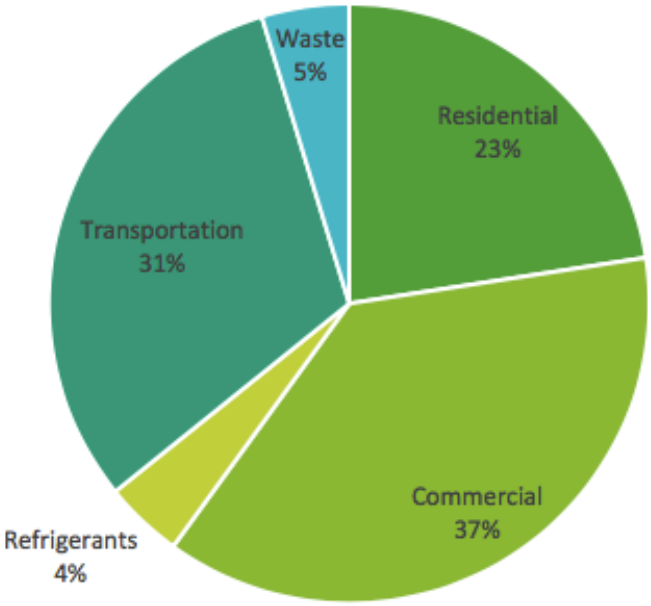


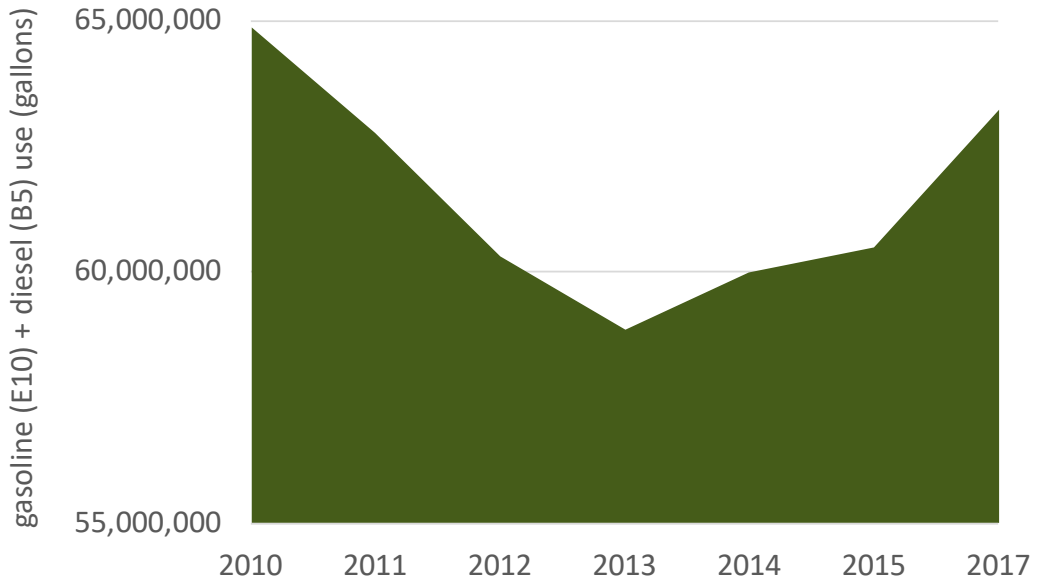
Figure 6: Eugene 2017 emissions by sector
(using location-based electricity accounting)



[4] Metric tons of carbon dioxide equivalent (MT CO_2e) is the international standard unit for measurement and reporting of greenhouse gas emissions.

Transportation emissions are primarily from the combustion of gasoline (E10) and diesel (B5) fuels in local, on-road passenger and freight vehicles as well as off-road equipment.[5] Use of transportation fuels and the associated emissions decreased by 3% between 2010 and 2017. But since 2013, the emissions have shown a rapid increase almost returning to 2010 levels, as shown on Figure 7.

Figure 7: Comparison of vehicle fuel use in Eugene between 2010 and 2017.



Solid waste emissions, as reported by Lane County for Short Mountain Landfill, decreased by 4% compared to 2010. Refrigerant emissions, calculated for Eugene based on Oregon per capita values, increased by 20% between 2010 and 2017.

[5] Oregon's Renewable Fuel Standard requires that all motor gasoline (with limited exceptions) is E10 (10% ethanol and 90% gasoline). Diesel fuel is required to be B5 (5% biodiesel and 95% diesel).

Figure 8: Detailed summary of Eugene's 2010–2015 and 2017 GHG sector-based emissions by sector and energy type. *Note – This table includes emissions using two accounting methods for electricity – Location-based and Market-based. These two methods are described in more detail in Figures 5, 6, and 10. The Sector sub-totals (light green highlighted rows) include location-based emissions for electricity.*

Total Emissions (MT CO2e / year)	2010	2011	2012	2013	2014	2015	2017	Percent Change 2010 to 2017
Residential	**468,256**	**471,635**	**372,627**	**389,072**	**467,885**	**446,035**	**386,659**	**-17%**
Electricity (Location-Based)	367,777	381,102	285,767	297,476	380,867	370,022	291,271	-21%
Electricity (Market-Based)	*28,736*	*14,888*	*12,245*	*20,591*	*12,869*	*11,609*	*9,861*	-66%
Natural Gas	70,801	76,473	74,771	78,758	73,234	65,655	85,079	20%
District Steam	15,143	*Steam plant decommissioned in 2014*						-100%
Other Fuels	14,535	14,060	12,089	12,838	13,784	10,358	10,309	-29%
Commercial & Industrial	**749,788**	**745,248**	**634,972**	**643,130**	**791,415**	**772,608**	**641,430**	**-14%**
Electricity (Location-Based)	553,658	545,969	434,798	433,201	583,601	585,081	433,855	-22%
Electricity (Market-Based)	*43,259*	*21,329*	*18,631*	*29,986*	*19,896*	*18,356*	*14,688*	-66%
Natural Gas	178,352	185,636	190,546	201,412	198,021	176,958	197,055	10%
Other Fuels	17,778	13,643	9,628	8,517	9,793	10,569	10,520	-41%
Transportation	**548,606**	**531,317**	**510,887**	**498,191**	**508,032**	**509,499**	**532,685**	**-3%**
Gasoline (E10)	354,773	341,045	326,015	319,368	324,898	339,062	354,493	0%
Diesel (B5)	193,833	190,272	184,872	178,823	183,134	170,407	178,162	-8%
Electric Vehicles	*not calculated*	*not calculated*	*not calculated*	*not calculated*	*not calculated*	30	30	n/a
Waste	**83,408**	**79,007**	**87,893**	**82,009**	**85,617**	**94,563**	**80,626**	**-3%**
Landfilled Solid Waste	80,024	75,824	84,252	77,980	82,180	90,860	76,972	-4%
Wastewater Treatment Process	3,384	3,183	3,641	4,029	3,437	3,703	3,654	8%
Process & Fugitive Emissions	**60,648**	**62,394**	**64,659**	**66,454**	**69,297**	**73,155**	**72,807**	**20%**
Stationary Refrigerant Loss	24,968	25,682	26,622	27,363	28,522	30,125	29,982	20%
Transportation Refrigerant Loss	35,680	36,712	38,037	39,091	40,775	43,030	42,825	20%
Total Emissions (Location-Based)	**1,910,706**	**1,889,601**	**1,671,038**	**1,678,856**	**1,922,246**	**1,895,860**	**1,714,207**	**-10%**
Total Emissions (Market-Based)	**1,061,266**	**998,748**	**981,349**	**998,756**	**990,543**	**970,693**	**1,013,600**	**-4%**
Per Capita Emissions (Location-Based)	**12.2**	**12.0**	**10.6**	**10.5**	**12.0**	**11.6**	**10.2**	**-16%**
Per Capita Emissions (Market-Based)	**6.8**	**6.4**	**6.2**	**6.3**	**6.2**	**5.9**	**6.0**	**-11%**

*Note: Refrigerant emissions are scaled per capita based on State of Oregon GHG reporting. The most recent Oregon data available, at the time of conducting Eugene's community inventory, was for calendar year 2012. This data is used as a proxy for 2013 forward.

Figure 9: Detailed summary Eugene's 2010–2015 and 2017 sector-based fossil fuel use by sector and energy type. *Note – This table only includes Market-based accounting. This approach was selected by the City as the preferred approach for accounting towards the CRO fossil fuel target, per guidance from Greenhouse Gas Protocol - Scope 2 Guidance. The guidance states that market-based accounting is the preferred method for organizational goal-related tracking.*

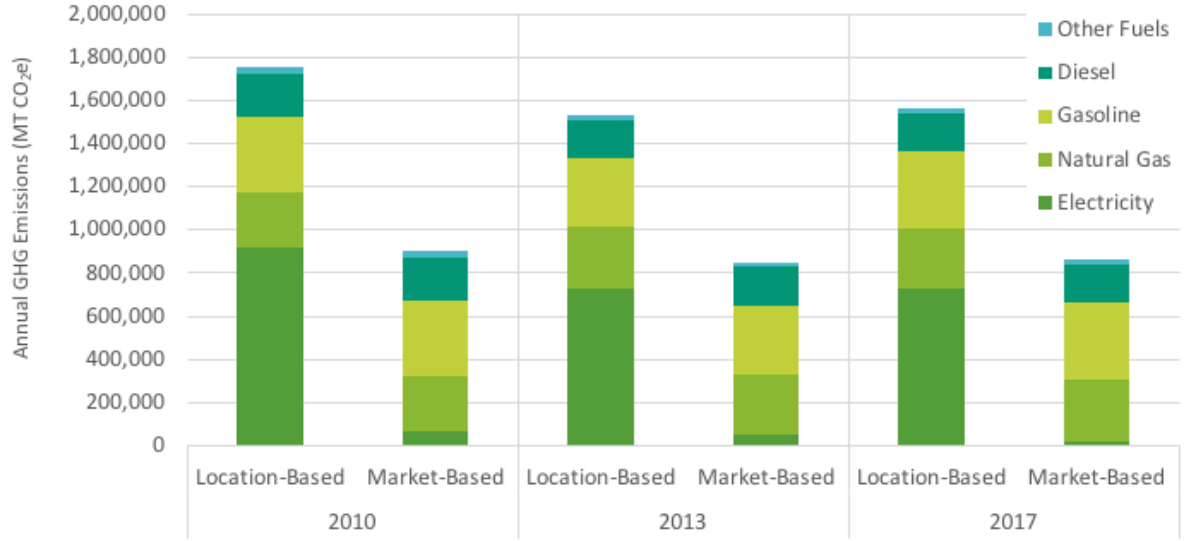
Total Emissions (MMBTU / year)	2010	2011	2012	2013	2014	2015	2017	Percent Change 2010 to 2017
Residential	**2,357,920**	**1,919,902**	**1,808,788**	**2,053,514**	**1,817,242**	**1,551,371**	**1,933,416**	**-18%**
Electricity (Location-Based)	*Market-based accounting used for CRO fossil fuel target*							
Electricity (Market-Based)	*541,461*	*280,539*	*230,733*	*387,993*	*242,481*	*168,269*	*185,810*	-66%
Natural Gas	1,331,175	1,437,831	1,405,819	1,480,797	1,376,936	1,234,425	1,599,635	20%
District Steam	277,449	*Steam plant decommissioned in 2014*						-100%
Other Fuels	207,835	201,532	172,236	184,724	197,825	148,677	147,971	-29%
Commercial & Industrial	**4,412,058**	**4,081,738**	**4,070,109**	**4,472,345**	**4,231,349**	**3,740,772**	**4,128,641**	**-6%**
Electricity (Location-Based)	*Market-based accounting used for CRO fossil fuel target*							
Electricity (Market-Based)	*815,125*	*401,902*	*351,063*	*565,018*	*371,552*	*266,067*	*276,768*	-66%
Natural Gas	3,353,328	3,490,286	3,582,606	3,786,892	3,723,150	3,327,114	3,704,983	10%
Other Fuels	243,605	189,550	136,441	120,436	136,646	147,591	146,890	-40%
Transportation	**7,672,560**	**7,428,954**	**7,141,943**	**6,965,498**	**7,102,514**	**7,132,287**	**7,456,874**	**-3%**
Gasoline (E10)	5,050,874	4,855,425	4,641,448	4,546,816	4,625,536	4,827,199	5,046,890	0%
Diesel (B5)	2,621,687	2,573,529	2,500,495	2,418,682	2,476,977	2,304,844	2,409,740	-8%
Electric Vehicles	0	0	0	0	0	244	244	*Not applicable*
Waste	*Does not include fossil fuel use*							
Landfilled Solid Waste								
Wastewater Treatment Process								
Process & Fugitive Emissions	*Does not include fossil fuel use*							
Stationary Refrigerant Loss								
Transportation Refrigerant Loss								
Total Fossil Fuel Use (Market-Based)	**14,442,538**	**13,430,594**	**13,020,841**	**13,491,356**	**13,151,104**	**12,424,187**	**13,518,930**	**-6%**
Per Capita Fossil Fuel Use (Market-Based)	**92.4**	**85.5**	**82.2**	**84.5**	**81.8**	**76.0**	**80.6**	**-13%**

*Note: Fossil fuels use for market-based electricity are calculated using a natural gas electricity generation benchmark. In other words, fossil fuels use from EWEB's electricity is assumed to be 100% from electricity generated by natural gas. Fossil fuel use for EWEB electricity is calculated using EWEB-specific fossil fuel emissions factors as provided by Oregon Department of Environmental Quality (kg CO_2e / MWh); heat rates for natural gas generated electricity (BTU / kWh) from the U.S. Energy Information Administration (https://www.eia.gov/electricity/annual/html/epa_08_01.html); and natural gas emissions factor (kg CO_2 / MMBTU) from the U.S. Energy Information Administration (https://www.eia.gov/electricity/annual/html/epa_a_03.html).

Figure 8 accounts for electricity emissions using two methods – Location-Based and Market-Based[6] - based on Greenhouse Gas Protocol's *Scope 2 Guidance*. The *Global Community GHG Protocol* requires users to report using the location-based method, which uses an average emissions factor for the Northwest's regional electricity grid to calculate emissions (i.e. Northwest Power Pool). The Guidance suggests conducting a sensitivity analysis using the market-based method. This accounting method uses EWEB's utility-specific carbon intensity[7], based on its owned and contracted generation resources, to calculate emissions. Eugene's market-based emissions are about 29 times less carbon intensive than the regional average, or about 3% of the Northwest Regional Power Pool. This is because EWEB, as a public utility, predominantly contracts with Bonneville Power Administration (BPA) whose generation supply is largely from low-carbon, hydroelectric and nuclear resources, and EWEB's owned, low-carbon resources which include hydro and wind.

Figure 10 presents Eugene's energy-related emissions, by energy type, including both the location-based and market-based electricity-accounting methodologies. Figure 10 highlights the significance of the electric accounting methodology used when presenting results. Scope 2 protocol guidance describes the Location-based method as a representation of the average GHG impacts associated with electricity use within a defined geographic territory and time period. Alternatively, the Market-based method represents electricity that has been purposefully chosen via the GHG impacts associated with EWEB's supply contracts that serve the community. Both methods are useful for different purposes; together, they provide a fuller documentation and assessment of risks, opportunities, and changes to emissions from electricity supply over time. See Greenhouse Gas Protocol's *Scope 2 Guidance* for details.

Figure 10: Comparison of community emissions, by fuel type, using location- and market-based electricity accounting methodologies.



[6] For details about these two accounting methodologies see Greenhouse Gas Protocol's Scope 2 Guidance.
[7] Utility-specific factors are provided by Oregon Department of Environmental Quality (ODEQ) based on EWEB regulatory reporting.

CONSUMPTION-BASED INVENTORY (LOCAL AND IMPORTED EMISSIONS)

In 2013, the City of Eugene, working with the Oregon Department of Environmental Quality, completed a consumption-based inventory (CBEI), that estimated an emissions total of 2.77 million MT CO_2e (3.45 million MT CO_2e using location-based accounting).[8] Many of the same sources found to be significant in the sector-based inventory are also significant in the consumption-based inventory, such as building and vehicle energy use. Many of these emissions are shown in Figure 11 in the Product Use column. Figure 11 also shows the significance of emissions generated outside of Eugene during production of goods, food, energy and services in the Production column. As in the sector-based inventory, waste disposal represents a relatively small fraction of the community's emissions. *Note that the subtotal emissions by category in Figure 11 are not available using market-based accounting.*

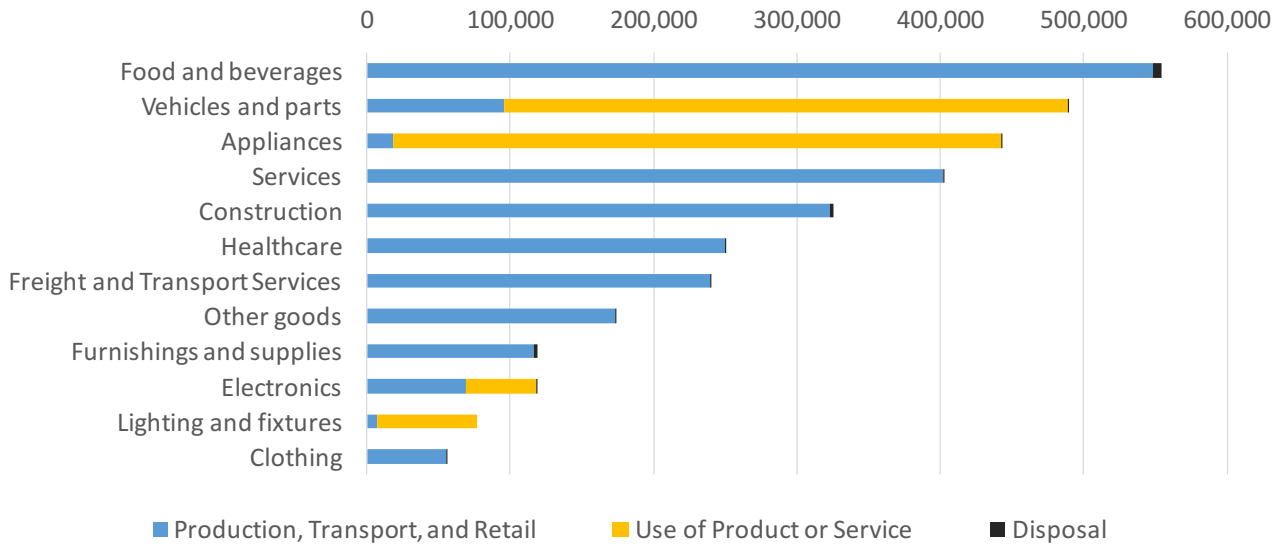
Figure 11: Summary of the Eugene's community's 2013 consumption-based emissions.

Category	Production, Transportation, and Retail	Product Use	Disposal	Total Emissions	Per-Capita Emissions	Percent of Total
Food and beverages	547,984	-	6,304	**554,288**	**3.5**	**16%**
Vehicles and parts	96,107	392,547	84	**488,738**	**3.1**	**14%**
Appliances	18,349	423,810	5	**442,163**	**2.8**	**13%**
Services	401,993	-	568	**402,561**	**2.5**	**12%**
Construction	322,772	-	2,728	**325,500**	**2.0**	**9%**
Healthcare	250,006	-	92	**250,098**	**1.6**	**7%**
Freight and Tranport Services	238,985	-	5	**238,990**	**1.5**	**7%**
Other manufactured goods	173,102	-	53	**173,155**	**1.1**	**5%**
Furnishings and supplies	116,615	-	2,747	**119,362**	**0.7**	**3%**
Electronics	69,330	48,898	44	**118,271**	**0.7**	**3%**
Retailers	134,807	-	-	**134,807**	**0.8**	**4%**
Lighting and fixtures	6,776	69,940	-	**76,716**	**0.5**	**2%**
Clothing	55,097	-	94	**55,191**	**0.3**	**2%**
Other	54,574	-	8	**54,581**	**0.3**	**2%**
Water and wastewater	12,948	-	6	**12,954**	**0.1**	**0%**
Total Emissions	**2,499,445**	**935,195**	**12,736**	**3,447,376**	**21.7**	**100%**
Per-Capita Emissions	**15.7**	**5.9**	**0.1**	**21.7**		
Percent of Total	**73%**	**27%**	**0.4%**	**100%**		

Production of food and beverages, vehicles, construction materials, air travel services, furnishings, electronics, and clothing are all significant consumption categories for the community. Figure 12 (on the next page) summarizes select categories in graphic form to show the scale of emissions by lifecycle stage for select consumption categories. Figure 12 also highlights the need to develop and implement GHG mitigation strategies differently depending on the category of consumption. For example, selecting food types, based on the carbon intensity of production, would be an effective strategy to reduce this large source of community emissions. Whereas for vehicles, the majority of emissions are generated during use, so climate action strategies should focus on selecting vehicles for efficiency and that utilize low-carbon fuels or electricity.

[8] The City plans to work with ODEQ in 2019 to update the CBEI using 2017 data.

Figure 12: Lifecycle emissions, split by lifecycle stage, for select consumption categories.



INVENTORY METHODOLGY

The Eugene **sector-based inventory** follows Greenhouse Gas Protocol's *Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories.* ICLEI'S web-based *ClearPath* Community-Scale Emissions Management Software was used to calculate all greenhouse gas (GHG) emissions for the Eugene's Community Inventories for 2010–2015 and 2017. Data and calculation files are cataloged in a corresponding audit trail organized by inventory year. Changes in previous year's results in this report compared to prior reports is the result of updates to emissions factors and improvements to accounting methodology.

The Eugene **consumption-based inventory** incorporates Eugene's sector-based emissions into a consumption-based emissions inventory model that was developed by Stockholm Environment Institute for Oregon Department of Environmental Quality (ODEQ) to support completion of the State of Oregon's 2005 Consumption-Based Inventory. ODEQ staff used the 2010 version of the Oregon model to estimate the Eugene community's 2013 consumption-based emissions. The City plans to work with ODEQ in 2019 to update the Eugene's CBEI using 2017 data.

All community 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 ICLEI's *ClearPath* carbon calculator and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), CFCs, PFCs, and sulfur hexafluoride (SF_6) per the Kyoto Protocol. All GHG calculations use the global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).