Appendix A

2016 Greenhouse Gas Emission Inventory Methodology & Calculations

City of Pittsburg

Greenhouse Gas Emission Inventories Updated 2005 and 2016

Appendix A
2016 Greenhouse Gas Emission Inventory Methodology & Calculations

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Introduction

This appendix outlines the methodologies followed to estimate the greenhouse gas (GHG) emissions for the incorporated City of Pittsburg for the 2016 calendar year. Baseline emissions in 2016 were estimated for both the incorporated communities within Pittsburg as well as those emissions resulting from City municipal operations. The GHG inventory relies on activity data for each of the primary emissions sectors including electricity, natural gas, transportation, waste and water. The following Appendix provides a description of the specific methodologies, assumptions, and variables used in the GHG emissions inventory.

Throughout this report, rounding is often required in calculations and tables. Values are rounded to the nearest integer of a higher order of magnitude. No rounding is performed in the intermediary steps of the calculation. As a result of rounding, some totals may differ slightly from the values summed.

Inventory Scope

The following section details the 2016 baseline inventory's geographical scope, data collection protocols, included and excluded emission sectors and GHG global warming potentials.

Boundary

This community-wide GHG emissions inventory includes emissions from actions taken within the incorporated community in the City of Pittsburg. This includes residential, commercial and, where applicable, industrial activities. The City operations inventory includes activities taken by the City government directly. These activities include electricity used in government buildings, fuel used in the government fleet vehicles, as well as water and waste generated by the City directly. Some City operations may take place outside of incorporated areas of the City, but are included as part of the inventory because those actions are under the operational control of the City. The City operations inventory is not additive to the community inventory, but is a subset of those emissions over which the City has direct control.

Accounting Protocol and Emission Sectors

The community-wide and municipal GHG emissions inventories utilize data methodology standards outlined in ICLEI USA's *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (the ICLEI Community Protocol, 2013). The California Air Resources Board (CARB) recommends the ICLEI Community Protocol for community-scale GHG emissions inventories in *California's 2017 Climate Change Scoping Plan Update (Scoping Plan Update).* The ICLEI Community Protocol recommends including emissions from five source sectors for a comprehensive community-scale GHG inventory. These sectors include:

- Electricity
- Natural gas
- On-road transportation
- Solid waste
- Water and wastewater

GHG emissions are calculated by multiplying activity data (i.e. kilowatt-hours of electricity, metric tons of solid waste) by a process-specific emissions factor (i.e. emission per kilowatt-hour, per ton, per therm). Calculations are refined with regional and City-specific data where available.

In addition to the basic sectors outlined by the ICLEI Community Protocol, inventories can include other sectors depending on community activity and characteristics. For the City of Pittsburg community-wide inventory, the following optional sectors were also included:

- Marine transportation
- Off-road transportation
- Passenger rail transportation

The inclusion of these sectors corresponds with the baseline inventory of 2005 for the City of Pittsburg to offer a comparison of change over the 11-year period.

Excluded Emissions

The baseline inventory focuses on Scope 1 and 2 emissions released within the jurisdictional boundary: direct emissions from owned (primary party) operations, and indirect emissions from operations owned by a second party (such as residential electricity or water consumption producing electricity and wastewater treatment emissions at local facilities). It also includes several Scope 3 emissions, indirect emissions by second and third parties. These include the optional ICLEI inventory sectors mentioned above of off-road equipment, marine goods movement and transportation, and the regional landfill. Scope 3 emissions excluded from the inventory include outsourced waste activities, aircraft operations at regional facilities, and consumption-based value chain emissions of goods and materials.

Aircraft Emissions

No public or private airports exist in the City of Pittsburg. Aircraft emissions are under the jurisdiction of the U.S. Federal Aviation Administration (FAA) and are considered Scope 3 transportation-related activities. As expressed in the ICLEI Community Protocol, these emissions are outside the scope of a community-wide inventory and are not included in the inventory for the City of Pittsburg.

Consumption-Based Emissions

Value chain or lifecycle GHG emissions include those related to extraction, production, use and disposal of purchased goods and materials within the City. These are considered Scope 3 emissions. Currently there exists no standard methodology for reporting consumption-based emissions. As expressed in the ICLEI Community Protocol, Scope 3 emissions are outside the scope required of a community-wide inventory. Consumption-based emissions are not included in the inventory for the unincorporated City of Pittsburg.

Other Stationary Sources

Stationary source emissions from activities other than natural gas combustion, electricity demand, solid waste, water and wastewater treatment are excluded from this inventory since they are not under City jurisdictional control. These include privately-owned operations such as petroleum refining and steel production.

Global Warming Potentials

The City of Pittsburg GHG inventory accounts for three primary GHGs: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHGs have varying global warming potentials (GWPs) or potency for trapping heat in the atmosphere, so a measurement referred to as “carbon dioxide equivalent” (CO_2e) is used to compare these with the GWP of CO_2 as a common base. For example, per the Intergovernmental Panel on Climate Change (IPCC)’s Fourth Assessment Report (AR4, 2007), CH_4 and N_2O are respectively 25 and 298 times more potent than CO_2 in their heat trapping abilities

in the first 100 years after initial emission.[1] Thus, they have 100-year GPWs of 25 and 298. The GWPs used in this baseline GHG emissions inventory are from the IPCC AR4[17]. A metric ton of CO_2e (MT CO_2e) is the standard measurement of GHG emissions produced and released into the atmosphere.

[1] Gases have different decay rates and retain their heat trapping abilities long after the first 100 years. However, this 100-year GWP is a standard base value for comparison. Intergovernmental Panel on Climate Change (IPCC). 2007. *Fourth Assessment Report: Climate Change 2007*. "Direct Global Warming Potentials." Accessed August 2018 at https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10- 2.html.

Inventory Methodology

The following section describes the methodologies used for the municipal and community-wide inventory updates. GHG emissions are calculated by multiplying activity data (kilowatt-hours of electricity, metric tons of solid waste) by an emission factor. Calculations are adapted with regional and City-specific data where available, as described below. Sectors included in the community-wide inventory are electricity, natural gas, on-road, off-road, passenger rail and marine transportation, solid waste, landfill waste, water, and wastewater, as shown in Figure 4 of the Greenhouse Gas Inventory. Sectors included in the municipal inventory are employee commutes, energy, vehicle fleet, waste, water and wastewater, as shown in Figure 10 of the Greenhouse Gas Inventory.

Transportation

On-Road Community-wide Transportation

Transportation data was obtained for residential, commercial and other vehicles by identifying average emissions and VMT per category. The California Air Resources Board (CARB)'s EMFAC 2007 mobile source model provided emissions factors for residential and other vehicles and the Bay Area Air Quality Management District (BAAQMD) VMT Dataportal provided VMT for residential vehicles. Bay Area Metro provided city-specific VMT and emissions data using an MTC transportation model. Residential travel composed the majority of on-road transportation-related emissions in the City of Pittsburg in 2016, with 68% of emissions, as shown in Figure 7 and Table 8 of the Greenhouse Gas Inventory.

Vehicle Miles Traveled

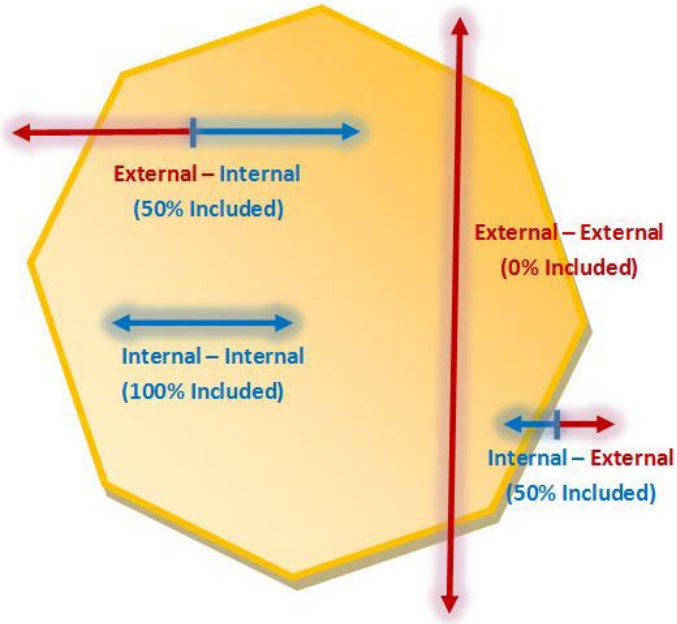
The City of Pittsburg Emissions Inventory estimated on-road vehicle emissions using the origin-destination model recommended in the ICLEI Community Protocol to establish vehicle miles traveled (VMT). The origin-destination model estimates trip mileage using a demand-based modeling system that incorporates traffic and activity in the surrounding areas and factors in various demographic and economic information including employment, vehicle types, school locations, public transit routes, population projections, and non-work or school related activities. [2] The origin-destination model is also consistent with CARB's Regional Targets Advisory Committee (RTAC) recommendations for compliance with SB 375.[3]

The origin-destination model better attributes transportation emissions by jurisdiction of a trip's origin and destination. Trips that begin and end within the jurisdiction (internal-internal) are 100% attributed to the jurisdiction; trips that being outside and within the jurisdiction (external-internal) are 50% attributed to the jurisdiction; trips that begin within and end outside the jurisdiction (internal-external) are 50% attributed to the jurisdiction; and trips that begin and end outside the jurisdiction, and are simply passing through, are entirely excluded. See Figure 1 below for an illustration.

[2] Metropolitan Transportation Commission. CAP VMT Travel Model One. http://capvmt.us-west-2.elasticbeanstalk.com/about

[3] California Air Resources Board. (August 2009). "Recommendations of the Regional Target Advisory Committee (RTAC) Pursuant to Senate Bill 375". Accessed August 2018 from https://www.arb.ca.gov/cc/ sb375/rtac/report/092909/finalreport.pdf

Figure 1 The Origin-Destination Model



VMT was separated by Residential, Commercial and Other vehicle category as defined by the MTC VMT model (see Table 1 below). Total daily commercial vehicle VMT for the City was obtained from personal communication with staff at Bay Area Metro who provided city-specific values based on countywide data from MTC. Vehicle category 'Other' VMT was obtained from the EMFAC 2007 mobile source model using the estimated on-road county vehicle mix of motorcycles, motor coaches and buses in 2016. This was multiplied by the citywide share of county employment[4] provided by Bay Area Metro. VMT was then multiplied by 365 to obtain average annual VMT.

Total daily residential vehicle VMT was obtained from the Bay Area Air Quality Management District (BAAQMD)'s VMT Data Portal, which provides city-wide non-commercial vehicle trip rates by origin and destination. Following the origin-destination model, half of partially inside trips (originating or ending inside the city), all inside trips (originating and ending inside the city), and no outside trips were included in estimating residential VMT. To obtain 2016 data, VMT was assumed to increase linearly from 2015 to 2020 using the values provided by the Data Portal. VMT per the origin-destination model are shown in Table 1 below.

[4] Longitudinal Employer-Household Dynamics (LHED), a common tool of the U.S. Census Bureau to provide information on regional employment and job flow.

Table 1 Residential VMT by Origin-Destination in the City of Pittsburg (2016)

Origin-Destination of Trips	VMT
Internal-Internal	76,739
Internal-External/ External-Internal	1,226,050
External-External	114,879,831
Weighted Jurisdictional	689,764

Source: BAAQMD VMT Data Portal 2015

To account for different emission factors of combustion engines and electric vehicles (EVs) among residential vehicles[5], residential EV VMT was also calculated. Countywide EV VMT in 2016 was provided by the EMFAC 2007 mobile source model and scaled by population to City level. EV trips accounted for less than one percent of VMT in 2016.

Vehicle Mix and Emissions

Residential and Other sector vehicle emissions data were derived from the CARB 2014 EMFAC Mobile Source Emission Inventory model using City-based emission factors, the model mix of all vehicle classes (classes are identified in EMFAC model version 2011), model years, speed bins, and associated fuel types for the City of Pittsburg in 2016. EMFAC speed bin distributions of each 5 mile per hour bin up to 90 mph were used to identify VMT and associated emissions. Residential and Other sector emissions were calculated from the average of all EMFAC vehicle classes in the corresponding MTC vehicle category (Passenger and 'Not included', as shown in Table 2 below). MTC categories were also used to identify inventory vehicle sector. Average EMFAC emissions per sector were then divided by EMFAC VMT per sector to obtain emissions per mile. This emissions factor was multiplied by the Residential and Other vehicle sector VMTs, as described in Section 4.4.1 above, to obtain total emissions.

Table 2 EMFAC Categories (2016)

EMFAC Class	MTC Vehicle Category	Transportation Sector
LDA	Passenger	Residential
LDT1	Passenger	Residential
LDT2	Passenger	Residential
MDV	Passenger	Residential
T6 (all)	Commercial	Commercial
T7 (all)	Commercial	Commercial
LHD1	Commercial	Commercial
LHD2	Commercial	Commercial
PTO	Commercial	Commercial
UBUS	Not Included	Other
MCY	Not included	Other
MH	Not included	Other

[5] EVs are included in EMFAC vehicle categories LDA and LDT1, both residential categories in this inventory (see Table 4).

SBUS	Not included	Other
OBUS	Not included	Other
Motor Coach	Not included	Other
All Other Buses	Not included	Other

Source: Personal communication with Harold Brazil, Bay Area Metro, 2/28/2018.

Commercial sector vehicle emissions data was provided by staff at Bay Area Metro utilizing an MTC transportation model. U.S. Census Bureau regional employment and job flow data, known as Longitudinal Employer-Household Dynamics (LEHD), was used to estimate the citywide share of county commercial transportation. Countywide emissions and VMT obtained from the MTC model was then scaled with this citywide share to identify the City of Pittsburg's commercial emissions, as shown in Table 3 below.

Table 3 Commercial VMT and Emissions the City of Pittsburg (2016)

Origin-Destination of Trips	VMT
City LEHD Share	5.83%
Countywide Emissions/Day (MT CO2e)	1,979
Countywide VMT/Day (miles)	1,458,983
Citywide Emissions/Day (MT CO2e)	115
Citywide VMT/Day (miles)	85,001

Source: Personal communication with Harold Brazil, Bay Area Metro, 2/28/2018

The electric vehicle (EV) emission factor was derived from PG&E's electricity emissions factor for 2016. The EMFAC model estimated VMT for EVs countywide, which was scaled to City level by percent of county population pre the U.S. Census Bureau. To estimate electricity required of EVs per VMT, U.S. Department of Energy (US DOE) current average fuel economy data was used for all-electric light-duty passenger vehicle and low-weight light-duty truck models. The calculated EV emissions factor was added into EMFAC countywide data for the two corresponding electric vehicle classes (LDA and LDT1) to determine the aggregate Residential sector emissions factor. The inventory quantification variables, data sources, and total emissions for EVs are shown in Table 4 below.

Table 4 Electric Vehicle Emission Variables & Consumption (2016)

Inventory Variable	Variable/Quantity	Data Source
Electricity Emission Factor	0.133 MT CO_2/MWh	PG&E[1]
EV Fuel Economy of Light-Duty Vehicles	35 kWh/100 mi	U.S. DOE Fuel Economy Database[2] and Alternative Fuel Data Center[3]
EV Emissions per mile	46.6 g CO_2e/mi	Calculated (EF x Fuel Economy)
EV Annual VMT in Incorporated City	2,177,046 VMT	CARB 2014 EMFAC Model
Total Annual EV Emissions	101.3 MT CO_2e	Calculated (EF x Consumption x VMT)

[1] PG&E. 2017. Corporate Responsibility and Sustainability Report 2017. Environment Chapter: Climate Change. Accessed March 2019 at http://www.pgecorp.com/corp_responsibility/reports/2017/

[2] U.S. DOE. (2018). Fuel Economy Database. "Compare Electric Vehicles Side by Side." Accessed September 2018 at https://www.fueleconomy.gov/feg/evsbs.shtml

[3] U.S. DOE. (2018). Alternative Fuel Data Center. "Charging Plug-in Electric Vehicles at Home." Accessed September 2018 at https://www.afdc.energy.gov/fuels/electricity_charging_home.html

On-Road Municipal Transportation

Municipal Commute Emissions

City employee commute data was provided by the City of Pittsburg and sourced from a Bay Area Commuter Benefits Program employee survey conducted in August 2014 per requirements of the BAAQMD (Regulation 14, Rule 1). At this time, the City had 239 full-time employees. One hundred eleven employees participated in the commute survey, approximately 46% of full-time staff. Respondents provided their home address by zip code (Figure 2), from which an average commute distance from urban or geographic centers in each zip code on major roads to the location of municipal central offices (65 Civic Avenue) was estimated (Table 5). Those selecting public transit (two respondents) were assumed to commute locally from within the 94565 zip code a slightly shorter distance than those who drive alone. This was estimated at two miles for one-way public transit commutes.

Figure 2 Employee Home Zip Code and Average Commute Distance

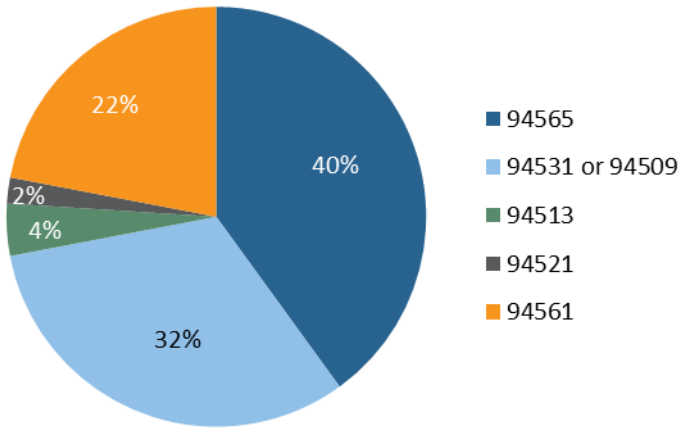


Table 5 Commute Distances by Zip Code

Zip Code	One-Way Daily VMT
94565	3
945311	6
945091	10
94513	16
94521	11
94561	12

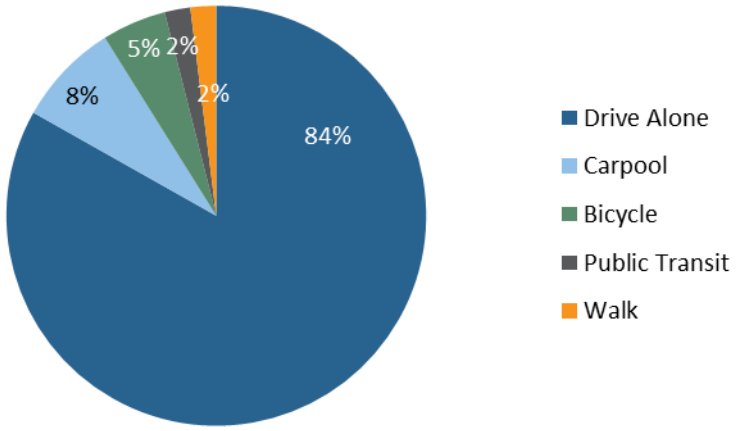
Note: VMT = vehicle miles traveled.

[1] Zip codes 94509 and 94513 were combined into one category the commute survey, creating an average of 8 VMT/day.

Sources: Google Maps 2019; UnitedStatesZipCodes.org 2019

Respondents also provided their preferred commute method (Figure 3). EMFAC 2016 average on-road emissions for the MTC Passenger Vehicle category (categories listed in Table 2 of the *Vehicle Mix and Emissions* section above) were used to calculate employee commute emissions for those selecting "Drive Alone" and "Carpool". Carpools were conservatively assumed to include two people commuting daily; therefore, the per capita carpool emission factor was halved compared to driving alone. EMFAC "UBUS" (Urban Bus) gas and diesel classes were used to estimate a per person "Public Transit" emission factor assuming a bus load of 15 people. In addition, all employees were assumed to commute to and from work daily for 250 days per year. Survey responses, calculation values and emissions are shown in Table 6 below.

Figure 3 Employee Preferred Commute Method



Note: Values may not add to 100% due to rounding.

Table 6 City Employee Commute Emissions & Vehicle Miles Traveled

Inventory Variable	Value
Passenger Vehicle Emissions (g CO2e/mi)	415.1
Daily VMT	3,261
Annual VMT	815,212
Annual Carpool and Drive Alone Emissions (MT CO2e)	338
Urban Bus Emissions (g CO2e/mi)	21.5
Per Passenger Urban Bus Emissions (g CO2e/mi)	1.4
Daily VMT	18
Annual VMT	4,422
Annual Public Transit Emissions (MT CO2e)	0.6
Total Commute Emissions	**339**

Note: VMT = vehicle miles traveled.

Sources: City of Pittsburg 2014. Bay Area Commuter Benefits Program employee commute survey.

CARB 2014 EMFAC Model. 2016 Average Fleet Mix.

Municipal Vehicle Fleet Emissions

City-owned and operated vehicle fleet data was provided by the City of Pittsburg's Environmental Services Department. Emissions were calculated based on the annual; volume of fuel purchased by the City,and an estimated emission factor for the entire municipal fleet. CO_2 emissions were calculated usingthe ICLEI Local Governments Operations Protocol (LGOP), utilizing the volume of fuel combustedmultiplied by the provided default national emission factors by fuel type. As CH_4 and N_2O emissionsvary by vehicle class, year, and fuel type, and mileage data was not available for the fleet, anemissions per volume of fuel combusted emission factor was derived for each on-road vehicle in themunicipal fleet using the appropriate EPA emissions per mile emission factor and the United StatesEnergy Information Administration (EIA) estimated fuel economy for the year and class of eachvehicle. These emission factors were averaged to obtain an average fleet emission factor which wasmultiplied by the total volume of gasoline purchased by the City in 2016. All non-highwayequipment was assumed to use diesel fuel, and separate diesel CH_4 and N_2O emissions factor weredetermined for on-road diesel vehicles. The volume of diesel fuel purchased in 2016 was multipliedby the proportion of on-road or off-road diesel fueled vehicles, and the appropriate emission factorto determine CH_4 and N_2O emissions. Emission factors and calculated emission values are shown in
Table 7.

Table 7 Municipal Fleet Emissions & Vehicle Miles Traveled (2016)

Fuel Type	Emission Factor	Emissions (MT CO_2e)[1]
CO_2		
Gasoline	8,870 grams/gallon[2]	1,120
Diesel	10,180 grams/gallon[2]	255
CH_4		
Gasoline	0.12 grams/gallon	0.4
Diesel (Off-Road)	0.58 grams/gallon	0.3
Diesel (On-Road)	0.03 grams/gallon	<0.1
N_2O		
Gasoline	0.34 grams/gallon	12.7
Diesel (Off-Road)	0.26 grams/gallon	1.52
Diesel (On-Road)	0.03 grams/gallon	<0.1
Total Fleet Emissions		**1,390**

Note: VMT = vehicle miles traveled

[1] U.S. Energy Information Administration (EIA). 2019. Total Energy Overview, Motor Vehicle Mileage, Consumption and Fuel Economy. https://www.eia.gov/totalenergy/data/browser/?tbl=T01.08 Accessed July 2019.

[2] U.S. EPA. 2018. Greenhouse Gas Emissions from a Typical Passenger Vehicle. https://nepis.epa.gov/Exe/ZyPDF.cgi/P100JPPH.PDF?Dockey=P100JPPH.PDF. Accessed June 2019.

Source: City of Pittsburg Environmental Services Department purchase records

Marine Transportation

Marine vessels operating at the City-owned Port of Pittsburg included three lessees in 2016—Koch Carbon, Dow Chemical and USS POSCO steel manufacturer. These operators use the port to import materials and export goods periodically throughout the year. The City of Pittsburg provided marine vessel data from lessees, approximated from 2016 or the nearest year available. The ICLEI Community Protocol's TR.7.A Marine Vessel methodology was used to identify emissions from these sources. Emissions include distance traveled within the Pittsburg Port waters, and energy used while during hoteling activities. In port shore power was provided for USS Posco vessels, while Dow Chemical and Koch Carbon hoteling activities were powered by auxiliary engines contained on the vessel. All vessels accounted for in this inventory are Dry Bulkers with a deadweight tonnage (DWT) of 35,000. Values and emissions are shown in Table 8 below.

Table 8 Marine Vessel Emissions (2016)

Port Lessee	Variable
Dow Chemical	
Number of Vessels	5
Activity Hours per Day	12
Days in Port	5
Annual Hoteling Hours per Vessel	60
Vessel Auxillary Engine Power Rating	2,259
Vessel Auxillary Engine Load Factor	10
Hoteling Emissions (MT CO2e)	46.9
Transport & Maneuvering Emissions (MT CO2e)	17.3
Koch Carbon	
Number of Vessels	28
Activity Hours per Day	12
Days in Port	5
Annual Hoteling Hours per Vessel	60
Vessel Auxillary Engine Power Rating	2,259
Vessel Auxillary Engine Load Factor	10
Hoteling Emissions (MT CO2e)	262.7
Transport & Maneuvering Emissions (MT CO2e)	96.6
USS Posco	
Number of Vessels	18
Annual Activity Hours per Vessel	973
Annual Hoteling Hours	905
Shore Power Electricity (kWh)	1,678
Annual Shore Power Emissions (MT CO2e)	0.22
Transport & Maneuvering Emissions (MT CO2e)	390.8
Total Emissions (MT CO2e)	**814.5**

Passenger Rail Transportation

Passenger rail emissions data was provided by Bay Area Rapid Transit (BART). BART has one station, Pittsburg/Bay Point, located near the intersection of Highway 4 and Bailey Road in central Pittsburg, which began serving passengers in December 1996. Another station, Pittsburg Center/Antioch opened in May 2018. However, emissions from this e-BART station are excluded from the inventory as the station was opened after the 2016 inventory year. BART, in coordination with Arup Consulting, performs an annual energy and passenger rail usage analysis, including current emissions by station and Climate Action Plan analysis of future emissions. Station-based emissions encompass all related operational emissions, including the station and support facilities, as well as BART systemwide apportioned to station use. In 2016, the Pittsburg/Bay Point station accounted for 1.5% of the BART systemwide usage. BART's energy sources also changed substantially in 2016, acquiring more renewable energy and releasing fossil fuel-based operations. Therefore, both portion of system use and station-based GHG emissions decreased markedly from the previous year. BART emissions and station usage are shown in Table 9 below.

Table 9 Pittsburg/Bay Point Passenger Rail Emissions (2016)

Inventory Variable	Value
Average Station Weekday Ridership (passenger exiting)	6,526
Percent of BART Systemwide Emissions	1.5%
Portion of BART Systemwide Emissions (MT CO2e)	127
Station Operational Emissions (MT CO2e)	36
Total Station Emissions (MT CO2e)	**163**

Source: BART 2019

Energy

Electricity

Electricity use within the City of Pittsburg includes residential and commercial consumption for the community-wide inventory, and government-owned building consumption for the municipal inventory. Because electricity is an indirect, Scope 2 emissions source, this category includes emissions that may occur outside the City bounds at regional power plants. Electricity consumed for water treatment and distribution was excluded from the electricity use category and instead incorporated in the water and wastewater source category. Electricity consumed for electric vehicles operating entirely within the City and half of electric vehicles operating partially within the City were excluded from the electricity use category and instead incorporated in the transportation source category as part of the residential on-road sector. Table 7 and Figure 5 of the Greenhouse Gas Inventory show the sources of electricity emissions in the City of Pittsburg in 2016.

Electricity use was provided by PG&E in the form of kilowatt-hours per year (kWh/yr) for the residential and commercial customer groups for 2016 and for the industrial group from 2005 to 2013. The California Public Utilities Commission (CPUC) passed a final regulation in May 2014 (Decision 14-05-016) prohibiting public access to a utility's commercial and/or industrial energy data if any one entity within the category exceeds 15 percent of total usage.[6] The decision also prohibits access to the combined total of commercial and industrial data if any one entity exceeds 15 percent of the usage total when combined. Known as the "15/15 Aggregation Rule", this new regulation prevents public access to all commercial natural gas and industrial electricity and natural gas data in the City of Pittsburg after 2014 because of large energy users existing in the community. Industrial usage is not under the City's direct operational control and larger facilities are subject to the CARB's Mandatory Regulation for GHG Reporting (MRR) if they exceed 25,000 MT per year. Therefore, the industrial sector, including industrial data originally reported in the 2005 inventory, is excluded from the scope of this inventory update.

The ICLEI Community Protocol's "Built Environment 2" methodology was used to estimate incorporated City commercial, residential and municipal electricity consumption. In addition to energy consumption, the amount of emissions generated due to electricity transmission and distribution (T&D) losses were determined. Although emissions generated due to electricity T&D

[6] California Public Utilities Commission. 2014. Decision 14-05-016. Decision Adopting Rules to Provide Access to Energy Usage and Usage-Related Data while Protecting Privacy of Personal Data. Accessed from http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M090/K845/90845985.PDF

losses are outside of the City's operational control, emissions related to T&D loses are directly related to electricity use within the community. Transmission and distribution losses were determined by multiplying a 2016 loss factor for PG&E of 1.0948 with annual electricity consumption. The electricity consumption emission factor was calculated from The Climate Registry's PG&E 2016 report and the T&D loss factor from the CPUC 2017 statewide energy grid report. These were multiplied by megawatt-hours (MWh) of electricity use to estimate total annual emissions in metric tons of CO_2e per MWh.

PG&E provided the emissions factor for electricity in data year 2016, a value reflecting its portfolio mix of renewable energy. PG&E's emission factor was reported in its Corporate Responsibility and Sustainability Report 2017 and to the California Climate Action Registry as 0.133 MT CO_2/MWh (0.294 lb CO_2/kWh).

Because eGRID uses GWPs from the IPCC Second Assessment Report rather than AR4, additional calculations were made to identify the updated electricity carbon-dioxide equivalent emissions and to allow for consistency across inventory sectors. N_2O and CH_4 emission factors from eGRID 2016 data for the California CAMX subregion were multiplied with the updated GWPs (298 for N_20 and 25 for CH_4, updated from SAR 310 for N_2O and 21 for CH_4). Then these were combined with the CO_2 emission factor to produce the total carbon dioxide-equivalent emissions in pounds CO_2e/MWh. This calculation is shown in Table 10 below.

Electricity for City municipal administration and operations was provided by the City of Pittsburg's energy management software. Municipal emissions were calculated similarly to community-wide emissions, multiplying by the PG&E emission factor in the City of Pittsburg service area. Table 10 shows the emission factors for community-wide electricity use in the City of Pittsburg in 2016, and for municipal operations.

Table 10 Citywide Electricity Emissions Factors (2016)

Inventory Variable	Quantity	Data Source
PG&E Emission Factor	0.133 MT CO2/ MWH	PG&E and TRC
CO2e Emission Factor	529.879 lb/MWh	Calculated (CO2 EF + N2O EF x 298+ CH4 EF x 25)
Transmission & Distribution Loss Factor	1.0948	CPUC 2017
Community-wide Electricity Consumption	228,272,687 kWh	PG&E
Municipal Electricity Consumption	17,597,150 kWh	PG&E/City invoices/purchase records
GHG Emissions	30,442 MT	Calculated (EF x Electricity Consumption)

Sources: US EPA. (February 2018). eGRID 2016 Data File. Accessed June 2019 at https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

The Climate Registry. 2018. CRIS Public Reports. https://www.theclimateregistry.org/our-members/cris-public-reports/

CPUC Decision 15-11-027 http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M156/K044/156044151.PDF

PG&E. 2017. Corporate Responsibility and Sustainability Report 2017. Environment Chapter: Climate Change. Accessed June 2019 at http://www.pgecorp.com/corp_responsibility/reports/2017/

CPUC. 2017 Report System Efficiency of California's Electricity Grid. Accessed June 2019 at http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/PPD_Work_Products_(2014_forward)/System_Efficiency_Report%20PPD_May_24_Final.pdf

Natural Gas

Natural gas use within the unincorporated City of Pittsburg includes residential and commercial consumption for the community-wide inventory, and government-owned building consumption for the municipal inventory. Because natural gas is a direct, Scope 1 emissions source with all emissions occurring at the point of consumption (such as indoor furnaces and stoves), no emissions external to the incorporated City must be considered. Table 7 and Figure 6 of the Greenhouse Gas Inventory show the sources of natural gas emissions in the City of Pittsburg in 2016.

The ICLEI Community Protocol's "Built Environment 1" methodology for Stationary Fuel Combustion was used to estimate unincorporated City natural gas consumption. The natural gas emission factor provided by PG&E was multiplied by natural gas consumed (in million therms, MM therms) to estimated total annual emissions in metric tons of CO_2e per MM therms. Natural gas use was provided by PG&E for the residential customer group in the form of therms per year (therms/yr).

Due to CPUC Decision 14-05-016 passed in May 2014[7], described above, commercial natural gas usage became publicly unavailable after 2013. This is caused by large energy users existing in the community that individually account for over 15 percent of commercial natural gas usage. To accommodate for missing data, a linear extrapolation of 2005 to 2013 PG&E reported data in kWh/yr was performed to estimate commercial natural gas usage in 2016. Total usage and the variables used for natural gas calculations are shown in Table 11 below.

Table 11 Citywide Natural Gas Emissions Factors & Consumption (2016)

Inventory Variable	Quantity	Data Source
Emissions Factor	5,850 MT/MM therms	PG&E
Community-wide Consumption	33.04 MM therms	PG&E
Residential Consumption	7.78 MM therms	PG&E
Commercial Consumption	25.26 MM therms	Calculated from PG&E
Municipal Consumption	396,949 therms	City of Pittsburg
Community-wide GHG Emissions	175,370 MT	Calculated (EF x Community-wide Consumption)
Municipal GHG Emissions	2,107 MT	Calculated (EF x Municipal Consumption)

Solid Waste

Emissions from solid waste include CO_2 resulting from decomposition in aerobic environments and CH_4 resulting from decomposition in anaerobic environments. GHG tailpipe emissions from waste collection and management vehicles are excluded from this sector and incorporated in the mobile sources sector.

Based on *ICLEI Community Protocol* standard methodology, waste CH_4 emissions were calculated from community-wide solid waste emissions using the "Solid Waste 4" method. Method 4 uses solid waste generated and deposited at landfill during the baseline year to estimate future emissions. This allows for an encompassing estimate of annual solid waste emissions reflecting the slow rate of

[7] California Public Utilities Commission. 2014. Decision 14-05-016. Decision Adopting Rules to Provide Access to Energy Usage and Usage-Related Data while Protecting Privacy of Personal Data. Accessed from http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M090/K845/90845985.PDF

waste decomposition. Because no landfills exist within the incorporated city, waste-in-place landfill emissions were not calculated into solid waste emissions.

Community-Generated Solid Waste

Community-generated solid waste emissions include waste disposal from the incorporated City and City municipal operations exclusive of whether or not waste disposal location was within the incorporated City. One active landfill exists just outside the City of Pittsburg—Keller Canyon Landfill—to which much of the waste is disposed. The rest of landfilled waste is sent to Altamont and Vasco Road Sanitary landfills. Calculations utilize the *ICLEI Community Protocol* "Solid Waste 4", Community-Generated Waste Sent to Landfills, methodology to estimate emissions. This method multiples an emissions factor that accounts for lifetime waste decomposition for mixed solid waste to community waste disposal volume in wet short tons. Since recycled waste and biomass material are removed from solid waste prior to landfill diversion, the impact of these efforts on emissions reductions are reflected in a lower landfill waste volume and emissions.

Community-wide solid waste generated in 2016 was provided by the California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System (DRS) in wet short tons per quarter. An emissions factor for CH_4 per wet short ton was multiplied with volume of disposed solid waste to calculate total solid waste emissions. Following *ICLEI Community Protocol* guidelines, landfill gas capture was assumed to be 75 percent with a 10 percent oxidation rate. Total waste generated, the emissions factor used, and total emissions from solid waste are shown in Table 12 below.

Table 12 Community-Generated Solid Waste (2016)

Waste Totals	Quantity
Keller Canyon Waste Disposal (wet short tons)	59,559
Altamont Landfill Waste Disposal (wet short tons)	488
Vasco Road Sanitary Landfill (wet short tons)	9
Other Landfills (wet short tons)	7,651
Total Community Waste to Landfills (wet short tons)	67,707
Waste Disposal Per Capita (MT/person/day)	0.28
Emission Factor (MT/wet short ton)	0.30
Total Community-wide Emissions (MT CO_2e)	**20,269**

Sources: City of Pittsburg, 2019; Calrecycle, 2018. Altamont and Vasco Road Landfill Quarterly Tonnage Reports. https://www2.calrecycle.ca.gov/LGCentral/ DisposalReporting/. Accessed June 2019

In addition to landfilled waste, the community has implemented various residential and community composting, recycling, and waste diversion programs. Many of these began in 1990 and others began later in the decade. They include curbside pick-up, self-hauling, and facility drop-off programs. Together, these programs reduced landfilled waste by 42,734 MT in 2016, as shown in Table 13.

Table 13 Community-Generated Alternative Daily Cover, Recycling and Biomass (2016)

Waste Totals	Quantity
Alternative Daily Cover (wet short tons)	11,033
Other Diverted Waste[1]	2,378
Community Composting (MT)	14,704
Community Biomass (MT)	6,633
Community Green Waste Total (MT)	21,337
Community Recycling (MT)	8,111
Total Diversion	**42,734**

[1] Includes diverted large items such as mattresses, tires, hazardous material, metal, concrete, carpeting and aluminum.
Sources: City of Pittsburg, 2019. Contra Costa Waste and Mt. Diablo Recycling Tonnage Report 2016.
City of Pittsburg, July 2018. Calrecycle Annual Report Summary: Pittsburg 2016.

Municipally-Generated Solid Waste

Municipal emissions composed two percent of total community-wide emissions from landfilled waste in 2016. Similarly to community waste diversion, municipal facilities participate in composting, recycling and biomass waste diversion. Pittsburg schools, including Los Menados College's Pittsburg campus, contribute the majority of waste diversion, while municipal facilities contribute a smaller amount. Total waste disposal, diversion, and associated emissions are shown in Table 14 below.

Table 14 Municipally-Generated Solid Waste, Recycling and Alternative Daily Cover (2016)

Waste Totals	Quantity
Municipal Solid Waste Entering Landfills (wet short tons)	2,745
Municipal Recycling (MT)	24
Municipal Composted (MT)	3
Emission Factor (MT/wet short ton)	0.34
Total Municipal Emissions (MT CO2e)	**926**

Source: City of Pittsburg 2019.

Water

Water emissions come from extraction, conveyance, treatment, distribution and storage of water to the incorporated community and municipal operations. Emissions vary by water origin and distance to treatment facility, water treatment process and equipment used at the facility. Emissions resulting from water use at City facilities are included in this total. Emissions from electricity used for pumping, storage and treatment are also included in water sector emissions and excluded from electricity sector emissions.

ICLEI Community Protocol's "Wastewater 14" method was utilized to calculate emissions separately for each step in water sourcing (extraction, treatment and conveyance, storage and distribution).

The City of Pittsburg 2015 Urban Water Management Plan provides total electricity used for these each step in the 2015 fiscal year (FY), as well as the energy intensity per water volume for recycled water treatment and distribution. Energy intensities, emission factors and sources are shown in Table 15 below.

Table 15 Water Energy Intensities & Emissions Factors (2016)

Inventory Variable	Quantity	Data Source
Water Consumption	2,169 MG	City of Pittsburg
Electricity Emissions Factor	294 MT CO2e/ MG	PG&E
Extraction Energy Intensity	471,299 kWh	Pittsburg 2015 UWMP
Treatment & Conveyance Energy Intensity	5,862,859 kWh	Pittsburg 2015 UWMP
Distribution Energy Intensity	242,376 kWh	Pittsburg 2015 UWMP
Storage Energy Intensity	279,243 kWh	Pittsburg 2015 UWMP
Recycled Water Energy Intensity	3,466 kWh/MG	Pittsburg 2015 UWMP
Community-wide GHG Emissions	1,917 MT CO2e	Calculated (EF x Community Consumption)
Municipal GHG Emissions	547 MT CO2e	Calculated (EF x Municipal Consumption)

The City of Pittsburg provided data on surface and groundwate supply to the incorporated community for the 2015 fiscal year (FY) and 2016 FY, and City municipal facilities for 2016. The 2015 FY data, which encompasses July 2015 through June 2016, is used as a proxy for all 2016 data as delivered water totals are comparable between the years and more complete data is available for the 2015 FY. Recycled water supply was provided by the City's 2015 UWMP. Table 16 lists total water supplied to the City and municipal operations in 2016.

The City of Pittsburg provided data on surface and groundwater supply to the incorporated community for the 2015 fiscal year (FY) and 2016 FY, and City municipal facilities for 2016. The 2015 FY data, which encompasses July 2015 through June 2016, is used as a proxy for all 2016 data as delivered water totals are comparable between the years and more complete data is available for the 2015 FY. Recycled water supply was provided by the City's 2015 UWMP. Table 16 lists total water supplied to the City and municipal operations in 2016.

Table 16 Water Supplied to Incorporated Community & Municipal Operations (2016)

Step	Community-wide Quantity (MG/Year)	Municipal Quantity (MG/Year)
Groundwater	441	9
Surface Water	2,227	47
Recycled Water	2,169	46
Total Supplied	**4,837**	**103**
Percent Municipal Use	2.13%	
Per Capita Supply (gal/person/day)	186	

MG = million gallons

Per Capita Supply = Total Water Supplied / Population Served / 365.25

Source: City of Pittsburg, 2019. Water Supply and Treatment Report 2005-2018.

Recycled water composes the majority of water sector emissions, followed by treatment and conveyance and extraction, while distribution and storage compose only a small contribution to water processing emissions. Figure 4 and Table 17 below show the contribution of water sourcing and processing emissions by step.

Table 17 Water Emissions by Sourcing and Processing Step (2016)

Processing Step	Emissions (MT CO_2e)
Groundwater Extraction	63
Surface Water Treatment and Conveyance	782
Storage	37
Distribution	32
Recycled Water Use	1,002
Total	1,917

Source: City of Pittsburg, 2019.

Figure 4 Water Emissions by Sourcing and Processing Step (2016)

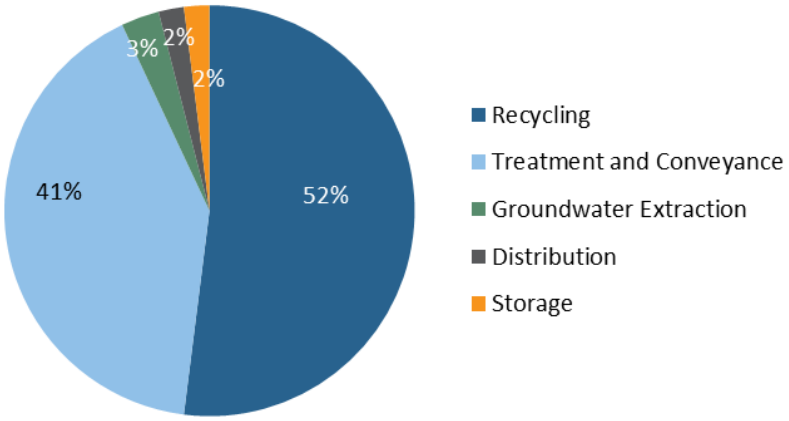


Table 18 shows water volume in each step of processing, along with energy intensity per volume water, electricity use and emissions. Water volume multiplied by energy intensity allowed for an estimate of electricity consumption for recycled water treatment and distribution. Groundwater extraction, total surface water treatment and conveyance, water distribution, and water storage electricity consumptions were reported in the City's 2015 Urban Water Management Plan and do not have associated energy intensities. These values were multiplied by the PG&E provided electricity emission factor to obtain total emissions. Electricity consumption required for water processing is excluded from electricity sector emissions to avoid double counting.

Table 18 Energy Use and Emissions by Water Processing Step (2016)

Processing Step	Volume (MG)	Energy Intensity (kWh/MG)1	Electricity Consumption (MWh)[1]	Emissions (MT CO_2e)	Percent of Emissions
Surface Water					
Treatment and Conveyance	2,227	–	5,863	782	41%
Groundwater					
Extraction	441	–	471	63	3%
Local Supply					
Recycled	2,169	3,466	7,518	1,002	52%
Other Processes					
Distribution	–	–	242	32	2%
Storage	–	–	279	37	2%
Total	**4,837**		**14,374**	**1,917**	**100%**

MG = million gallons; kWh = kilowatt-hour; MWh = megawatt-hour

[1] City of Pittsburg. 2016. City of Pittsburg 2015 Urban Water Management Plan. Energy intensities were not provided for all processing steps. Where energy intensities per volume were not provided, total electricity consumption by each process was used to calculate emissions.

Source: City of Pittsburg, 2019. Water Supply and Treatment Report 2005-2018

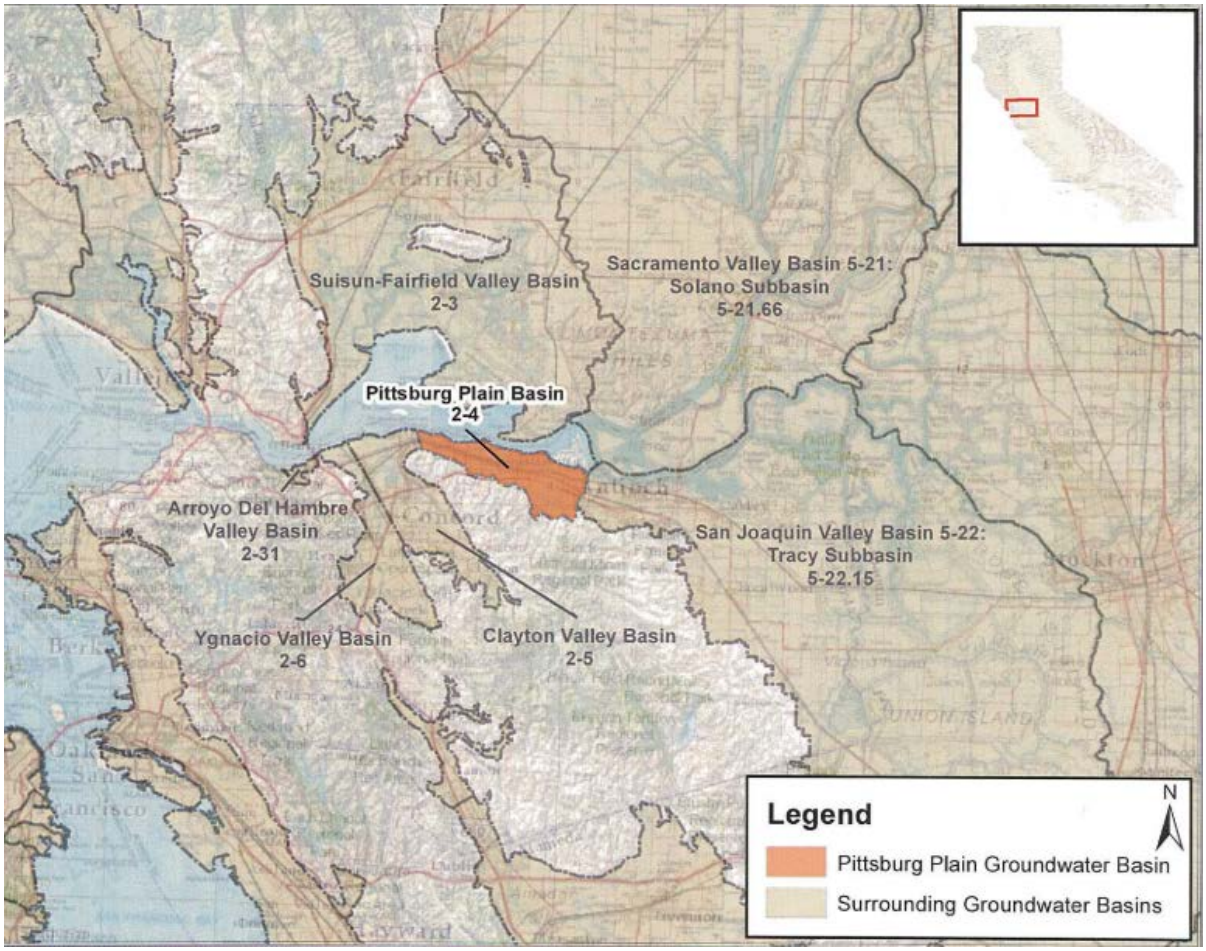
Surface Water Supply

Volume of water supplied to the incorporated community and municipal operations was provided by the City of Pittsburg. The population served by this water supply was 71,342 in 2016. The City purchases Central Valley Project (CVP) water pumped from the California Delta by Contra Costa Water District (CCWD), its wholesale supplier. According to its 2015 Urban Water Management Plan, the City obtains 85% to 95% of its water supply from CCWD pursuant to a contractual arrangement.

Groundwater Supply

In addition to water supplied by CCWD, approximately 9 percent of the total water supplied by CCWD was sourced from groundwater extracted from two City-owned wells. This water is extracted from the Pittsburg Plain Groundwater Basin. The basin is bounded by Suisun Bay to the north, the Tracy Sub-basin of the San Joaquin Valley Groundwater Basin on the east, and the Clayton Valley Groundwater Basin on the west, as shown in Figure 5 below.

Figure 5 Groundwater Basin Serving the City of Pittsburg



Source: Luhdorff and Scalmanini Consulting Engineers and MWH Global, Inc. (October 2012). *Pittsburg Plain Groundwater Basin Groundwater Management Plan.* Executive Summary, Figure ES-1. Retrieved March 2019 from http://apps.ci.pittsburg.ca.us/sirepub/cache/2/o5dzrgyc1geldijjtxvlkt55/28508570311201905333273 2.PDF

Surface Water Emissions

Electricity consumption for surface water treatment and conveyance was multiplied by PG&E's electricity emissions factor in 2016 to estimate associated emissions. The provided electricity consumption encompasses energy used in the conveyance of surface water from the Contra Costa Canal to the City's water treatment plant (WTP), and the treatment of this water at the WTP prior to distribution to the City's local service reservoirs.

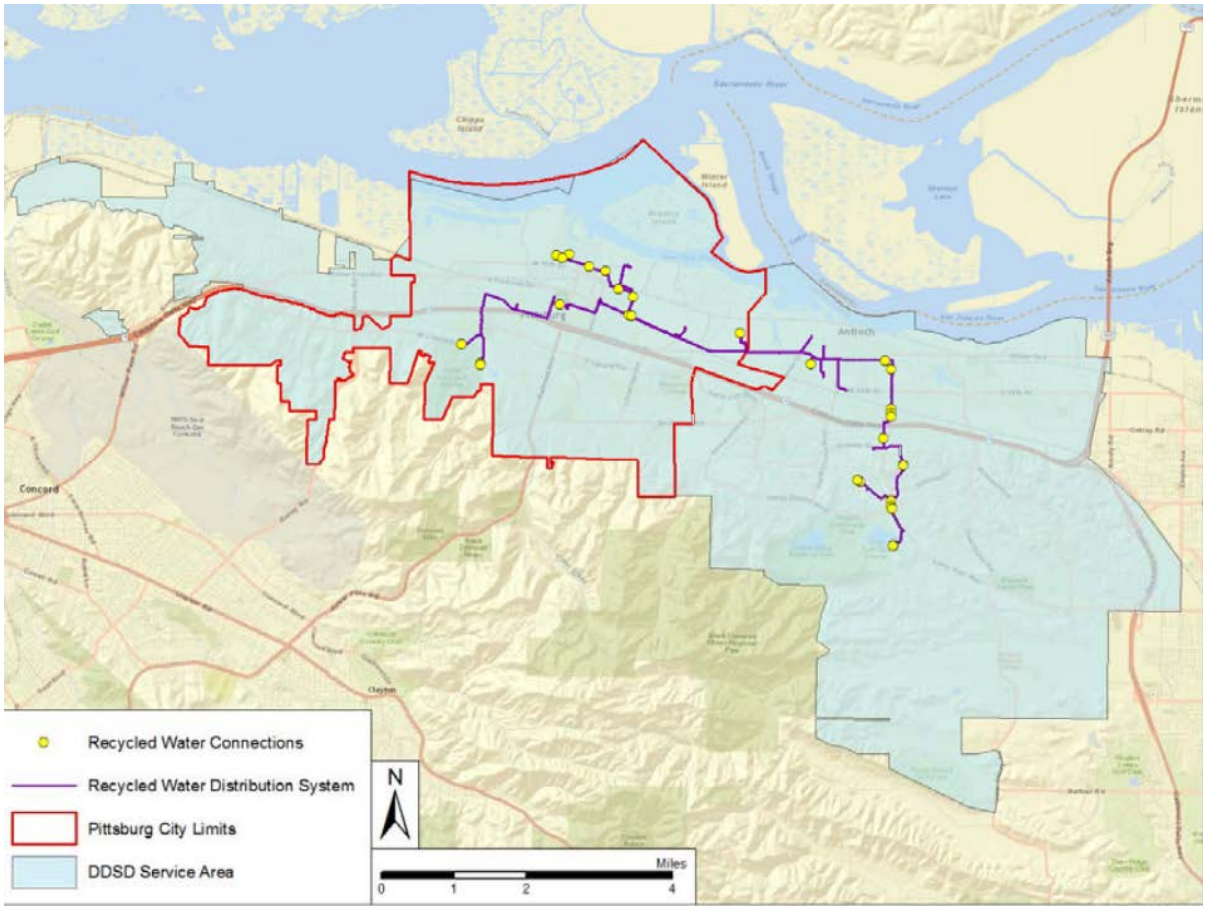
Groundwater Emissions

Electricity consumption associated with groundwater extraction was multiplied by PG&E's electricity emission factor in 2016 to identify emissions from groundwater extraction. Groundwater in Pittsburg is blended with surface water after extraction and treated at the City's WTP; therefore, treatment energy use of groundwater is included in surface water emissions and only energy associated with extraction is accounted for here. Electricity and associated emissions from distribution of extracted groundwater are included in total water distribution emissions as shown in Table 18. Electricity used by groundwater extraction was excluded from electricity sector emissions to avoid double counting.

Recycled Water Emissions

Recycled water volume was multiplied by recycled water treatment and distribution energy intensity to identify electricity use and associated emissions. No further treatment is assumed for recycled water beyond tertiary treatment at water reclamation facilities. Recycled water is provided for non-potable uses in industrial cooling and irrigation. Recycled water electricity and emissions totals were also excluded from the electricity sector. Figure 6 below shows DDSD's recycled water system in the City of Pittsburg.

Figure 6 Delta Diablo Sanitation District Recycled Water System



Source: City of Pittsburg. June 2016. *City of Pittsburg 2015 Urban Water Management Plan*. Figure 6-1 Recycled Water System, p. 25. Prepared by RMC Water and Environment and City of Pittsburg Water Utilities Department. Accessed March 2018 at http://www.ci.pittsburg.ca.us/Modules/ShowDocument.aspx?documentid=8283

Wastewater

Wastewater treatment processes include both direct and indirect emissions. Direct emissions include combustion of digester gas produced at the wastewater treatment plant (WWTP) and fugitive emissions from processing methods. Digester gas combustion produces CH_4 and N_2O emissions, while process emissions include fugitive CH_4 and/or N_2O, depending on the treatment process utilized. Indirect emissions result from processes related to wastewater collection and treatment, but not emitted directly from the WWTP itself. These include energy use emissions

associated with the collection and treatment of wastewater, as well as fugitive N_2O resulting from additional chemical reactions when effluent discharge reaches a natural watershed.

Wastewater Treatment Servicer

Delta Diablo Sanitation District (DDSD) provides treatment services for the Cities of Pittsburg and Antioch and the unincorporated area of Bay Point. Treatment occurs at a centralized WWTP for which DDSD provided the volume of water treated in 2016, 4.453 million gallons. The total population served by the district was then divided by City of Pittsburg population in 2016 to identify Pittsburg's contribution to DDSD-treated wastewater. Since DDSD's facility emission factors are not known, default ICLEI Community Protocol emission factors were used for calculating wastewater treatment emissions.

The DDSD WWTP provides primary, secondary and tertiary treatment of wastewater. Primary treatment is a mechanical process which utilizes screens, grit chambers and settling tanks to remove trash and settable solids. Secondary treatment utilizes biological processes to convert suspended particles into sludge, which then undergoes anaerobic digestion to break down organic solids. The anaerobic digestion process produces methane gas which is captured and burned to power treatment plant facilities. Secondarily treated water is discharged to the New York Slough without nitrification/denitrification processing. A portion of the wastewater undergoes tertiary treatment, requiring additional chemical and treatment and filtration. This water is recycled and used for industrial cooling and irrigation.

Wastewater Treatment Emissions

The *ICLEI Community Protocol's* "Wastewater 1 alt.", "Wastewater 2 alt." and "Wastewater 8" methods were used to calculate direct emissions from wastewater treatment. "Wastewater 1 alt." and "Wastewater 2 alt." methods calculate CH_4 and N_2O emissions resulting from the combustion of captured digester gas produced by anaerobic digestion of biosolids. These calculations use the default values provided by the *ICLEI Community Protocol* for digester gas generation based on WWTP service population and for efficiency of digester gas combustion. Method "Wastewater 8" accounts for N_2O process emissions in WWTPs which do not support nitrification or denitrification, based on population served by the WWTP. Default values provided by the *ICLEI Community Protocol* for N_2O emissions factors were used, with the assumption that the WWTP received wastewater with high nitrogen loading of industrial or commercial discharge.

Indirect emissions associated with wastewater consumption were calculated using *ICLEI Community Protocol* "Wastewater 12 alt." and "Wastewater 15.1". These calculations include N_2O emissions from effluent discharge and energy use emissions from wastewater collection and treatment modalities. "Wastewater 12 alt" method was used for calculating fugitive N_2O emissions resulting from effluent discharge of secondarily treated wastewater. This calculation used the nitrogen load discharged, 1,500 kg or nitrogen per day provided by DDSD, scaled by the population of Pittsburg, as well as default *ICLEI Community Protocol* values for emission factors. Energy use emissions calculated using method "Wastewater 15.1" utilized default values provided by the *ICLEI Community Protocol* for energy intensities per unit volume of collection and treatment at a centralized WWTP. The DDSD utilizes conventional aerobic treatment for sludge; therefore, only this treatment modality is included in calculations. The treatment energy intensity used for calculations was 2,000 kilowatt-hours per million gallons (kWh/MG), the default for WWTPs with a capacity of 5-20 million gallons per day. The median default value was chosen for collection energy intensity, 280 kWh/MG. Wastewater treatment volumes for 2016 were provided by DDSD and scaled to represent the

population of Pittsburg. Table 19 provides emissions by source for both direct and indirect emissions resulting from wastewater treatment.

Table 19 Wastewater Emissions by Source (2016)

Source	Emissions (MT CO_2e)
Direct Emissions	
Anaerobic Digester Gas Combustion	5
Fugitive N2O from Process Emissions	84
Total Direct Emissions	89
Indirect Emissions	
Fugitive N2O from Effluent Discharge	438
Collection Energy	57
Treatment Energy	463
Total Indirect Emissions	958
Total Emissions	**1,046**

Source: City of Pittsburg, 2019

Appendix B

2005 Greenhouse Gas Emission Inventory Methodology and Calculations

City of Pittsburg

Greenhouse Gas Emission Inventories
Updated 2005 and 2016

Appendix B
2005 Greenhouse Gas Emission Inventory Methodology & Calculations

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July 2019

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Tables

Introduction

This appendix outlines the methodologies followed to estimate the greenhouse gas (GHG) emissions for the incorporated City of Pittsburg for the 2005 calendar year. Baseline emissions in 2005 were estimated for both the incorporated communities within Pittsburg as well as those emissions resulting from City municipal operations. As for the 2016 inventory update, the 2005 GHG inventory relies on activity data for each of the primary emissions sectors including electricity, natural gas, transportation, waste and water. The majority of this data is reported in the original inventory published in 2008; however, some sectors have been updated with new methodologies and more complete data as available, described below. The following Appendix provides a description of the specific methodologies, assumptions, and variables used for the 2005 GHG emissions inventory update.

Throughout this report, rounding is often required in calculations and tables. Values are rounded to the nearest integer of a higher order of magnitude. No rounding is performed in the intermediary steps of the calculation. As a result of rounding, some totals may differ slightly from the values summed.

Inventory Scope

The 2005 updated baseline inventory's geographical scope, data collection protocols, included and excluded emission sectors and GHG global warming potentials are consistent with those of the 2016 inventory, described in *Inventory Scope* of Appendix A. Notably, off-road transportation and equipment were not included in the originally published 2005 inventory, but this sector has been added to this inventory update due to data availability and to provide a more complete comparison to 2005 communitywide activity.

Inventory Methodology

The following section describes the methodologies used for the municipal and community-wide inventory updates. GHG emissions are calculated by multiplying activity data (kilowatt-hours of electricity, metric tons of solid waste) by an emission factor. Calculations are adapted with regional and City-specific data where available, as described below. Sectors included in the communitywide inventory are electricity, natural gas, on-road, off-road, passenger rail and marine transportation, solid waste, water, and wastewater, as shown in Figure 1 of the Greenhouse Gas Inventory Update. Sectors included in the municipal inventory are employee commutes and vehicle fleet, energy, waste, water and wastewater, as shown in Figure 3 of the Greenhouse Gas Inventory Update.

Transportation

On-Road Communitywide Transportation

The originally published 2005 inventory relied on a Contra Costa Transit Authority (CCTA) travel model to estimate on-road vehicle miles traveled (VMT) and emissions. The CCTA travel model is currently undergoing updates to be complete in late 2019. CCTA staff recommend using the Metropolitan Transportation Commission (MTC) model for VMT, as outputs from the two models have increasingly differed with updates in recent years. For comparison between the 2005 and 2016 inventories, 2005 on-road transportation emissions were thus updated using an MTC model as described below. The following methodology matches that described in Appendix A for the 2016 inventory update.

On-road transportation data was obtained for residential, commercial and other vehicles by identifying average emissions and VMT per category, as described in the *Transportation* section of Appendix A. Residential travel composed the majority of on-road transportation-related emissions in the City of Pittsburg in 2005, with 71% of emissions.

Table 1 Citywide Transportation Emissions and Vehicle Miles Traveled (2005)

Vehicle Category	Emissions (MT CO2e/yr)
Residential	131,652
Commercial	47,125
Other	5,542
Total	**184,310**
Daily VMT	832,276
Annual VMT	303,780,604
Average Emissions/Mile (g CO_{2e}/mi)	607[1]

Note: VMT = vehicle miles traveled

[1] Includes electric vehicles. Excluding electric vehicles, emissions per mile are 0.2 g CO_2e/mi less.

Sources: CARB EMFAC 2007 tool; Personal communication with Harold Brazil, Bay Area Metro, 2/28/2018; BAAQMD VMT Data Portal 2015

Vehicle Miles Traveled

The City of Pittsburg Emissions Inventory estimated on-road vehicle emissions using the origin-destination model recommended in the ICLEI Community Protocol to establish vehicle miles traveled (VMT). Refer to *Transportation: Vehicle Miles Traveled* in Appendix A for description of the origin-destination model.

VMT was separated by Residential, Commercial and Other vehicle category as defined by the MTC VMT model using the same methodology described the the *Transportation* section of Appendix A. VMT in 2005 per the origin-destination model are shown in Table 2 below.

Table 2 Residential VMT by Origin-Destination in the City of Pittsburg (2005)

Origin-Destination of Trips	VMT
Internal-Internal	78,126
Internal-External/External-Internal	1,267,562
External-External	110,098,642
Weighted Jurisdictional	711,907

Source: BAAQMD VMT Data Portal 2015

To account for different emission factors of combustion engines and electric vehicles (EVs) among residential vehicles[1], residential EV VMT was also calculated. Countywide EV VMT in 2005 was provided by the EMFAC 2014 mobile source model and scaled by population to City level. EV trips accounted for less than one percent of VMT in 2005.

Vehicle Mix and Emissions

Residential and Other sector vehicle emissions data were derived from the CARB 2014 EMFAC Mobile Source Emission Inventory model using City-based emission factors, the model mix of all vehicle classes (classes are identified in EMFAC model version 2011), model years, speed bins, and associated fuel types for the City of Pittsburg in 2005. Methodologies are further described in *Transportation: Vehicle Mix and Emissions* in Appendix A.

Commercial sector vehicle emissions data was provided by staff at Bay Area Metro utilizing an MTC transportation model, also described in Appendix A. The City of Pittsburg's commercial vehicle emissions for 2005 are shown in Table 3 below.

[1] EVs are included in EMFAC vehicle categories LDA and LDT1, both residential categories in this inventory (see Table 4).

Table 3 Commercial VMT and Emissions the City of Pittsburg (2005)

Transportation Variable	Quantity
City LEHD Share	6.3%
Countywide Emissions/Day (MT CO_2e)	2,051
Countywide VMT/Day (miles)	1,584,529
Citywide Emissions/Day (MT CO_2e)	129
Citywide VMT/Day (miles)	99,764

Source: Personal communication with Harold Brazil, Bay Area Metro, 2/28/2018

The electric vehicle (EV) emission factor was derived from PG&E's electricity emissions factor for 2005 provided by the Institute for Local Governments. This methodology is also consistent with that for the 2016 inventory and described in Appendix A. The inventory quantification variables, data sources, and total emissions for EVs in 2005 are shown in Table 4 below.

Table 4 Electric Vehicle Emission Variables and Consumption (2005)

Inventory Variable	Variable/Quantity	Data Source
Electricity Emission Factor	0.222 MT CO_2/MWh	ILG[1]
EV Fuel Economy of Light-Duty Vehicles	35 kWh/100 mi	U.S. DOE Fuel Economy Database[2] and Alternative Fuel Data Center[3]
EV Emissions per mile	77.8 g CO_2e/mi	Calculated (EF x Fuel Economy)
EV Annual VMT in Incorporated City	116,549 VMT	CARB 2014 EMFAC Model
Total Annual EV Emissions	9.1 MT CO_2e	Calculated (EF x Consumption x VMT)

[1] California Institute for Local Government (ILG) 2011. Greenhouse Gas Emissions Factors Info Sheet. Accessed March 2019 at https://www.ca-ilg.org/sites/main/files/file-attachments/ghg_emission_factor_guidance.pdf

[2] U.S. DOE. (2018). Fuel Economy Database. "Compare Electric Vehicles Side by Side." Accessed September 2018 at https://www.fueleconomy.gov/feg/evsbs.shtml

[3] U.S. DOE. (2018). Alternative Fuel Data Center. "Charging Plug-in Electric Vehicles at Home." Accessed September 2018 at https://www.afdc.energy.gov/fuels/electricity_charging_home.html

On-Road Municipal Transportation

Municipal Commute Emissions

City employee commute data was provided by the City of Pittsburg and sourced from an employee survey conducted in November 2008 which estimated 2005 full-time employee commute patterns and 2008 seasonal employee commute patterns as a proxy for 2005. One hundred twenty-five employees participated in the commute survey, including approximately 38% of full-time and 5% of seasonal staff. Employees commuted an average of 22 miles per day, with the majority driving alone five days per week. Total emissions were 887 MT CO_2e. Details of methodology are provided in the City of Pittsburg 2005 Inventory Appendix B: Data Sources.

Municipal Vehicle Fleet Emissions

City-owned and operated vehicle fleet data for 2005 was provided by the City of Pittsburg's purchase and data logs. Emissions were calculated based on volume of gasoline and diesel fuel purchased and consumed by the Environmental Services Dept., police and other municipal fleet

vehicles. The City reported 105,000 gal of gasoline and 27,000 gal of diesel use in 2005, totaling 1,207 MT CO_2e. Details of methodology are provided in the City of Pittsburg 2005 Inventory Appendix B: Data Sources.

Marine Transportation

Marine vessels operating at the City-owned Port of Pittsburg included two lessees in 2005—Koch Carbon and USS POSCO, steel manufacturer. These operators use the port to import materials and export goods periodically throughout the year. The City of Pittsburg provided marine vessel number of port calls from lessees. The CARB provided an estimate of combined vessel transportation emissions by water segment for lessees, while port operations (i.e., hoteling, berthing) were based on estimates from the nearby Carquinez and Richmond ports. Because shore-power electricity was provided to USS Posco during hoteling, its hoteling emissions were included in the electricity sector. Emissions for port operations are shown in Table 5 below. Details of methodology are provided in the City of Pittsburg's original 2005 Inventory Appendix B, *Data Sources*, and Appendix F, *Secondary Emission Sources*.

Table 5 Marine Vessel Emissions (2005)

Vessel Operation Phase	Emissions (MT CO_2e)
Koch Carbon	
Number of Calls (Annual)	20
Hoteling Emissions (MT CO_2e)	1,863
Maneuvering Emissions (MT CO_2e)	44
Annual Emissions (MT CO_2e)	**1,907**
USS Posco	
Number of Calls (Annual)	25
Hoteling Emissions (MT CO_2e)	0
Maneuvering Emissions (MT CO_2e)	54
Annual Emissions (MT CO_2e)	**54**
Transit Emissions (MT CO_2e)	175
Total Emissions (MT CO_2e)	**2,136**

Passenger Rail Transportation

The originally published 2005 inventory included all Bay Area Rapid Transit (BART) emissions in the commercial electricity sector, as BART energy is sourced largely from electricity. To provide more accurate data for 2005 and to compare changes in emissions to 2016, communitywide passenger rail emissions data for 2005 was provided by Bay Area Rapid Transit (BART) in this inventory update. BART had one station in 2005, Pittsburg/Bay Point, located near the intersection of Highway 4 and Bailey Road in central Pittsburg, which began serving passengers in December 1996. BART performs an annual energy and passenger rail usage analysis. In 2005, emissions by station were not available; instead, available 2007 systemwide emissions and available 2005 and 2007 ridership by station were used to estimate 2005 emissions. In 2005, the Pittsburg/Bay Point station accounted for and estimated 1.6% of the BART systemwide usage. BART emissions and station usage are shown in Table 6 below.

Table 6 Pittsburg/Bay Point Passenger Rail Emissions (2005)

Inventory Variable	Value
Annual Ridership at Pittsbug/Bay Point Station (passengers exiting)	4,818
Percent of BART Systemwide Emissions	1.6%
BART Systemwide Emissions (MT CO_2e)1	75,480
Total Station Emissions (MT CO_2e)	163

[1] 2007 emissions of 82,438 MT CO2e and the change in systemwide ridership from 2005 to 2007 used to estimate 2005 total emissions

Sources: Personal communication with Norman Wong, BART, January 25, 2019; BART 2008. BART Fiscal Year Weekday Average Exists, FY01-FY08.

Energy

Electricity

Electricity use within the City of Pittsburg includes residential and commercial consumption for the community-wide inventory, and government-owned building consumption for the municipal inventory. Because electricity is an indirect, Scope 2 emissions source, this category includes emissions that may occur outside the City bounds at regional power plants. Electricity consumed for water treatment and distribution was excluded from the electricity use category and instead incorporated in the water and wastewater source category. Electricity consumed for electric vehicles operating entirely within the City and half of electric vehicles operating partially within the City were excluded from the electricity use category and instead incorporated in the transportation source category as part of the residential on-road sector.

Electricity use was provided by PG&E in the form of kilowatt-hours per year (kWh/yr) for the residential, commercial and industrial customer groups for 2005. As described in the *Electricity* section of Appendix A, the California Public Utilities Commission (CPUC) Decision 14-05-016 has made industrial energy data no longer publicly available.[2] To compare energy sector emissions between the two inventory years consistently, industrial data originally provided by PG&E and reported in the 2005 inventory is excluded from this inventory update. Details of electricity methodology are provided in the City of Pittsburg 2005 Inventory Appendix B, *Data Sources* and Appendix D, *PG&E Power Mix*. Transmission and distribution losses in 2005 were determined to be 1.057 from the statewide average loss rate of 5.4%, as a PG&E-specific factor was unavailable.[3]

Electricity for City municipal administration and operations was provided by the City of Pittsburg's energy management software. Municipal emissions were calculated similarly to communitywide emissions, multiplying by the PG&E emission factor in the City of Pittsburg service area. Table 7 shows the electricity usage and emissions in the City of Pittsburg in 2005 for communitywide and municipal activities.

[2] California Public Utilities Commission. 2014. Decision 14-05-016. Decision Adopting Rules to Provide Access to Energy Usage and Usage-Related Data while Protecting Privacy of Personal Data. Accessed from http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M090/K845/90845985.PDF

[3] Wong, Lana. 2011. A Review of Transmission Losses in Planning Studies. California Energy Commission. CEC-200-2011-009. Accessed from https://www.energy.ca.gov/2011publications/CEC-200-2011-009/CEC-200-2011-009.pdf

Table 7 Citywide Electricity Emissions Factors (2005)

Inventory Variable	Quantity	Data Source
Commercial Energy Consumption (kWh)	187,429,876	PG&E
Residential Energy Consumption (kWh)	135,750,067	PG&E
Commercial Electricity Emissions (MT CO_2e)	41,901	PG&E
Residential Electricity Emissions (MT CO_2e)	30,348	PG&E
Communitywide Electricity Emissions (MT CO_2e)	72,249	
Municipal Building Electricity Consumption (kWh)	3,722,239	City data summaries
Streetlighting Electricity Consumption (kWh)	2,437,026	City data summaries
Municipal Electricity Emissions (MT CO_2e)	1,377	

Natural Gas

Natural gas use within the City of Pittsburg includes residential and commercial consumption for the communitywide inventory, and government-owned building consumption for the municipal inventory. Because natural gas is a direct, Scope 1 emissions source, with all emissions occurring at the point of consumption (such as indoor furnaces and stoves), no emissions external to the incorporated City must be considered.

Natural gas use was provided by PG&E in the form of therms per year for the residential, commercial and industrial customer groups for 2005. As described above and in the *Energy* section of Appendix A, CPUC Decision 14-05-016 made 2016 industrial energy data no longer publicly available. To compare energy sector emissions between the two inventory years consistently, industrial data originally provided by PG&E and reported in the 2005 inventory is excluded from this inventory update. Details of natural gas methodology are provided in the City of Pittsburg 2005 Inventory Appendix B, *Data Sources*. Total usage and emissions for the community and municipal operations are shown in Table 8 below.

Table 8 Citywide Natural Gas Use and Emissions (2005)

Inventory Variable	Quantity	Data Source
Commercial Consumption (therms)	18,877,308	PG&E
Residential Consumption (therms)	8,239,892	PG&E
Commercial Emissions (MT CO_2e)	100,963	PG&E
Residential Emissions (MT CO_2e)	44,070	PG&E
Communitywide Emissions (MT CO_2e)	145,034	Calculated
Municipal Building Consumption (therms)	100,501	City data summaries
Municipal Emissions (MT CO_2e)	538	Calculated

Solid Waste

Emissions from solid waste include CO_2 resulting from decomposition in aerobic environments and CH_4 resulting from decomposition in anaerobic environments. GHG tailpipe emissions from waste collection and management vehicles are excluded from this sector and incorporated in the mobile

sources sector. Details of waste sector methodology are provided in the City of Pittsburg 2005 Inventory Appendix B, *Data Sources*.

Community-Generated Solid Waste

Communitywide solid waste generated in 2005 was provided by the City of Pittsburg and includes all community-generated waste regardless of whether or not the waste disposed at a facility located within incorporated City bounds. The mix of municipal solid waste was provided by CalRecycle's 2004 Statewide Waste Characterization Study. While the original 2005 inventory used an IPCC recommended methane recovery rate of 60%, the current ICLEI Protocol recommends a recovery rate of 70%. Therefore, emissions were recalculated for comparability with the 2016 inventory, following the method described in Section 4.4 of Appendix A and utilizing 2005 waste generation data. Total waste generated and emissions from solid waste in 2005 are shown in Table 9 below.

Table 9 Community-Generated Solid Waste, Recycling and Alternative Daily Cover (2005)

Waste Totals	Quantity
Solid Waste Entering Landfills (wet short tons)	55,559
Special Waste (MT)	9,354
Municipal Alternative Daily Cover (MT)	11,383
Biomass Incineration (MT)	13,594
Municipal Recycling (MT)	3,660
Municipal Composted (MT)	1,976
Total Municipal Emissions (MT CO2e)	**20,101**
Municipal Solid Waste (wet short tons)	611
Municipal Emissions (MT CO2e)	206

Source: City of Pittsburg, 2008

In addition to landfilled waste, the community has implemented various residential and community composting, recycling, and waste diversion programs. Many of these began in 1990 and others began later in the decade. They include curbside pick-up, self-hauling, and facility drop-off programs.

Municipally-Generated Solid Waste

Total waste disposed by municipal facilities in 2005 was provided by Garaventa Enterprise and totaled 611 MT, resulting in emissions of 206 MT CO_2e, also shown in Table 9. Similar to community waste diversion, municipal facilities participated in composting, recycling and biomass waste diversion in 2005.

Water

Water emissions come from extraction, conveyance, treatment, distribution and storage of water to the incorporated community and municipal operations. Emissions vary by water origin and distance to treatment facility, water treatment process and equipment used at the facility. Emissions

resulting from water use at City facilities are included in this total. Emissions from electricity used for pumping, storage and treatment are also included in water sector emissions and excluded from electricity sector emissions.

Energy intensities, emission factors and sources are shown in Table 10 below.

Table 10 Water Energy Intensities and Emissions Factors (2005)

Inventory Variable	Quantity	Data Source
Water Consumption	7,290 MG	Pittsburg 2010 UWMP and 2015 UWMP
Municipal Water Treatment	3,526 MG	Pittsburg 2005 UWMP
Electricity Emissions Factor	0.000222 MT CO_2e/ kWh	PG&E
Extraction Energy Intensity	1,069 kWh/MG	Pittsburg 2015 UWMP
Treatment & Conveyance Energy Intensity	2,198 kWh/MG	Pittsburg 2015 UWMP
Distribution Energy Intensity	91 kWh/MG	Pittsburg 2015 UWMP
Storage Energy Intensity	105 kWh/MG	Pittsburg 2015 UWMP
Recycled Water Energy Intensity	3,466 kWh/MG	Pittsburg 2015 UWMP
Communitywide GHG Emissions	4,708 MT CO_2e	Calculated (EF x Community Consumption)
Municipal GHG Emissions	1,413 MT CO_2e	Calculated (EF x Municipal Consumption)

The City of Pittsburg's Urban Water Management Plans (UWMPs) provided data on water supply to the incorporated community and City municipal facilities for 2005. To identify municipal water use, the proportion of municipal to communitywide use in 2016 provided by the City was multiplied by the 2005 total water supply. To identify municipal water use by source, the calculated total municipal supply was multiplied by proportion by source communitywide in 2005 provided in the UWMPs. In 2005, the City population served was 62,600.

Table 11 Water Supplied to Incorporated Community and Municipal Operations (2005)

Step	Communitywide Quantity (MG/Year)	Municipal Quantity (MG/Year)
Groundwater	326	7
Surface Water	3,764	80
Recycled Water	3,200	68
Total Supplied	**7,290**	**155**
Percent Municipal Use	2.12%	
Per Capita Supply (gal/person/day)	319	

MG = million gallons

Per Capita Supply = Total Water Supplied/Population Served/365.25

Source: City of Pittsburg, 2019. Water Supply and Treatment Report 2005-2018.

Recycled water composes the majority of water sector emissions, followed by treatment and conveyance and extraction, while distribution and storage compose only a small contribution to water processing emissions. Table 12 below shows the contribution of water sourcing and processing emissions by step.

Table 12 Water Emissions by Sourcing and Processing Step (2005)

Processing Step	Emissions (MT CO_2e)
Groundwater Extraction	77
Surface Water Treatment and Conveyance	1,994
Storage	95
Distribution	82
Recycled Water Use	2,460
Total	**4,708**

Source: City of Pittsburg 2005, 2010 and 2015 UWMPs

Table 13 shows water volume in each step of processing, along with energy intensity per volume water, electricity use and emissions. Groundwater extraction, surface water treatment and conveyance, water distribution, water storage and water recycling electricity consumptions were reported in the City's 2015 Urban Water Management Plan and used as a proxy for 2005. Water volume multiplied by energy intensity allowed for an estimate of electricity consumption for each step. These values were multiplied by the PG&E provided electricity emission factor to obtain total emissions. Electricity consumption required for water processing is excluded from electricity sector emissions to avoid double counting.

Table 13 Energy Use and Emissions by Water Processing Step (2005)

Processing Step	Volume (MG)	Energy Intensity (kWh/MG)[1]	Electricity Consumption (MWh)[1]	Emissions (MT CO_2e)	Percent of Emissions
Surface Water					
Treatment and Conveyance	4,090	2,197	8,988	1,994	42%
Groundwater					
Extraction	326	1,069	348	77	2%
Local Supply					
Recycled	3,200	3,466	11,091	2,460	52%
Other Processes					
Distribution	4,090	91	372	82	2%
Storage	4,090	105	428	95	2%
Total			**21,227**	**4,708**	**100%**

MG = million gallons; kWh = kilowatt-hour; MWh = megawatt-hour

[1] 2015 UWMP factors were used as these were not provided in previous UWMPs.

Source: City of Pittsburg 2005, 2010, 2015 Urban Water Management Plans

Surface Water Supply

Volume of water supplied to the incorporated community was provided by the City of Pittsburg's 2005 Urban Water Management Plan (UWMP) for surface water supply. The City purchases Central Valley Project (CVP) water pumped from the California Delta by Contra Costa Water District (CCWD), its wholesale supplier.

Groundwater Supply

In addition to water supplied by CCWD, approximately 4.5 percent of the total water supplied by CCWD was sourced from groundwater extracted from City-owned wells. This water is extracted from the Pittsburg Plain Groundwater Basin, shown in Figure 5 in Appendix A.

Surface Water Emissions

Surface water volume provided in the City's 2005 UWMP was multiplied by treatment, conveyance and distribution energy intensities provided in the City's 2015 UWMP and by PG&E's electricity emissions factor in 2005 to estimate associated surface water emissions. The 2015 UWMP was provided as a proxy for 2005 energy intensity factors since these were not provided in the 2005 UWMP. The provided conveyance and distribution intensity factor encompasses energy used in the conveyance of surface water from the Contra Costa Canal to the City's water treatment plant (WTP), and the treatment of this water at the WTP prior to distribution to the City's local service reservoirs.

Groundwater Emissions

Emissions associated with groundwater extraction were calculated by multiplying PG&E's electricity emission factor in 2005 with extraction volume based on the 2005 UWMP and with the groundwater extraction energy intensity provided in the 2015 UWMP. Groundwater in Pittsburg is blended with surface water after extraction and treated at the City's WTP; therefore, treatment energy use of groundwater is included in surface water emissions and only energy associated with extraction is accounted for here. Electricity and associated emissions from distribution of extracted groundwater are included in total water distribution emissions as shown in Table 13. Electricity used by groundwater extraction was excluded from electricity sector emissions to avoid double counting.

Recycled Water Emissions

Recycled water volume was based on the 2010 UWMP and multiplied by recycled water energy intensity provided in the 2015 UWMP to identify electricity use and associated emissions. No further treatment is assumed for recycled water beyond tertiary treatment at water reclamation facilities. Recycled water is provided for non-potable uses in industrial cooling and irrigation. Recycled water electricity and emissions totals were also excluded from the electricity sector.

Wastewater

Wastewater treatment processes include both direct and indirect emissions. Direct emissions include combustion of digester gas produced at the wastewater treatment plant (WWTP) and fugitive emissions from processing methods. Indirect emissions result from processes related to wastewater collection and treatment, but not emitted directly from the WWTP itself. These are further described in the *Wastewater* section of Appendix A.

Delta Diablo Sanitation District (DDSD) provides treatment services for the Cities of Pittsburg and Antioch and the unincorporated area of Bay Point. Treatment occurs at a centralized WWTP for which DDSD provided the volume of water treated in 2005, 4.453 million gallons. The methodology for identifying Pittsburg's contribution to DDSD-treated wastewater are further described in Appendix A, *Wastewater Treatment Servicer*, along with DDSD's wastewater treatment methods. Methodology for 2005 wastewater treatment emissions is consistent with that of the 2016 inventory and also described in the *Wastewater Treatment Emissions* section of Appendix A. Table

14 provides emissions by source in 2005 for both direct and indirect emissions resulting from wastewater treatment.

Table 14 Wastewater Emissions by Source (2005)

Source	Emissions (MT CO_2e)
Direct Emissions	
Anaerobic Digester Gas Combustion	4
Fugitive N_2O from Process Emissions	75
Total Direct Emissions	79
Indirect Emissions	
Fugitive N_2O from Effluent Discharge	438
Collection Energy	111
Treatment Energy	567
Total Indirect Emissions	1,116
Total Emissions	**1,195**

Source: City of Pittsburg, 2019