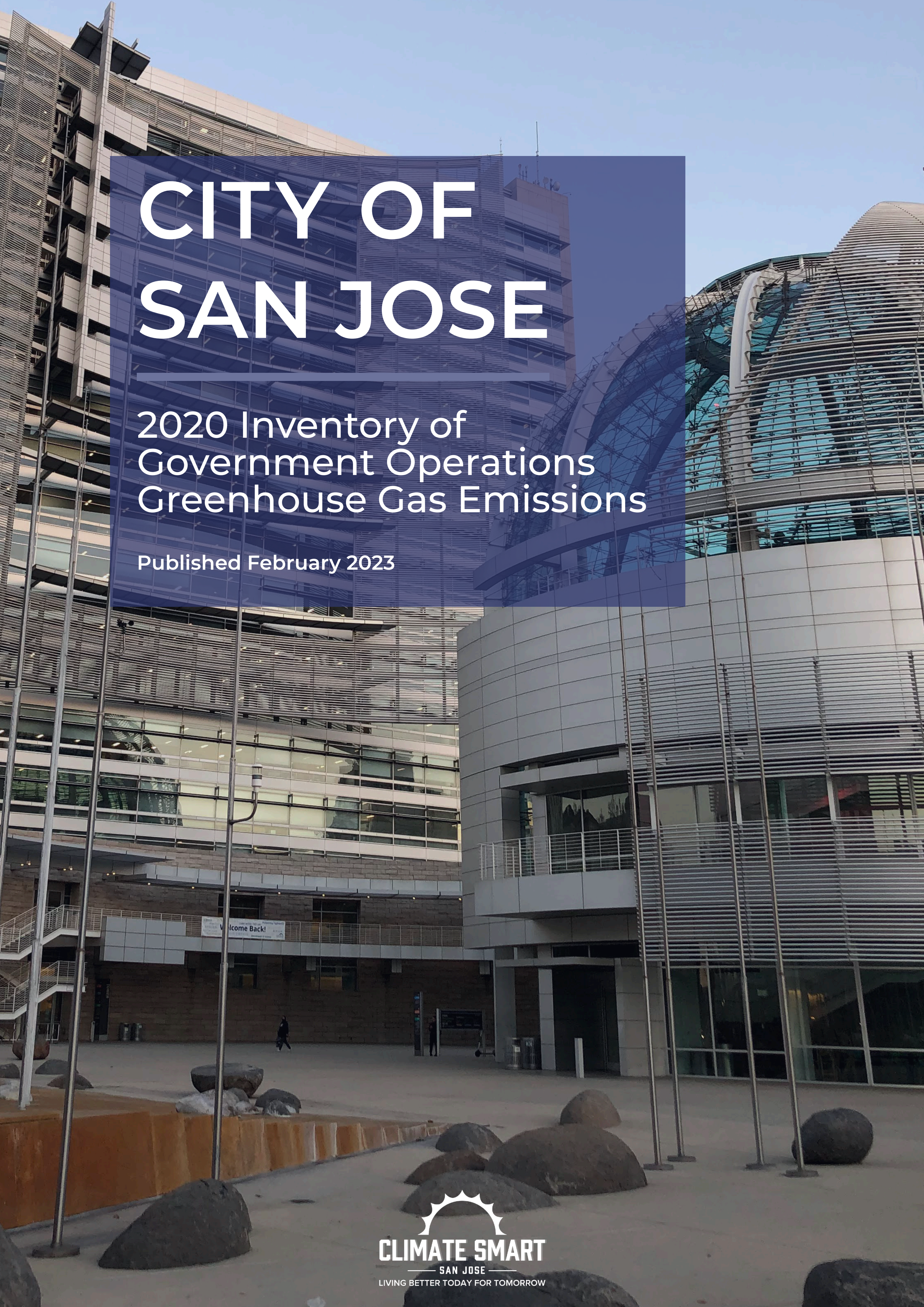

CITY OF SAN JOSE

2020 Inventory of Government Operations Greenhouse Gas Emissions

Published February 2023

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Credits and Acknowledgements

City of San José

Lead Author
Yael Kisel
Environmental Services Department (ESD)

Julie Benabente, *ESD*

Geoff Blair, *ESD*

Eric Dunlavey, *ESD*

Anthony Guerra, *ESD*

Jose Guerrero, *ESD*

Patrick Hansen
Norman Y. Mineta San José International Airport (Airport)

Russel Hansen
Department of Transportation (DOT)

Derek Hentschke, *ESD*

Peggy Horning, *ESD*

Riley Knight, *ESD*

Rachel Lam, *Airport*

David Mesa
Public Works Department

Carrie Rank
Human Resources Department

Kerrie Romanow, *ESD*

Marcos Santiago
Community Energy Department

Kevin Spinks, *Airport*

Sarah Steele
Office of Employee Relations

Sylvia Trejo, *SJC*

Jay Van Biljouw, *DOT*

Other agencies

Great Oaks Water Company
Tim Guster
Wendy Pon-Villalpando

ICLEI - Local Governments for Sustainability USA (ICLEI)
Eli Yewdall

Pacific Gas & Electric (PG&E)
Maira Salazar

San Jose Water Company
Frantascia Price

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Abbreviations

Airport	Norman Y. Mineta San José International Airport
Btu	British thermal units
Cal e-GGRT	California Electronic Greenhouse Gas Reporting Tool
CEQA	California Environmental Quality Act
CH_4	Methane
CNG	Compressed natural gas
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DOT	Department of Transportation
eGRID	Emissions & Generation Resource Integrated Database
EPA	United States Environmental Protection Agency
ESD	Environmental Services Department
EV	Electric vehicle
FTE	Full-time equivalent
g	Grams
GHG	Greenhouse gas
GWh	Gigawatt hours (1,000,000,000 watt hours)
GWP	Global warming potential
ICLEI	ICLEI - Local Governments for Sustainability USA
IPCC	Intergovernmental Panel on Climate Change
kg	Kilograms
kWh	Kilowatt hours (1,000 watt hours)
lbs	Pounds
LGO Protocol	Local Government Operations Protocol
LPG	Liquefied petroleum gas
MMBtu	Million British thermal units
MT	Metric tons
MWh	Megawatt hours (1,000,000 watt hours)
N_2O	Nitrous oxide
PG&E	Pacific Gas and Electric
Wastewater Facility	San José-Santa Clara Regional Wastewater Facility
scf	Standard cubic feet
SJCE	San José Clean Energy
VMT	Vehicle miles traveled

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EXECUTIVE SUMMARY

The City of San José (“City”) recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, well-being, and prosperity of our community. San José has multiple opportunities to benefit by acting quickly to reduce community GHG emissions. Actions to reduce GHG emissions can reduce energy and transportation costs for residents and businesses, create green jobs, improve the health of residents, and make the community a more attractive place to live and locate a business.

In response to the urgency of the climate crisis, the City of San José adopted the Climate Smart San José plan in 2018 to align with the Paris Agreement, and then in 2021 adopted the accelerated goal of carbon neutrality communitywide by 2030. San José's strategies for reducing GHG emissions are laid out in the Climate Smart San José plan and in the Pathway to Carbon Neutrality by 2030, which was adopted by the City in 2022.

The City of San José strives to lead by example by reducing GHG emissions from its own operations. To track progress, this report provides estimates of GHG emissions resulting from the City of San José's government operations in calendar year 2020 and compares them to updated versions of previously completed government operations GHG inventories - for 2005, 2010, and 2018. As the Climate Smart San José plan prioritizes reductions in water consumption alongside emissions reductions, this report also provides data on water usage by City operations in 2020.

Key Findings

Figure ES-1 provides a breakdown of City government operations emissions by sector in 2020. The largest contributor is the wastewater treatment sector, which comprises 38 percent of total emissions. The next largest contributor is buildings and facilities, comprising 21 percent of total emissions. Solid waste, employee commutes, the vehicle fleet, and water services are responsible for the remainder of emissions. The Inventory Results section of this report provides a detailed profile of emissions from San José's government operations in 2020 - key information for guiding future reduction efforts.

City government operations released 78,753 metric tons of carbon dioxide equivalent (MT CO_2e) in 2020 and sequestered 10,529 MT CO_2e, leading to net emissions of 68,224 MT CO_2e. In the most recent community-wide inventory, calculated for 2019, emissions totaled 5,412,154 MT CO_2e. This means that net emissions from City government operations made up approximately one percent of all emissions in San José in 2020.

2010 is the baseline year for measuring progress in reducing City government GHG emissions. Total City government emissions decreased by 16 percent from 2010 to 2020 (not including sequestration by street trees for either year since this data is not available for 2010). Table ES-1 shows changes in emissions from 2010 to 2020 by sector. Emissions decreased from 2010 to 2020 for all sectors except solid waste and wastewater treatment. Emissions from these sectors increased because more biosolids from wastewater treatment were taken to landfill in 2020 and because the City treated wastewater from more people in 2020. Wastewater treatment emissions per capita did not change between 2010 and 2020.

A partial emissions inventory is also available for 2005. When considering only the sectors that were included in that inventory, total City government emissions declined by 17 percent from 2005 to 2020. Figure ES-2 (page 9) provides a comparison of City government operations emissions in 2005, 2010, 2018, and 2020.

City operations and activities used 887 million gallons of water in 2020, a 10 percent decrease from 2018. 25 percent of the total water consumption was supplied by recycled water. 65 percent of total water consumption was used for irrigation.

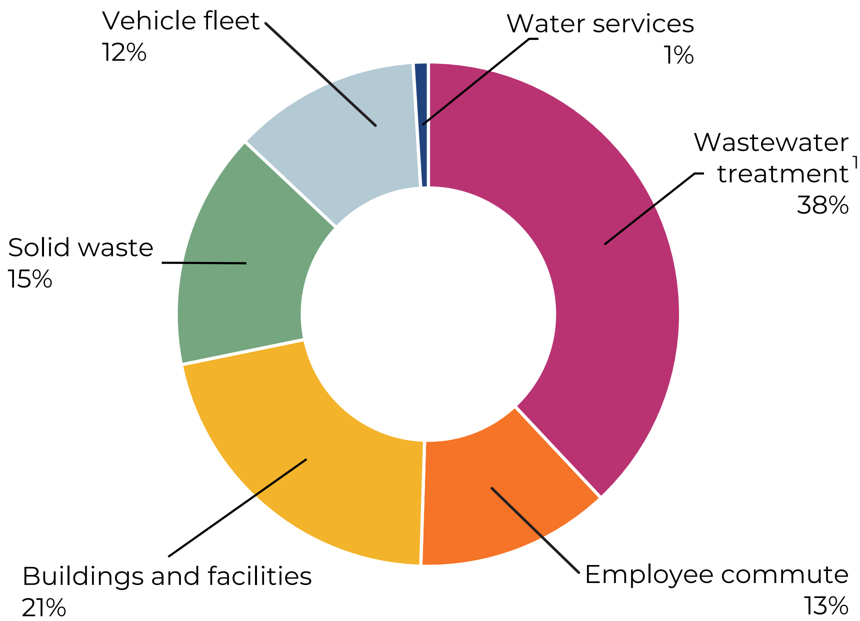


Figure ES-1 *2020 City of San José government operations emissions by sector*

[1] The City of San José provides wastewater treatment services to about three-quarters of Santa Clara County, including more than 1.4 million residents and 17,000 businesses in eight cities and four sanitation districts: Cities of San José, Santa Clara, Milpitas; Cupertino Sanitary District (Cupertino); West Valley Sanitation District (Campbell, Los Gatos, Monte Sereno, and Saratoga); County Sanitation Districts 2-3 (unincorporated); and Burbank Sanitary District (unincorporated).

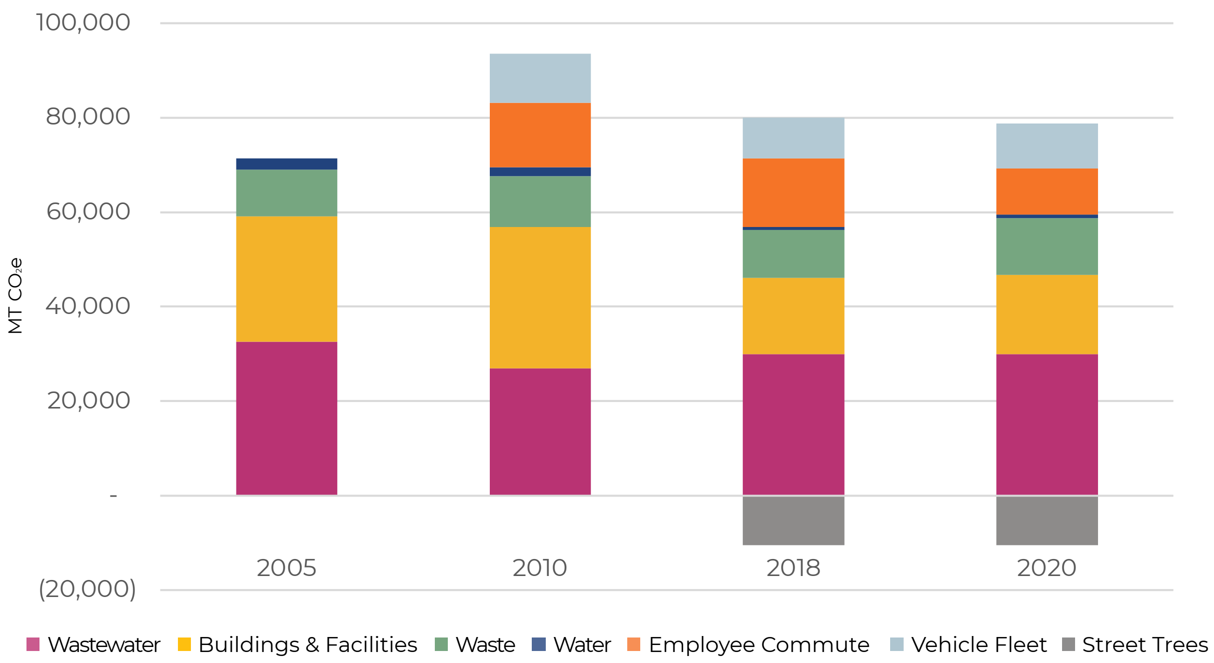
Impact

Because GHG emissions from City operations make up only a small portion of community-wide emissions, reducing City government emissions will have a limited direct impact on community-wide emissions. However, City action to reduce emissions from City operations can indirectly impact community-wide emissions by (1) setting an example, (2) supporting the local green economy, and (3) building City knowledge of emission-reducing strategies.

Table ES-1 *2020 City of San José government operations emissions and change from baseline*

Emission sector/subsector	2020 emissions (MT CO_2e)	Percent change from 2010
Wastewater Treatment	29,927	+ 11%
Employee Commute	9,828	- 28%
Buildings and Facilities	16,779	- 44%
Buildings & Facilities (excluding Airport)	*9,996*	*- 22%*
Airport Buildings & Facilities	*3,731*	*- 55%*
Public Lighting	*2,579*	*- 64%*
Transmission & Distribution Losses	*473*	*- 69%*
Solid Waste	11,990	+ 11%
Vehicle Fleet	9,465	- 9%
Water Services	763	- 59%
Total emissions	**78,753**	**- 16%**
Street Trees	-10,529	No data available for 2010
Net Emissions	**68,224**	**Not comparable**

Figure ES-2 *Comparison of 2005, 2010, 2018, and 2020 City government operations emissions*



Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible GHG emission reductions is to measure current emissions levels and identify sources and activities generating emissions in the community. This report presents emissions from operations of the San José city government, which are a subset of community emissions, as shown in Figure 1. For example, data on commercial energy use in the community includes energy consumed by City government buildings, and community vehicle miles traveled (VMT) estimates include miles driven by City fleet vehicles. San José is focusing on City government operations emissions in order to lead by example.

Local Government Operations Protocol

As local governments have continued to join the climate protection movement, a standardized approach to quantifying GHG emissions has proven essential. In 2008, ICLEI, the California Air Resources Board, and the California Climate Action Registry released the Local Government Operations Protocol (LGO Protocol).[2]

The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. This inventory uses the approach and methods of the latest version of the LGO Protocol, version 1.1, which was published in 2010.

Figure 1 *Relationship between community and local government operations inventories*

[2] Local Government Operations Protocol. http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

Boundary

The LGO Protocol requires local governments to report all GHG emissions from operations over which they have control. It provides two approaches for determining whether emission sources fall within or outside a local government's organizational boundary: the operational control approach, and the financial control approach. Under the operational control approach, a local government should report emissions from all operations where it has full authority to introduce and implement operating policies. Under the financial control approach, a local government should report emissions from all operations that are fully consolidated in financial accounts.

The intention of this inventory is to use the operational control approach. For most City operations, this is straightforward, but in the case of City-owned buildings that are managed by other organizations and City-owned buildings at the Norman Y. Mineta San José International Airport ("Airport") that are occupied by tenants, it is not.

Many important San José buildings, such as the McEnery Convention Center, SAP Center, and Children's Discovery Museum, are owned by the City but managed by other organizations with City oversight. At the Airport, City and tenant operations are intertwined, with many buildings used by both City and tenant operations. In both cases, the City has some power to influence GHG emissions from these buildings, for instance by choosing to purchase electricity from San José Clean Energy (SJCE). Further complicating matters, a comprehensive list of City-owned buildings by tenant or management status was not available when this inventory was prepared, and utility data was not available for all City-owned buildings.

With the aim of maximizing transparency, given current data availability, this inventory includes electricity and natural gas usage for all buildings for which the City pays the utility bills. Table 1 lists City-owned buildings that are not operated by the City, noting whether they are or are not included in this inventory. Future City government operations inventories for San José will hopefully be able to address this issue in more detail.

The situation is similarly complex for street and park trees. Of the approximately 270,000 street trees in in San José, the City directly manages only about 37,000, and the rest are the responsibility of adjacent property owners. However, the City still inventories these trees and responds to calls for emergency maintenance. For these reasons, all street trees are included in this

Table 1 *Buildings owned but not operated by the City, and their status in this inventory*

Included in this inventory	Not included in this inventory
• San José McEnery Convention Center • San José Museum of Art • Center for Performing Arts • History Park • Peralta Adobe – Fallon House Historic Site • Airport: Terminals A and B, Consolidated Rental Auto Center, Federal Inspection Services building, Southwest Airlines Provisioning and GSE Maintenance Hangar, Multiple Tenant Hangars, West Hangar, East Hangar, General Aviation Hangar #9, Air Freight (all occupied by tenants or by both City operations and tenants) • Reuse facilities (community and youth centers that can be used by nonprofits, associations, school districts, and providers at no cost)	• California Theatre • Children's Discovery Museum • City National Civic Auditorium • Hammer Theatre Center • Mexican Heritage Plaza • Montgomery Theater • The Tech Interactive • SAP Center • Excite Ballpark • Solar4America Ice at San José • South Hall • Parkside Hall

inventory. Park trees are directly managed by the City, but no data is currently available for them. They will be included in future inventories if data becomes available.

Emission Scopes

Emissions in local government operations inventories, as in community-wide inventories, are categorized by scope. The scope framework allows emissions from multiple jurisdictions or locations to be added up without double counting. There are three emissions scopes. In the context of a local government inventory, they encompass:

Scope 1: All direct emissions from a facility or piece of equipment operated by the local government. Examples include tailpipe emissions from local government fleet vehicles, and emissions from a furnace in a local government building.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

Scope 3: All other indirect or embodied emissions not covered in Scope 2. Examples include emissions from contracted services, embodied emissions in goods purchased by the local government, emissions from employee commutes, and emissions associated with disposal of government-generated waste.

Scope 1 and Scope 2 emissions are the most essential components of a government operations GHG analysis, as they are the most easily affected by local policy making. This inventory includes all Scope 1 and Scope 2 emissions generated by City government operations, and some Scope 3 emissions.

Base Year

Previous City government operations emissions inventories were completed for 2005 , 2010, and 2018. This inventory utilizes 2010 as its base year, as data for many sectors is missing for 2005. However, to provide as much context as possible, this report also includes a comparison with 2005 City government emissions. Table 2 lists data gaps in the 2005 and 2010 inventories as compared to more recent inventories.

Table 2 *Data gaps in the 2005 and 2010 City of San José government GHG inventories as compared to the more recent City government GHG inventories*

Sector	2005	2010
Buildings and Facilities	No data on fuel use in generators, energy use in the San José McEnery Convention Center, or electricity use in one Airport account served by Silicon Valley Power	No data on energy use in the San José McEnery Convention Center or the Center for the Performing Arts, or electricity use in one Airport account served by Silicon Valley Power
Vehicle Fleet	No data	No data on fuel use by compressed natural gas (CNG) shuttle buses at the Airport
Water Services	No data on fuel use in water pump backup generators	
Wastewater Treatment		
Solid Waste	No data on grit, grease, and screenings sent to landfill from the San José-Santa Clara Regional Wastewater Facility (Wastewater Facility)[3], or on City facilities with residential waste service.	No data on City facilities with residential waste service.
Employee Commute	No data	
Street Trees	No data	No data

[3] The legal, official name of the facility remains San Jose/Santa Clara Water Pollution Control Plant, but beginning in early 2013, the facility was approved to use a new common name, the San José-Santa Clara Regional Wastewater Facility.

The 2005 City government operations inventory was completed by DNV-KEMA with data provided through Joint Venture Silicon Valley. The 2010 City government operations inventory was completed by DNV-KEMA and later updated by AECOM. The 2018 City government operations inventory was completed by City staff with assistance from ICLEI. In the process of compiling the 2020 City government operations inventory, the 2005, 2010, and 2018 inventories were also updated for the sectors where data was available, to be comparable to the 2020 inventory. Data used for all calculations, a detailed description of the methods used, and what was changed from the methodology of previous inventory years are provided in Appendix 1 and 2.

Quantification Methods

GHG emissions can be quantified in two ways:

Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (using a monitoring system), for instance from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.[4]

Calculation-based methodologies calculate emissions using activity data and emission factors. The basic equation used to calculate emissions is:

Activity Data x Emission Factor = Emissions

All emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refers to the measurement of GHG-generating processes, such as fuel consumption by fuel type, metered electricity consumption, and VMT.

Emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emission factors are expressed in terms of emissions per unit of activity data (for example, kilograms of CO_2 per megawatt hour of electricity).

To prepare this inventory, emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) were calculated. CH_4 and N_2O emissions were converted into CO_2e using global warming potential (GWP) values from the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).[5] CO_2e values represent the amount of CO_2 that would lead to the same

[4] This inventory includes emissions data provided by the Wastewater Facility that was gathered through direct measurement.
[5] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change .

amount of warming as a given amount of CH_4 or other GHG, and are used to make GHG emissions easier to summarize and compare.

Calculations for this inventory were made using a new spreadsheet tool built specifically for San José GHG inventories. See Appendix 1 and 2 for details of the activity data, emissions factors, and calculation methods used in composing this inventory. Grand totals presented in this report differ in some cases from summed subsector totals due to rounding.

Inventory Sectors Not Included

Due to a lack of available data, fugitive emissions from refrigerants and other GHGs leaking out of vehicles and equipment were not included.

Fugitive emissions from natural gas transmission and distribution (for instance, pipeline leaks) are not accounted for in this inventory because, according to LGO Protocol guidance, this is required only for local governments that own or operate natural gas transmission or distribution systems.

Data Quality and Uncertainties

The accuracy of a GHG inventory depends on the accuracy of the activity data and emission factors upon which it is based. Data errors, incomplete or missing data, inaccurate estimates, and inaccurate emission factors can all limit inventory accuracy. In this inventory, possible sources of error include:

- **Billing data used to calculate electricity and natural gas usage in City buildings and facilities.** The City oversees a large and complex set of facilities, including the Airport, the Wastewater Facility, pumping stations and reservoirs for the San José Municipal Water System and South Bay Water Recycling, the Animal Care Center, neighborhood and regional parks, fire stations, libraries, community centers, policing centers and police stations, parking lots and garages, sewer pump stations, tens of thousands of streetlights, and more. These facilities are covered by more than 2,000 electricity and natural gas billing accounts. Despite data cleaning, the billing data used here may be missing some City accounts, may include errors in usage, and may include errors in the assignment of accounts to inventory sectors.

- **Estimates of emissions from City solid waste.** The ESD Integrated Waste Management Division has precise data on the amount of waste sent to landfill from most City facilities, but not all - the solid waste from small libraries and fire stations that have residential waste service is not tracked or measured. For 2018 and 2020 inventories, Integrated Waste Management staff provided the number of such facilities and their waste was estimated by assuming that they each have one full bin each week. In addition, though we expect that very little City waste sent to landfill is organic and could generate emissions, we lack a detailed characterization of its composition, and so used a default national emission factor for this calculation. Also, the last detailed characterization of City waste was conducted in 2014, and the composition of City waste may have changed since then. Finally, only some of the amount of green waste generated by City operations is directly measured. The rest was estimated as a percentage of citywide residential green waste, based on information from Integrated Waste Management staff. All of these estimates introduce errors of unknown magnitude.

- **Estimate of emissions from biosolids sent to landfill.** Biosolids, the waste product of the wastewater treatment process, are currently sent to landfill, where they are used as alternative daily cover. Before going to landfill, they are stored in lagoons for two and a half to three years and then in drying beds for about six months. For this inventory, following guidance from ICLEI, it was assumed that they generate as much emissions in landfill as leaves. This assumption was made because, of all waste categories with existing emission factors, leaves are the category expected to behave most similarly to biosolids in landfill. However, their true emissions generation rate is unknown.

- **Estimate of emissions from nitrification and denitrification during wastewater treatment.** In the absence of detailed data, the amount of nitrogen from industrial and commercial wastewater was assumed to be one quarter of the amount of nitrogen from sewage (a default value). Actual data on industrial and commercial wastewater would likely yield a different value.

- **Estimate of emissions from employee commutes.** Employee commute emissions were estimated using data from a 2015 employee survey. This survey was not designed to support estimating commute emissions, and did not ask employees about the distance of their commute, the kind of car they drive, or what kind of public transit they use. In addition, it was answered by only 625 employees, about one-tenth of the total City workforce at the time, and commute patterns may have changed between 2015 and 2020. Multiple assumptions were made in order to estimate emissions, each of which likely introduced error to the calculation.

- **Estimate of sequestration by street trees.** This inventory includes an estimate of negative emissions (sequestration) from street trees in San José. This was based on detailed data on each street tree, but resources do not exist to survey each tree every year and data on some trees is more than 10 years old. In addition, this inventory would ideally include an estimate of sequestration from all vegetation over which the City has influence, not just from street trees. However, no data was available on trees or other vegetation in City parks, or on other vegetation in landscaping in street medians or along streets.

- **Emission factors.** When available, emission factors specific to San José were used, but many of the emission factors used in this inventory are default or average emission factors that may not exactly capture local conditions. The emission calculations in this inventory should be seen as estimates, which would likely differ from direct measurements of emissions.

This inventory was completed as accurately as currently possible. Our hope is for each future City government inventory to be more accurate than the last, thanks to improvements over time in City data capabilities and inventory methodologies.

San José 2020 City Government Operations Inventory Results

Emissions by Scope

As described in the Inventory Methodology section, scopes are used to categorize emissions to avoid double counting within and between entities. Table 3 lists San José government operations emissions for 2020 by scope. CO_2 sequestration by street trees (estimated at 10,529 MT CO_2e), although reported in this inventory, is not accounted for in Table 3.

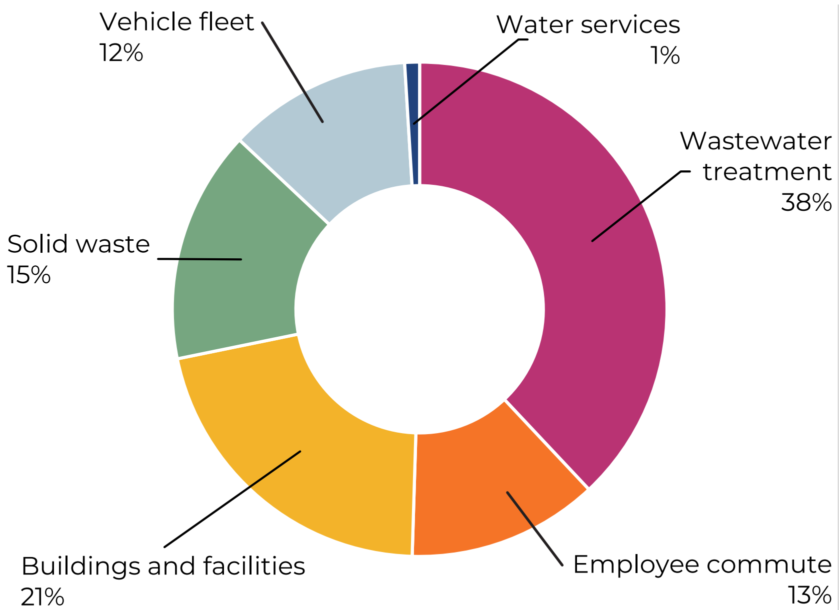
Table 3 *2020 City of San José government operations emissions by scope*

Scope	2020 emissions (MT CO_2e)	Percent of total	Emission sources included
Scope 1	44,822	57%	• Combustion of natural gas in buildings and facilities, including Airport • Combustion of natural gas, fuel oil, and biogas for wastewater treatment • Process emissions from wastewater treatment • Combustion of fuel in City vehicles, generators, and other equipment • Flaring of landfill gas at Singleton Landfill
Scope 2	11,515	15%	• Electricity used in buildings and facilities, including Airport (includes electric vehicle charging) • Electricity used for wastewater treatment • Electricity used for public lighting • Electricity used for water services
Scope 3	22,416	28%	• Employee commutes • Waste sent to landfill • Composted waste • Electricity transmission & distribution losses
Total	**78,753**	**100%**	

Emissions by Sector

In developing emissions reduction policies, it is useful to look at emissions by sector, as each sector will require a different set of strategies. Figure 2 shows a breakdown of San José's 2020 City government operations emissions by sector. Figure 3 and Table 4 show San José's 2020 emissions broken down by sector and subsector. The remainder of this section discusses emissions from each sector in detail.

Figure 2 *2020 City of San José government operations emissions by sector*



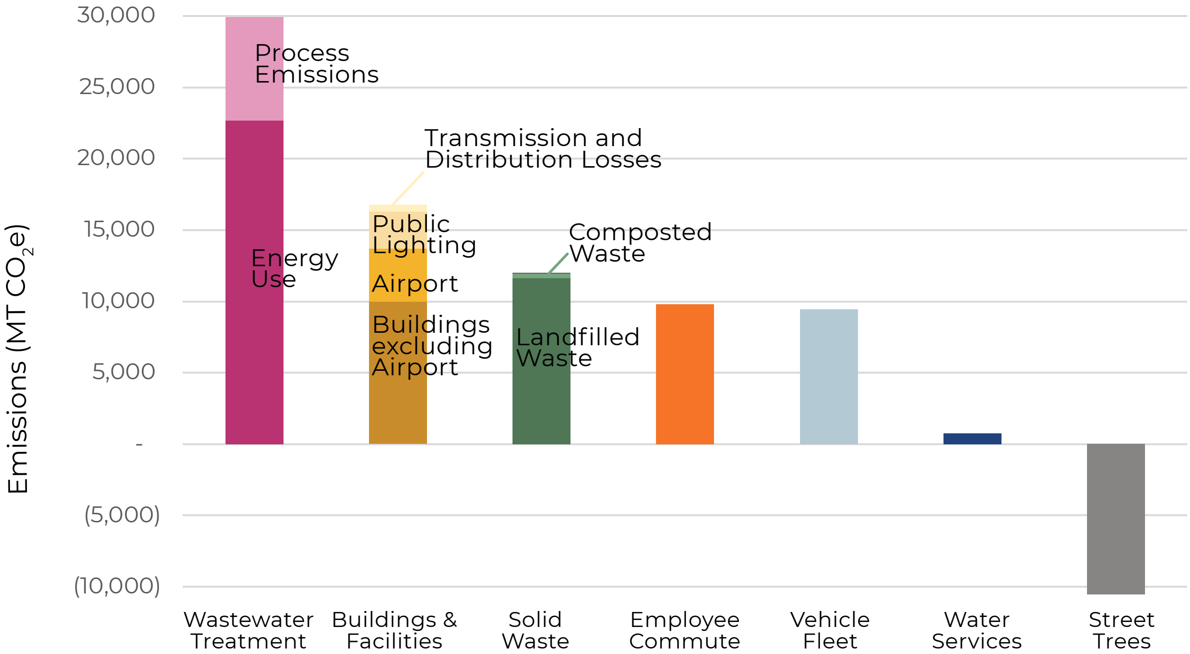


Figure 3 *2020 City of San José government operations emissions in detail*

Table 4 *2020 City of San José government operations emissions by sector and subsector*

Emission sector/subsector	Scope	2020 emissions ($MT\ CO_2e$)	Percent of total
Wastewater Treatment	1 & 2	29,927	38%
Energy Use	*1 & 2*	*22,677*	*29%*
Process Emissions	*1*	*7,250*	*9%*
Buildings and Facilities	1 & 2	16,779	21%
Buildings & Facilities (excluding Airport)	*1 & 2*	*9,996*	*13%*
Airport Buildings & Facilities	*1 & 2*	*3,731*	*5%*
Public Lighting	*2*	*2,579*	*3%*
Transmission & Distribution Losses	*3*	*473*	*0.6%*
Solid Waste	3	11,990	15%
Waste Sent to Landfill	*3*	*11,623*	*14.8%*
Composted Waste	*3*	*355*	*0.5%*
Singleton Landfill	*3*	*13*	*0.02%*
Employee Commute	3	9,828	12%
Vehicle Fleet	1	9,465	12%
Water Services	1 & 2	763	1%
Street Trees	N/A	-10,529	-13%
Total		**68,224**	**100%**

Wastewater Treatment

Wastewater treatment was the largest source of San José's government operations emissions in 2020. Wastewater collection and treatment is an essential public service provided by the Wastewater Facility to about three-quarters of Santa Clara County, including more than 1.5 million residents and 17,000 businesses in eight cities and four sanitation districts. Although the cities of San José and Santa Clara co-own the Wastewater Facility, San José has full operational control of the facility and thus assumes responsibility for and reports all emissions from Wastewater Facility operations.

Wastewater treatment uses a significant amount of energy. The emissions from this energy consumption, most of which are from natural gas use, made up 76 percent of the emissions from this sector and 29 percent of total City government emissions in 2020. Table 5 shows 2020 wastewater treatment energy use emissions by fuel type.

Table 5 *2020 City of San José wastewater treatment emissions by subsector*

Subsector	Emissions (MT CO_2e)	Percent of total wastewater treatment emissions
Energy Use	22,677	75.8%
Natural gas	*20,441*	*68.3%*
Electricity	*1,865*	*6.2%*
Distillate fuel oil no. 2 (Diesel)	*179*	*0.6%*
Transmission & distribution losses	*99*	*0.3%*
Digester gas	*93*	*0.3%*
Process Emissions	7,250	24.2%
Treated effluent discharge	*3,667*	*12.3%*
Nitrification/denitrification	*3,583*	*12.0%*
Total	**29,927**	**100%**

The need for natural gas use at the Wastewater Facility is expected to decrease in future as a result of two projects in the Wastewater Facility's Capital Improvement Program. First, a new Cogeneration Facility was completed in December 2020 that uses digester gas more efficiently than the previous cogeneration engines. Second, the digester rehabilitation project should increase the amount of digester gas produced and available for consumption.

As wastewater is collected, treated, and discharged, chemical and biological processes in aerobic and anaerobic conditions lead to the creation and emission of N_2O. Table 5 shows wastewater process emissions broken down by process within the treatment plant.

The emissions from digester gas combustion were low because it is a biogas, and the CO_2 produced when biogases are burned is classified as biogenic and excluded from GHG inventories. Only the CH_4 and N_2O produced when biogases are burned are included. This is because burning biofuels, which are made from plants or animals, releases carbon that was recently pulled from the atmosphere by plants. Burning fossil fuels, on the other hand, adds ancient carbon to the atmosphere. The combustion of digester gas at the Wastewater Facility released 18,729 MT of biogenic CO_2 in 2020.

Buildings and Facilities

This sector was the second largest source of San José's government operations emissions in 2020. Table 6 shows buildings and facilities emissions by fuel type.

Electricity was the largest source of emissions, followed by natural gas.

The buildings and facilities sector is divided into three subsectors:

- **City-owned buildings & facilities** (excluding those at the Airport, but including those at the Wastewater Facility)
- **City-owned buildings and facilities at the Airport**
- **Public lighting** (streetlights, traffic signals, park lights, and tree and streetscape lighting)

Table 7 provides a full breakdown of emissions by subsector.

Table 6 *2020 City of San José buildings and facilities emissions by fuel type*

Fuel type	Use	Emissions (MT CO_2e)	Percent of total buildings and facilities emissions
Electricity *(including Transmission & Distribution losses)*	City buildings and facilities, public lighting	9,398	56.0%
Natural gas	City buildings and facilities	7,380	44.0%
Gasoline	Generators	0.49	0.003%
Renewable diesel	Generators	0.05	0.0003%
Total		**16,779**	**100%**

Table 7 *2020 City of San José buildings and facilities emissions by subsector*

Subsector	Emissions (MT CO_2e)	Percent of total buildings and facilities emissions
Buildings & Facilities (excluding Airport)	9,996	60%
Electricity	*3,771*	*22%*
Natural gas	*6,225*	*37%*
Generators	*0.5*	*0.003%*
Airport Buildings & Facilities	3,731	22%
Electricity	*2,576*	*15%*
Natural gas	*1,155*	*7%*
Generators	*0.01*	*0.0001%*
Public Lighting	2,579	15%
Transmission & Distribution Losses	473	3%
Total	**16,779**	**100%**

Electricity usage in City-owned buildings and facilities (including at the Airport) includes electricity used to charge City-owned electric vehicles (EVs) and equipment. Emissions from all other City vehicles are included in the vehicle fleet sector.

Airport energy use includes tenant energy use in City-owned buildings because it is difficult to separate from City operations energy use and because the City has some power to influence emissions from these buildings (see Inventory Methodology - Boundary section). Airport natural gas use does not include natural gas supplied to the CNG filling station at the Airport, as this station is also used by non-City vehicles. CNG used in Airport shuttle buses is included in the vehicle fleet sector. In December 2021, the Airport achieved Level 1 of Airport Carbon Accreditation, a global carbon management certification program for airports. As the Airport follows its Sustainability Plan and works toward higher levels of accreditation, it is expected to reduce its emissions.

All City stationary and mobile generators are included in this sector, with the exception of backup generators for water pumps, which are included in the water services sector. Emissions from generators were low because they used little fuel, most of this was renewable diesel, a biofuel, and the CO_2 produced when biofuels are burned is classified as biogenic and excluded from GHG inventories. Only the CH_4 and N_2O produced when biofuels are burned are included. The combustion of renewable diesel by City generators released 57 MT of biogenic CO_2 in 2020.

Solid Waste

Many City government operations generate solid waste. The most prominent source of GHG emissions from solid waste is fugitive CH_4 released by the decomposition of organic waste over time in the anaerobic conditions of a landfill. The scale of these emissions depends upon the size and type of the landfill and the presence or absence of a landfill gas collection system. City waste that is not composted or recycled is sent to Newby Island Landfill, which has a system for collecting and flaring landfill gas. Other emissions included in this sector are from combustion of landfill gas at the closed Singleton Landfill, which is owned by the City, and from CH_4 and N_2O generated by composting green waste (for example, tree trimmings) and biowaste (organic debris sorted from City waste). Table 8 shows solid waste emissions by subsector and source. Waste and emissions totals given here include waste generated at the Airport.

Table 8 *2020 City of San José solid waste emissions and quantity by subsector*

Subsector	Quantity (short tons)	Emissions (MT CO_2e)	Percent of total waste emissions
Waste sent to landfill	61,804	11,623	96.9%
Biosolids from Wastewater Facility	*59,972*	*10,930*	*91.2%*
Grit, grease, and screenings from Wastewater Facility	*1,294*	*489*	*4.1%*
Other City waste	*538*	*204*	*1.7%*
Composted waste	5,972	355	3.0%
Green waste	*3,604*	*255*	*2.1%*
Biowaste	*2,368*	*100*	*0.8%*
Singleton Landfill	N/A	13	0.1%
Total	**56,575**	**11,990**	**100%**

Employee Commute

City employee commutes were a much smaller source of emissions in 2020 than in previous years because of the COVID-19 pandemic, which led to about 40 percent of employees working from home from mid-March until the end of the year.

Employee commute emissions are not under direct operational control of the City of San José, but the City has a variety of tools available to influence them. Emissions presented here are a rough estimate based on a 2015 Employee Commute Survey from the City DOT and 2020 data on number of employees and number of employees working remotely. Full details on the assumptions used to calculate this estimate are given in Appendix 1. A breakdown of employee commute modes from the 2015 survey is given in Figure 4 and a breakdown of estimated employee commute emissions by travel mode is given in Table 9.

The City can influence employee commute emissions by promoting alternative commute modes such as public transit, walking, bicycling, and carpooling, and by promoting options such as compressed workweeks and telecommuting that reduce the number of commute trips employees must make.

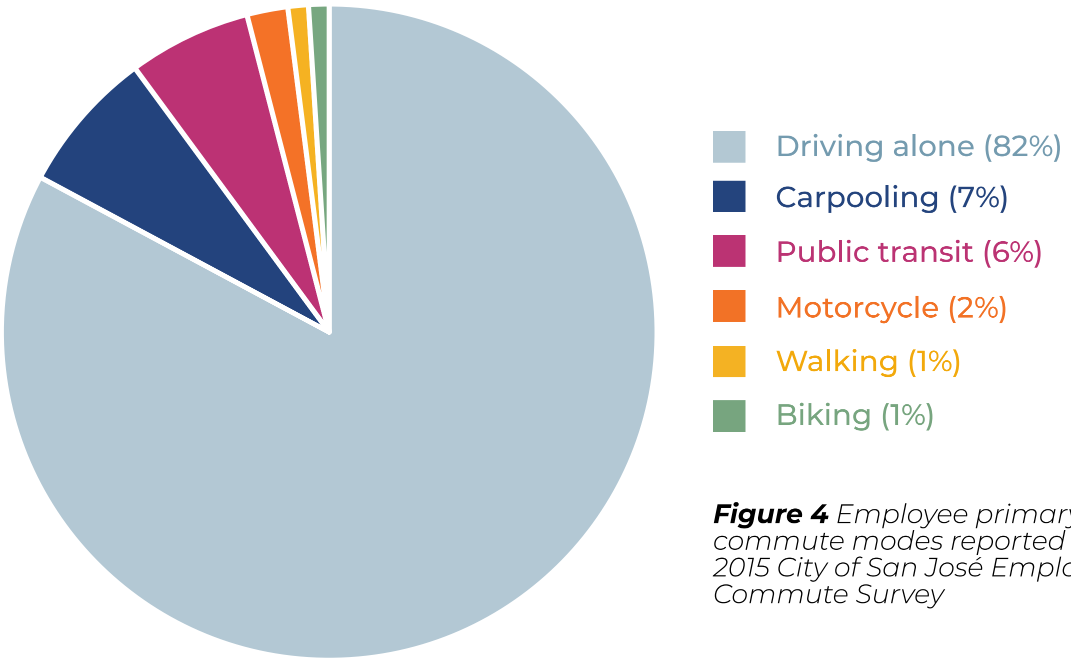


Figure 4 *Employee primary commute modes reported in the 2015 City of San José Employee Commute Survey*

Table 9 *2020 estimated City of San José employee commute emissions by commute mode*

Commute mode	Passenger /vehicle miles	Emissions (MT CO_2e)	Percent of total commute emissions	Emissions per employee (MT CO_2e)
Driving alone	32,279,065	9,262	94.2%	1.7
Carpooling	2,570,980	369	3.8%	0.8
Light rail	1,285,490	128	1.3%	0.6
Bus	1,285,490	69	0.7%	0.3
Total	**37,421,025**	**9,828**	**100%**	**-**

Vehicle Fleet

In 2020, San José operated a fleet of over 2,900 vehicles and mobile equipment units (2,559 on-road and 374 off-road) to perform services such as firefighting, policing, and street maintenance. Table 10 shows vehicle emissions by fuel type.

Emissions from EV charging were counted in the buildings and facilities sector, as City EV chargers are connected to City parking garage or building electric meters. The data currently available does not allow the separation of electricity used for vehicle charging from electricity used elsewhere in buildings with EV chargers, so it is not currently possible to calculate the amount of electricity used for City EV charging. Mobile generators were also counted in the buildings and facilities sector.

Fuel use and emissions for City-owned Airport vehicles are included in this sector. Emissions from non-City owned vehicles used at the Airport (for instance, airline-owned ground support equipment) are not included in this inventory.

In 2020, the diesel vehicles in the City fleet used 100% renewable diesel, and no "regular" (fossil fuel) diesel. Emissions from renewable diesel appear low because the CO_2 produced when biofuels are burned is classified as biogenic, and excluded from GHG inventories. Only the CH_4 and N_2O produced when biofuels are burned are included. The combustion of renewable diesel by the City vehicle fleet released 2,983 MT of biogenic CO_2 in 2020.

Table 10 *2020 City of San José vehicle fleet emissions and fuel use by fuel type*

Fuel type	Fuel consumption (gallons or gallons gas equivalent)	Emissions (MT CO_2e)	Percent of total vehicle fleet emissions
Gasoline	1,050,770	9,249	97.7%
CNG (Airport shuttle buses)	31,177	207	2.2%
Renewable diesel	315,661	7	0.1%
Liquefied petroleum gas (LPG)	484	3	0.03%
Total	**1,398,091**	**9,465**	**100%**

Water Services

The City of San José provides multiple water services: potable water treatment and supply, stormwater and sewer pumping, and irrigation of public parks and landscaping. Table 11 shows emissions from electricity and fuel combustion used to provide these services.

City water pumps run on electricity but also have backup diesel generators. In 2020, these generators used renewable biodiesel, a biofuel. The CO_2 produced when biofuels are burned is classified as biogenic and excluded from GHG inventories. Only the CH_4 and N_2O produced when biofuels are burned are included. The combustion of renewable diesel by City water pumps released 17 MT of biogenic CO_2 in 2020.

Table 11 *2020 City of San José water services emissions by fuel type*

Fuel type	Emissions ($MT\ CO_2e$)	Percent of total water services emissions
Electricity *(including transmission and distribution losses)*	763	99.998%
Renewable diesel	0.01	0.002%
Total	**763**	**100%**

Street Trees

Land use can result in GHG emissions, but it can also lead to removal of CO_2 from the atmosphere. The net effect of land use is calculated by estimating the change in carbon stocks - the stores of carbon in biomass, litter, dead wood, and soils.

Data was not available for a full accounting of GHG emissions and sequestration from City-owned land use in San José, but data on street trees was available. The City of San José maintains approximately 270,000 street trees throughout the community. These trees pull and sequester CO_2 from the atmosphere as they grow, resulting in negative emissions in a GHG inventory. Table 12 shows an estimate of the negative emissions from San José street trees in 2020. Note that this estimate accounts for CO_2 released when street trees are cut down, chipped, and allowed to decompose, which reduces net sequestration.

Table 12 *2020 City of San José emissions sequestration by street trees*

Subsector	Emissions ($MT\ CO_2e$)
Sequestration by street trees	-11,738
Emissions from removed street trees	1,209
Total	**- 10,529**

City Government Water Use

The Climate Smart San José plan aims to reduce water use as well as energy use and GHG emissions. In line with this, this inventory provides data on water use from City government operations.

Data on City government water use (including water use at the Airport) was compiled from billing data provided by the San José Municipal Water System, Great Oaks Water Company, and San Jose Water Company. City government water use in 2020 is presented in Table 13 and Figure 5, broken down by type (potable or recycled) and use (irrigation or other). All water accounts with "irrigation" or "landscaping" account types were counted in the "Irrigation" categories; one City recycled water account with an "agriculture" account type was not counted as irrigation.

City water use decreased by 10 percent from 2018 to 2020. One reason is that 2020 was a drier year, in which there was more awareness of the need for water conservation. The COVID-19 pandemic is also a contributor, as City facilities were used less by employees and members of the public once shelter-in-place orders were put in place.

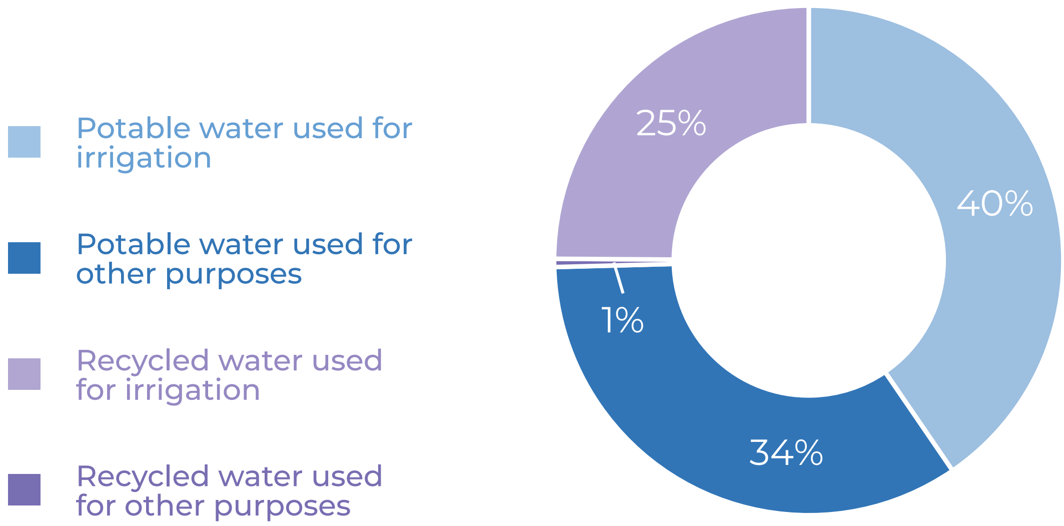


Figure 5 *2020 City of San José government water use*

Table 13 *Comparison of 2018 and 2020 City of San José government water use*

Type	Use	Million gallons 2018	Percent of total 2018	Million gallons 2020	Percent of total 2020
Potable	Irrigation	405.3	41%	358.7	40%
Potable	Non-irrigation	354.5	36%	302.8	34%
Recycled	Irrigation	216.6	22%	220.8	25%
Recycled	Non-irrigation	10.5	1%	4.6	1%
Total		**987.0**	**100%**	**886.9**	**100%**

The Airport is a good example of water conservation practices in City facilities. In FY 2020-2021, approximately 60% of water used at the Airport was recycled. This included all water used for landscaping and the water used to flush toilets in Terminal B.

Conclusion

This 2020 inventory was completed in order to measure City progress in reducing GHG emissions from government operations, using the earlier 2005, 2010, and 2018 City government operations emissions inventories as reference points. Overall emissions in 2020 were lower than in 2005, 2010, and 2018. When considering only the sectors that were included in the 2005 inventory (buildings and facilities, solid waste, wastewater services, and water services), total City government emissions declined by 17 percent from 2005 to 2020. When considering only the sectors that were included in the 2010 inventory (everything except street trees), total City government emissions decreased by 16 percent from 2010 to 2020. When considering all sectors, total City government emissions decreased by 2 percent from 2018 to 2020, mainly because employee commute emissions decreased as a result of the COVID-19 pandemic and shelter-in-place orders. Table 14 and Figure 6 provide a full breakdown of emissions in all four inventory years.

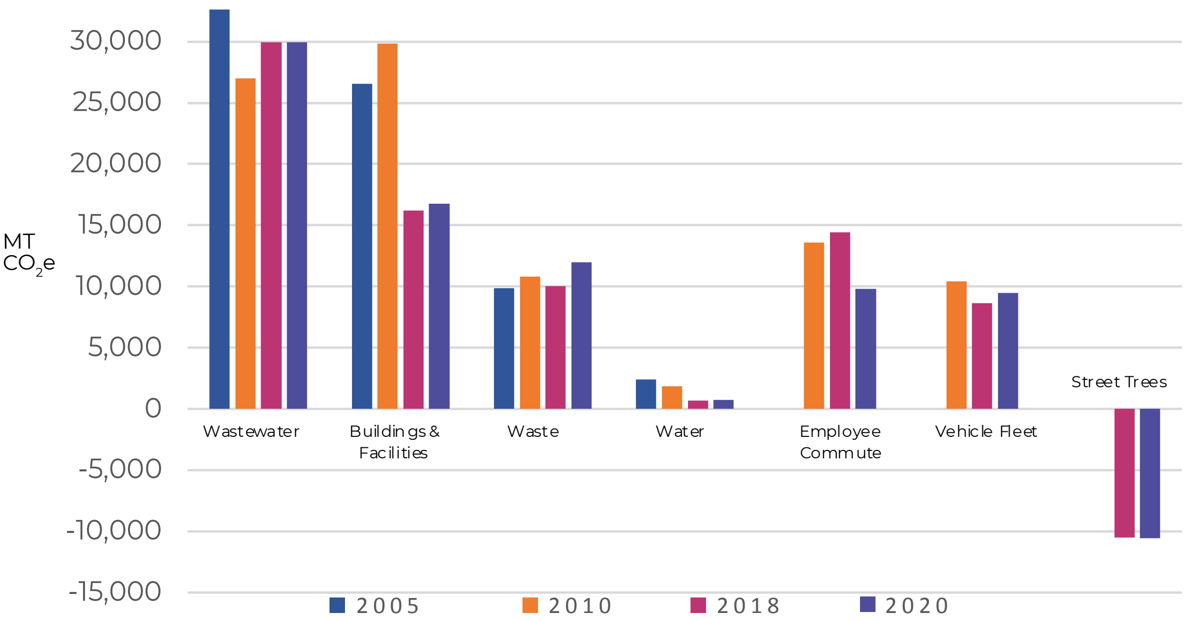
Table 14 *Comparison of 2005, 2010, 2018, and 2020 City government operations emissions (continued on next page)*

Emission sector/subsector	2005 emissions (MT CO_2e)	2010 emissions (MT CO_2e)	2018 emissions (MT CO_2e)	2020 emissions (MT CO_2e)
Wastewater Treatment	**32,611**	**27,012**	**29,951**	**29,927**
Energy Use	26,184	20,391	22,675	22,677
Natural gas	*24,081*	*14,926*	*19,648*	*20,441*
Electricity	*1,613*	*4,795*	*2,656*	*1,865*
Fuel Oil	*261*	*315*	*161*	*179*
Biogas	*143*	*26*	*83*	*93*
Transmission & distribution losses	*86*	*328*	*128*	*99*
Process Emissions	6,427	6,621	7,276	7,250
Treated effluent discharge	*3,321*	*3,360*	*3,932*	*3,667*
Nitrification/denitrification	*3,105*	*3,261*	*3,344*	*3,583*
Employee Commute	**No data**	**13,599**	**14,450**	**9,828**

Table 14 *continued*

Emission sector/subsector	2005 Emissions (MT CO_2e)	2010 Emissions (MT CO_2e)	2018 Emissions (MT CO_2e)	2020 Emissions (MT CO_2e)
Buildings and Facilities	**26,572**	**29,819**	**16,220**	**16,779**
Buildings & Facilities (excluding Airport)	12,993	12,782	9,628	9,996
Electricity	*9,195*	*8,435*	*3,872*	*3,771*
Natural gas	*3,798*	*4,261*	*5,756*	*6,225*
Generators	*No data*	*87*	*0.3*	*0.5*
Airport Buildings & Facilities	4,813	8,267	3,907	3,731
Electricity	*3,909*	*6,659*	*2,658*	*2,576*
Natural gas	*904*	*1,587*	*1,249*	*1,155*
Generators	*No data*	*21*	*0.01*	*0.01*
Public Lighting	7,659	7,242	2,263	2,579
Transmission & Distribution Losses	1,107	1,528	422	473
Solid Waste	**9,853**	**10,808**	**10,059**	**11,990**
Waste Sent to Landfill	9,250	10,352	9,603	11,623
Biosolids from Wastewater Facility	*6,618*	*9,356*	*8,259*	*10,930*
Grit, grease, and screenings from Wastewater Facility	*No data*	*693*	*542*	*489*
Other City waste	*2,632*	*303*	*802*	*204*
Composted Waste	344	389	425	355
Green waste	*344*	*265*	*247*	*255*
Biowaste	*0*	*125*	*178*	*100*
Singleton Landfill	259	67	32	13
Vehicle Fleet	**No data**	**10,398**	**8,622**	**9,465**
Airport CNG Shuttle Buses	No data	No data	1,094	207
Other City Vehicles and Equipment	No data	10,398	7,528	9,259
Water Services	**2,401**	**1,872**	**693**	**763**
Street Trees	**No data**	**No data**	**-10,469**	**-10,529**
Total	**71,437**	**93,508**	**69,526**	**68,224**
Total - excluding Vehicle Fleet, Employee Commute, and Street Trees	**71,437**	**69,511**	**56,923**	**59,459**

Figure 6 *Comparison of 2005, 2010, 2018, and 2020 City government operations emissions by sector*

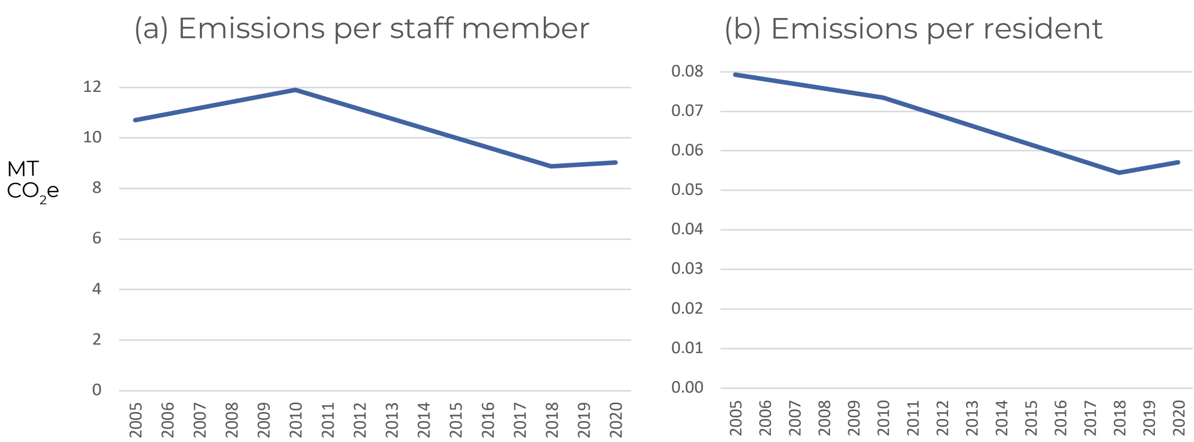


When considering only the sectors that were included in the 2005 inventory GHG emissions per City staff member and per San José resident have decreased since 2005 and 2010 (See Table 15 and Figure 7), but increased slightly from 2018 to 2020.

Table 15 *Number of City staff and total San José population in 2005, 2010, 2018, and 2020*

	2005	2010	2018	2020
Number of City staff (full-time equivalent (FTE) from adopted City operating budgets)	6,671.8	5,839.7	6,412.6	6,592.2
Total San José population (From California Department of Finance Demographics Unit)	901,159	946,954	1,045,854	1,041,466

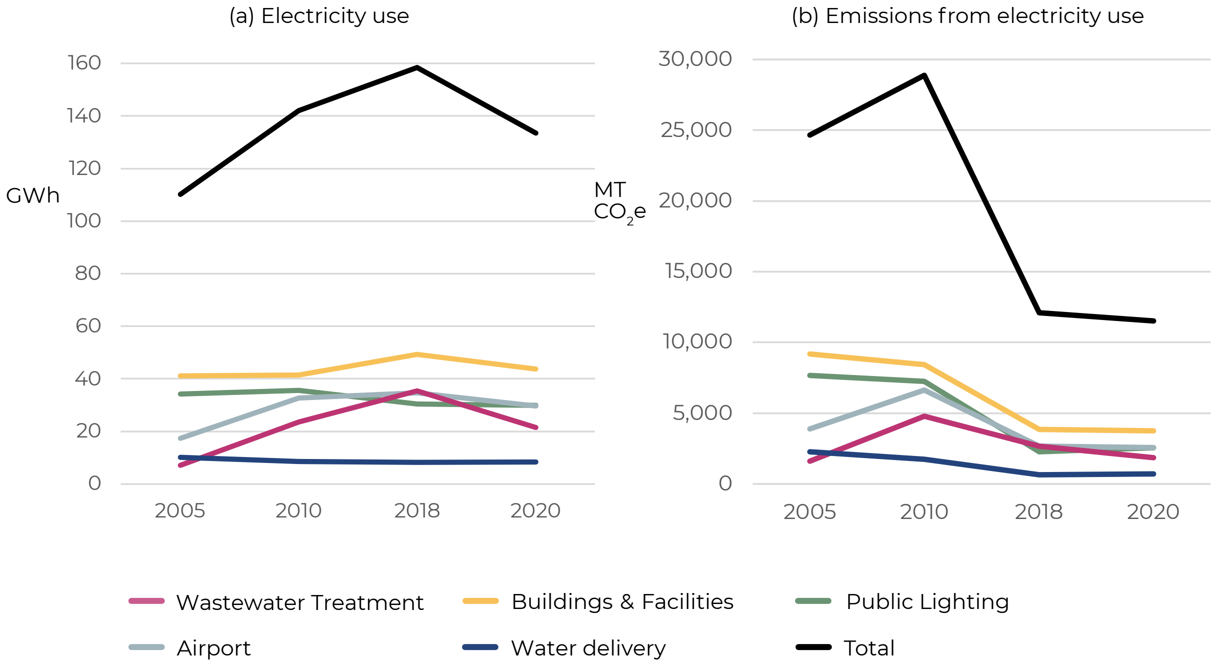
Figure 7 *GHG emissions per (a) City staff member and (b) San José resident from 2005 to 2020*



For most sectors, 2020 emissions were similar to 2018 emissions. The greatest differences were in the following sectors:

- **Decrease in employee commute emissions.** Estimated emissions from employee commutes decreased 32 percent from 2018 to 2020. While commute emissions for both 2018 and 2020 are rough estimates based on incomplete data on employee commute habits, this decrease makes sense because 40 percent of City employees worked from home during COVID-19 shelter-in-place orders in 2020. This large decrease in estimated commute emissions highlights the emissions reductions benefits of remote working.
- **Decrease in use of Airport CNG shuttle buses.** Emissions from CNG shuttle buses at the Airport decreased 81 percent from 2018 to 2020, from 1,094 to 207 MT CO_2e. Prior to the COVID-19 pandemic, the CNG shuttle buses were used to transport employees to a remote lot. That lot was closed mid-March 2020, and since then the CNG buses have remained in service only as emergency backups in case the electric shuttle buses need repair.
- **Decrease in solid waste from City facilities.** From 2018 to 2020, the amount of solid waste sent to landfill and biowaste sent to composting from City facilities, and the associated emissions, decreased by 75 and 44 percent, respectively. This is likely a result of the COVID-19 pandemic and associated shelter-in-place orders, which led to fewer City employees and members of the public using City facilities.
- **Increase in biosolids sent to landfill.** Emissions from biosolids sent to landfill increased 32 percent from 2018 to 2020, as a result of a greater volume of biosolids being sent to landfill. This is the result of normal year-to-year variation. Biosolids are dried for several years before being sent to landfill, and the amount taken to landfill each year varies significantly due to both operational factors and weather.
- **Increase in vehicle fleet fuel use.** Emissions from the City vehicle fleet increased by 10 percent from 2018 to 2020 due to multiple factors: the overall size of the City fleet increased; a suitable EV option was not available for all new vehicles that were added; service calls increased over all City departments; fleet usage was increased to meet COVID and Public Safety Power Shutoff-related needs; and additional short-term rental vehicles were added to the fleet.

__Figure 8__ (a) City government electricity use and (b) emissions from City government electricity use, 2005 to 2020



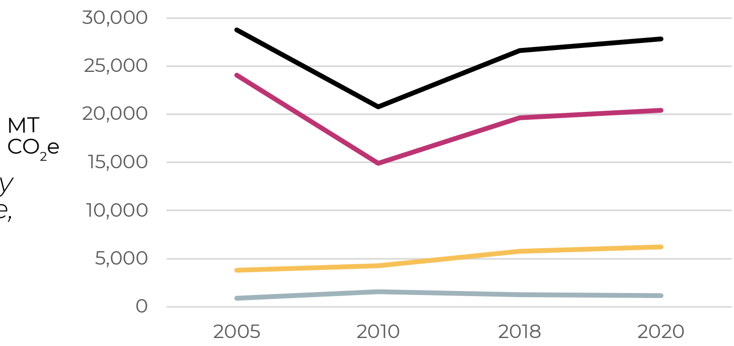


__Figure 9__ Emissions from City government natural gas use, 2005 to 2020

From 2018 to 2020, buildings and facilities electricity usage and emissions decreased because City accounts switched from PG&E to SJCE, which procures cleaner electricity, partway through 2018, and SJCE has continued to procure more carbon-neutral electricity each year. In addition, in 2020 one City facility, the Environmental Innovation Center, received 100% carbon-neutral electricity through SJCE's Total Green option. However, natural gas usage and emissions continued to increase from 2018 to 2020 (see Figures 8 and 9). Given the City's current focus on building electrification, this could be an important area in which to lead by example.

Overall, San José is making progress in decreasing emissions from City government operations and will continue to strive to do so. Actions currently in progress or in the planning phase include upgrading the Wastewater Facility as part of its 10-year Capital Improvement Program, increasing citywide tree canopy following the guidelines in the newly-adopted Community Forest Management Plan, and developing a Transportation Demand Management plan to encourage City employees to commute by alternative modes or telecommute. As identified in the Pathway to Carbon Neutrality by 2030, key next steps could include switching to 100% carbon-neutral electricity from SJCE for all City operations, and continued fuel switching/electrification of both buildings and vehicles.

Through these efforts and others, the City of San José can achieve both emissions reductions and additional accompanying benefits, such as saving money and improving employee safety and quality of life.

Appendix 1
Detailed Methods

Changes from methodology used in previous inventories

- Emissions from electricity transmission and distribution losses were calculated for all inventory years. This subsector was not included in previous inventories.
- Conversions from CH_4 and N_2O to CO_2e for all inventory years were calculated or recalculated using GWP values from the IPCC's Sixth Assessment Report.[6]
- For the employee commute analyses for 2018 and 2020, a new definition of which City facilities are downtown versus not downtown was used. The original 2018 analysis assumed that City Hall is the only downtown City facility. The redone 2018 analysis and new 2020 analysis acknowledge that there are also many other City facilities downtown.
- For the 2010 and 2018 employee commute analyses, a mistake was found in the assumption of the number of workdays in the year. The analyses were redone with a corrected number of workdays (233 for both years, instead of 237 for 2010 and 241 for 2018).
- The emission factors used in the 2010 and 2018 employee commute analyses were updated. The bus and light rail emission factors used in the original analyses came from a 2014 U.S Environmental Protection Agency (EPA) Climate Leaders Emission Factors document, and were updated to emission factors from the EPA Climate Leaders Emission Factors documents for 2011 and 2018, respectively. The driving emission factors used in the original analysis were national averages, and were updated to emission factors for Santa Clara County from the California Air Resources Board's EMFAC 2021 model.

Buildings and facilities

Natural gas. Activity data for City accounts was provided by PG&E. Accounts were categorized based on account descriptions and addresses. Natural gas use from the Airport's CNG filling station was excluded because this station was also used by the general public, and any City vehicle fuel usage from this station was captured in the City fleet fuel use dataset (described in the Vehicle Fleet section below). Emissions were estimated by multiplying usage data by emission factors from the LGO Protocol. Emissions from natural gas used for wastewater treatment were not included, as they were included in the Wastewater Treatment sector.

[6] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change .

Electricity. Activity data for City accounts was provided by PG&E and by the Airport (for one account with Silicon Valley Power). Accounts were categorized based on account descriptions and addresses. Activity data from electricity use for wastewater treatment and water services was not included, as it was included in the Wastewater Treatment and Water Services sectors.

For 2005, 2010, and 2018, CO_2 emissions were estimated by multiplying usage data by emission factors provided by PG&E (via the Climate Registry), SJCE (in its 2018 Integrated Resource Plan), and Silicon Valley Power (via Joint Venture Silicon Valley's Silicon Valley Indicators website - https://siliconvalleyindicators.org/data/place/environment/electricity-use/emissions-intensity-for-power-providers). CH_4 and N_2O emissions were estimated by multiplying usage data by emission factors for each inventory year from the U.S. EPA Emissions & Generation Resource Integrated Database (eGRID) for the CAMX region.

For 2020, CO_2e emissions were estimated by multiplying usage data by CO_2e emission factors provided by SJCE and Silicon Valley Power in their Power Content Labels (the City did not purchase electricity from PG&E in 2020).

Electricity (transmission and distribution losses). Emissions from electricity lost during transmission and distribution were estimated using the grid gross loss factors reported in eGRID for the CAMX region. Emissions were estimated by multiplying the total emissions from electricity use from the Buildings and Facilities sector for each year by the grid gross loss factor for that year.

Generators. Activity (fuel use) data for City generators was provided by the City Fleet Manager. No fuel use data for generators was available for 2005. Emissions were estimated by multiplying usage data by emission factors for gasoline, diesel, and renewable diesel from the LGO Protocol for stationary combustion.

Employee commute

No data on commuting was available for 2005.

For 2010, the average daily employee commute distance was estimated by calculating the weighted average of the answers to the question "How long is your one-way commute distance?" from the 2011 City of San José Employee Commuter/Eco Pass Survey and then doubling this number.

For 2018 and 2020, the average daily employee commute distances for downtown and non-downtown workers were estimated by calculating a weighted average using data on employee home city for downtown and non-downtown workers from the 2015 City of San José Employee Transportation Modes Survey. A commute distance for each city to San José was estimated using Google Maps. The percentages of employees listed in the survey report as commuting from "Other" cities were divided evenly among other cities shown in the maps in the survey report. The percentage of employees working downtown versus not downtown was calculated using data for 2018 and 2020 from the City Human Resources Department on number of employees per City location. Downtown was defined as the Downtown Growth Area in the City's General Plan.

The number of commute days in 2010 (233) was estimated by subtracting 28 (the number of City holidays and holiday closure days plus 10 vacation/sick days) from 261 (the numbers of weekdays in 2010).

The number of commute days in 2018 (233) was estimated by subtracting 28 (the number of City holidays and holiday closure days plus 10 vacation/sick days) from 261 (the numbers of weekdays in 2010).

The number of commute days in 2020 (160.6) was calculated as a weighted average of the number of commute days for the approximately 60% employees who worked on-site all year and the number of commute days for the approximately 40% of employees who worked remotely after COVID-19 shelter-in-place orders started on March 17. The percent of employees who worked remotely was provided by the Office of Employee Services. For employees who worked on-site all year, the number of commute days (235) was estimated by subtracting 27 (the number of City holidays and holiday closure days plus 10 vacation/sick days) from 262 (the numbers of weekdays in 2020). For employees who worked remotely after March, the number of commute days (49) was estimated by subtracting 5 (the number of City holidays before March 17, plus 2 vacation/sick days) from 54 (the numbers of weekdays in 2020 before March 17).

For all inventory years, passenger and vehicle miles traveled by public transit, driving alone, and carpooling/vanpooling were estimated by multiplying the average daily commute distance by the number of workdays, by the number of FTE in the City Operating Budget for the fiscal year starting in the inventory year, and by the percent of 2011 or 2015 survey respondents who indicated that they got to work via public transit, driving alone, or carpooling/vanpooling. For 2018 and 2020, separate survey results for downtown and non-downtown workers were used.The number of public transit passenger miles was divided by two to estimate the number of bus and light rail passenger miles. The number of carpooling/vanpooling passenger miles was divided by two to account for carsharing.

Emission factors for commuting by bus and light rail came from EPA Climate Leaders Emission Factors documents for 2011, 2018, and 2020 from the EPA GHG Emission Factors Hub (https://www.epa.gov/climateleadership/ghg-emission-factors-hub). Emission factors for commuting by driving (alone or carpooling) were calculated from data downloaded from the California Air Resources Board's online EMFAC2021 model (version 1.0.2 - https://arb.ca.gov/emfac/). The "Onroad Emission Rates" option of the Emissions Inventory module was used to download data for 2010, 2018, and 2020 for passenger vehicles (vehicle category "LDA") in Santa Clara County. First, the average number of miles per trip was calculated for each vehicle fuel type by dividing total VMT by the total number of trips. Next, "CO2_STREX", "CH4_STREX", and "N2O_STREX" were converted from g/trip to g/mile by dividing by the average number of miles per trip. Next, total emissions for each gas for each vehicle fuel type were calculated by adding the "RUNEX" and "STREX" values in g/mi. Finally, emission factors were calculated by taking the average of the total emissions factors for each gas, weighted by the population (total number of vehicles in the county) for each vehicle fuel type.

Solid waste

Biosolids and grit, grease, and screenings from Wastewater Facility sent to landfill. For 2005 and 2010, activity data (tons sent to landfill) was provided by ESD staff. No data on grit, grease, and screenings sent to landfill was available for 2005. For 2018 and 2020, activity data was compiled from Wastewater Facility Annual Self-Monitoring Reports. Emissions were estimated using standard emissions factors from ICLEI's ClearPath tool. Following guidance from ICLEI, it was assumed that biosolids generate as much emissions in landfill as leaves, and that grit, grease, and screenings generate as much emissions as generic municipal solid waste. Following the LGO Protocol's Equation 9.1, it was assumed that 10% of the methane generated is oxidized in the landfill and 75% of the methane remaining after oxidation is captured by the landfill gas collection system and not emitted.

Waste from other City facilities sent to landfill. For 2005 and 2010, emissions from landfilled waste were calculated by DNV-KEMA, the consultants who conducted the original 2005 and 2010 inventories, by modeling year-over-year emissions for 100 years. They used activity data (tons sent to landfill) for 2006 and

2010 provided by ESD staff. The emission calculations assumed that 75 percent of methane produced was captured by landfill gas collection systems and that 10 percent was oxidized (and thus subtracted from emissions).

For 2018 and 2020, ESD staff provided data on waste from City facilities sent to landfill. Only residues from solid waste processing were counted, as other landfilled wastes are either inert materials produced by City operations (e.g. asphalt from street work or debris from the fire training center) or trash picked up by the City but not generated by the City (e.g. street sweepings and trash from creek clean ups).

For 2018 and 2020, the amount of solid waste sent to landfill from small City libraries and fire stations with residential service, which are not counted in City waste totals, was also estimated. ESD staff provided a list of such facilities for each inventory year. The amount of landfilled waste produced by these facilities was estimated by assuming that they each produce 1 cubic yard of solid waste per week (the upper limit for receiving residential service), that there are 52 weeks per year, that mixed waste weighs 800 lbs/cubic yard (from https://www.calrecycle.ca.gov/swfacilities/cdi/tools/calculations), and that the percent of this waste that goes to landfill is the same as in the most recent City waste characterization.

For 2018 and 2020, emissions were estimated using the standard emissions factor for municipal solid waste from ICLEI's ClearPath tool. This is a conservative estimate, as solid waste processing in San José removes almost all organics from the waste stream for composting. Following the LGO Protocol's Equation 9.1, it was assumed that 10% of the methane generated is oxidized in the landfill and 75% of the methane remaining after oxidation is captured by the landfill gas collection system and not emitted.

Composted biowaste. Activity data (tons sent to composting) was provided by ESD staff. In 2005, no biowaste was composted, as organic wastes only began to be separated from the City waste stream for composting in 2008. For 2010, the amount of biowaste composted was estimated by multiplying the total amount of waste collected by the share of City government waste that was compostable in a previous waste characterization survey (64.4%).

For 2018 and 2020, the amount of biowaste generated by small City libraries and fire stations with residential service, which are not counted in City waste totals, was also estimated. ESD staff provided a list of such facilities for each inventory year. The amount of biowaste produced by these facilities was estimated by assuming that they each produce 1 cubic yard of solid waste per week (the upper limit for receiving residential service), that there are 52 weeks per year, that mixed waste weighs 800 lbs/cubic yard (from https://www.calrecycle.ca.gov/swfacilities/cdi/tools/calculations), and that the percent of this waste that goes to composting is the same as in the most recent City waste characterization.

Emissions were estimated using standard emissions factors for composted biowaste from ICLEI's ClearPath tool.

Composted green waste. Activity data (tons sent to composting) was provided by ESD staff. Emissions were estimated using standard emissions factors for composted green waste from ICLEI's ClearPath tool.

Combustion of landfill gas at Singleton Landfill. Activity data (landfill gas flared, percent of methane in landfill gas, destruction efficiency of the landfill flare) came from reports submitted by the City to the Bay Area Air Quality Management District, provided by ESD staff. Emissions were calculated by multiplying the total amount of landfill gas flared in each inventory year by the percent of methane in the landfill gas, by the density of methane (18.735 g/scf), and by the percent of landfill gas not combusted by the landfill flare (0% - reflecting a 100% destruction efficiency). This calculation assumes that all landfill gas produced by Singleton

Landfill is collected by the landfill's collection system and passes through the flare. Annual leakage tests at the landfill have shown no appreciable leakage, supporting this assumption.

Street trees

Carbon sequestration. No data on street trees was available for 2005 or 2010. For 2018 and 2020, sequestration was estimated using i-Tree Eco version 6, software provided by the USDA Forest Service (https://www.itreetools.org/tools/i-tree-eco). Individual data for San José's street trees came from the street tree dataset maintained by DOT (https://data.sanjoseca.gov/dataset/street-tree1) - one version from 2019, and one from 2022. The datasets were cleaned for analysis by updating species names to match the names used by i-Tree Eco; removing vacant sites and stumps; removing trees lacking data for diameter at breast height; and editing diameter at breast height data for trees with values over 90 inches, assuming that these values were missing a decimal point. The I-Tree Eco analysis was run using only species names and diameter at breast height, to maximize the number of trees with enough data to be included. The results from the analysis of the 2019 dataset were used for the 2018 inventory. Numbers for the 2020 inventory were estimated by linear interpolation between the 2019 and 2022 values.

Emissions from removed trees. No data on street trees was available for 2005 or 2010. The estimated number of trees removed and mulched per year was provided by the City Arborist. Emissions from removed trees were estimated by calculating the fraction of street trees removed per year (trees removed divided by total number of street trees) and multiplying this by the total street tree carbon stock and the mass ratio of carbon dioxide to carbon. The total street tree carbon stock came from the I-Tree Eco analysis described in the Carbon sequestration section above.

Vehicle fleet

City fleet. No data was available for 2005. Activity data on fuel use and VMT by City vehicles and equipment was provided by the City fleet manager. Activity data from generators and water pumps was not included, as it was included in the Buildings and Facilites and Water Services sectors. Vehicles and equipment were categorized using vehicle and equipment makes, models, and descriptions. On-road vehicles were categorized by vehicle type and weight:

- passenger vehicles - "ordinary cars", not an SUV, truck, or van
- light truck - SUVs, trucks, vans, with Gross Vehicle Weight Rating < 8500 lb
- heavy truck - SUVs, trucks, vans, with Gross Vehicle Weight Rating > 8,500 lb

For 2020, some vehicles and equipment were lacking information on fuel type. Where possible, they were assigned a fuel type based on their make, model, and description. Where this was not possible, their fuel use and VMT was divided among fuel types based on fuel use by all other vehicles or equipment of that type. For example, 28% of offroad-small utility vehicle fuel use was unleaded gasoline, so 28% of the fuel use of off-road small utility vehicles of unknown fuel type was treated like unleaded gasoline.

Emissions were estimated using emission factors from the LGO Protocol and EPA 1990-2020 inventory, Annex 3.2, Table A-88.

Airport CNG shuttle buses. No data was available for 2005 or 2010. 2018 activity data on fuel use and VMT came from the 2019 Mineta San José International Airport CEQA Greenhouse Gas Emissions Technical Report – Amendment to Airport Master Plan and was from 2017. 2020 activity data was provided by the Airport. Emissions were estimated using emission and conversion factors from ICLEI's ClearPath tool and the LGO Protocol.

Wastewater treatment

Energy use. For 2005, electricity, natural gas, landfill gas, digester gas, and diesel usage data was provided by ESD staff, and emissions were calculated using emissions factors from PG&E and eGRID (as described in the Buildings and Facilities electricity section above) and from the LGO Protocol. For 2010, 2018, and 2020, emissions data from the combustion of digester gas, landfill gas, natural gas, and diesel at the Wastewater Facility was taken from reports submitted by ESD staff to CARB's electronic Greenhouse Gas Reporting Tool (Cal e-GGRT). To calculate emissions from electricity use, electricity use data from Wastewater Facility Cal e-GGRT reports was multiplied by PG&E, SJCE, and eGRID emission factors as described in the Buildings and Facilities electricity section above.

Electricity (transmission and distribution losses). Emissions from electricity lost during transmission and distribution were estimated using the grid gross loss factors reported in eGRID for the CAMX region. Emissions were estimated by multiplying the total emissions from electricity use from the Wastewater Treatment sector for each year by the grid gross loss factor for that year.

Process emissions. N_2O emissions from nitrification/denitrification during the treatment process and from effluent were calculated using equations 10.7 and 10.9 from the LGO Protocol. For emissions from nitrification/denitrification, an industrial commercial discharge multiplier of 1.25 was used. Information on the Wastewater Facility's service population over time was provided by ESD staff and taken from Wastewater Facility Annual Self-Monitoring Reports. For emissions from effluent, data on inorganic nitrogen in effluent (provided by Wastewater Facility staff) rather than total nitrogen was used because the organic nitrogen present in Wastewater Facility effluent after treatment is not bioavailable, and the emission factor for discharge to a river or stream was used.

Water services

Electricity. Activity data for City accounts used to power sanitary and stormwater pumps was provided by PG&E. For 2005, 2010, and 2018, CO_2 emissions were estimated by multiplying usage data by emission factors provided by PG&E (via the Climate Registry) and SJCE (in its 2018 Integrated Resource Plan). CH_4 and N_2O emissions were estimated by multiplying usage data by emission factors for each inventory year from eGRID for the CAMX region. For 2020, CO_2e emissions were estimated by multiplying usage data by the CO_2e emission factor provided by SJCE in its Power Content Label (the City did not purchase electricity from PG&E in 2020).

Electricity (transmission and distribution losses). Emissions from electricity lost during transmission and distribution were estimated using the grid gross loss factors reported in eGRID for the CAMX region. Emissions were estimated by multiplying the total emissions from electricity use from the Water Services sector for each year by the grid gross loss factor for that year.

Fuel use. Activity data on fuel use by backup generators used to power sanitary and stormwater pumps was provided by the City fleet manager. Emissions were estimated using emission factors for stationary combustion from the LGO Protocol.

Appendix 2

Data and calculation factors by sector

Note: cells that are not filled in indicate types of data or emission factors that were not used in calculations for that inventory year.

Table A-1 *Buildings and facilities - Electricity*

		2005	2010	2018	2020	Units	Source
Activity data	Airport						
	PG&E	17,477,799	32,751,401	27,141,193	0	kWh	PG&E
	SJCE Green Source	0	0	7,631,006	29,678,562	kWh	PG&E
	SVP	no data	no data	46,944	74,208	kWh	Airport
	Total	**17,477,799**	**32,751,401**	**34,819,143**	**29,752,770**	**kWh**	**Calculated**
	Buildings & Facilities						
	PG&E	41,114,430	41,485,115	39,870,857	0	kWh	PG&E
	SJCE Green Source	0	0	9,425,986	43,750,854	kWh	PG&E/SJCE
	SJCE Total Green	0	0	0	17,775	kWh	PG&E/SJCE
	Total	**41,114,430**	**41,485,115**	**49,296,843**	**43,768,629**	**kWh**	**Calculated**
	Public Lighting						
	PG&E	34,246,233	35,620,953	23,069,634	0	kWh	PG&E
	SJCE Green Source	0	0	7,476,060	29,919,282	kWh	PG&E
	Total	**34,246,233**	**35,620,953**	**30,545,693**	**29,919,282**	**kWh**	**Calculated**
	TOTAL (all subsectors)	**92,838,462**	**109,857,469**	**114,661,679**	**103,440,681**	**kWh**	**Calculated**
	Transmission and distribution losses						
	Grid gross loss for CAMX region	5.3%	6.8%	4.8%	5.3%	Percent	eGRID
Emission factors							
	PG&E - CO2	489.16	444.64	206.29		lbs CO2 per MWh	PG&E
	SJCE - CO2 - Green Source			0.01		MT CO2 per MWh	SJCE 2018 Integrated Resource Plan
	SJCE - CO2e - Green Source				190	lbs CO2e per MWh	SJCE Power Content Label
	SJCE - CO2e - Total Green				0	lbs CO2e per MWh	SJCE Power Content Label
	SVP - CO2			410.1		lbs CO2 per MWh	Joint Venture Silicon Valley - Silicon Valley Indicators website
	SVP - CO2e				542	lbs CO2e per MWh	SVP Power Content Label
	CAMX region - CH4	30	29	34		lbs CH4 per GWh	eGRID
	CAMX region - N2O	11	10	4		lbs N2O per GWh	eGRID

Table A-2 *Buildings and facilities - Natural gas*

		2005	2010	2018	2020	Units	Source
Activity data	Airport	169,878	298,409	234,825	217,154	therms	PG&E
	Buildings & Facilities	714,019	800,973	1,081,967	1,170,187	therms	PG&E
	Total	**883,897**	**1,099,382**	**1,316,792**	**1,387,341**	**therms**	**Calculated**
Emission factors	Pipeline gas (US weighted average) - CO2	53.02				kg CO2 per MMBtu	LGO Protocol 1.1, Table G.1
	Commercial natural gas use - CH4	0.005				kg CH4 per MMBtu	LGO Protocol 1.1, Table G.3
	Natural gas use - N2O	0.0001				kg N2O per MMBtu	LGO Protocol 1.1, Table G.3

***Table A-3** Buildings and facilities - Generators*

		2005	2010	2018	2020	Units	Source
Activity data	Airport						
	Diesel use	no data	2,006	0	0	gallons	City fleet manager
	Renewable diesel use	no data	0	1,285	1,198	gallons	City fleet manager
	Buildings & Facilities						
	Diesel use	no data	8,446	0	0	gallons	City fleet manager
	Renewable diesel use	no data	0	3,512	4,795	gallons	City fleet manager
	Gasoline use	no data	0	29	55	gallons	City fleet manager
Conversion factors	Renewable diesel - MMBtu per gallon	0.13				MMBtu	LGO Protocol 1.1, Table G.2
Emission factors	Diesel use - CO2	10.21				kg CO2 per gallon	LGO Protocol 1.1, Table G.1
	Diesel use for stationary combustion - CH4	0.0015				kg CH4 per gallon	LGO Protocol 1.1, Table G.4
	Diesel use for stationary combustion - N2O	0.0001				kg N2O per gallon	LGO Protocol 1.1, Table G.4
	Renewable diesel use - biogenic CO2	9.45				kg CO2 per gallon	LGO Protocol 1.1, Table G.2
	Renewable diesel use - CH4	0.0011				kg CH4 per MMBtu	LGO Protocol 1.1, Table G.3
	Renewable diesel use - N2O	0.00011				kg N2O per MMBtu	LGO Protocol 1.1, Table G.3
	Gasoline use - CO2	8.78				kg CO2 per gallon	LGO Protocol 1.1, Table G.1
	Gasoline use for stationary combustion - CH4	0.0004				kg CH4 per gallon	LGO Protocol 1.1, Table G.4
	Gasoline use for stationary combustion - N2O	0.0001				kg N2O per gallon	LGO Protocol 1.1, Table G.4

***Table A-4** Employee commutes*

		2005	2010	2018	2020	Units	Source
Activity data	Employees						
	Number of employees working at downtown facilities	no data	no data	2,635	2,483	employees	Human Resources
	Number of employees working at non-downtown facilities	no data	no data	5,022	4,948	employees	Human Resources
	Total	**no data**	**no data**	**7,657**	**7,431**	**employees**	**Calculated**
	Estimated total miles traveled						
	Bus commute passenger miles	no data	11,091,717	1,834,313	1,285,490	miles per year	Calculated based on employee commute surveys from 2011 and 2015
	Light rail commute passenger miles	no data	11,091,717	1,834,313	1,285,490	miles per year	Calculated based on employee commute surveys from 2011 and 2015
	Driving alone commute vehicle miles	no data	28,586,900	45,415,853	32,279,065	miles per year	Calculated based on employee commute surveys from 2011 and 2015
	Carpool/vanpool commute vehicle miles	no data	1,658,040	1,834,313	1,285,490	miles per year	Calculated based on employee commute surveys from 2011 and 2015
Emission factors	Bus travel - CO2	no data	107	56	53	g CO2 per passenger mile	EPA Climate Leaders/GHG s Hub
	Bus travel - CH4	no data	0.0006	0.0013	0.0206	g CH4 per passenger mile	EPA Climate Leaders/GHG s Hub
	Bus travel - N2O	no data	0.0005	0.0009	0.0009	g N2O per passenger mile	EPA Climate Leaders/GHG s Hub
	Light rail travel - CO2	no data	163	119	99	g CO2 per passenger mile	EPA Climate Leaders/GHG s Hub
	Light rail travel - CH4	no data	0.0040	0.0025	0.0089	g CH4 per passenger mile	EPA Climate Leaders/GHG s Hub
	Light rail travel -N2O	no data	0.0020	0.0017	0.0013	g N2O per passenger mile	EPA Climate Leaders/GHG s Hub
	Driving - CO2	no data	349	295	284	g CO2 per vehicle mile	CARB EMFAC2021 model, v1.0.2
	Driving - CH4	no data	0.0428	0.0173	0.0156	g CH4 per vehicle mile	CARB EMFAC2021 model, v1.0.2
	Driving - N2O	no data	0.0274	0.0122	0.0108	g N2O per vehicle mile	CARB EMFAC2021 model, v1.0.2

Table A-5 *Solid waste*

		2005	2010	2018	2020	Units	Source
Activity data	Biosolids from RWF sent to landfill - wet weight	36,312	51,335	45,315	59,972	short tons	Wastewater Facility Annual Self-Monitoring Reports
	Grit, grease, and screenings from RWF sent to landfill	no data	1,833	1,434	1,294	short tons	Wastewater Facility Annual Self-Monitoring Reports
	Number of City facilities with residential trash service	no data	no data	15	16	facilities	Environmental Services Department, Integrated Waste Management
	Percent of City solid waste going to landfill ("residue rate")			17%	17%	percent	Environmental Services Department, Integrated Waste Management
	Percent of City solid waste going to compost			61%	61%	percent	Environmental Services Department, Integrated Waste Management
	Known City waste sent to landfill	4,220	802	2,122	538	short tons	Environmental Services Department, Integrated Waste Management
	Known City biowaste sent to compost	0	2,950	4,204	2,368	short tons	Environmental Services Department, Integrated Waste Management
	Total City green waste sent to compost	4,860	3,746	3,500	3,604	short tons	Environmental Services Department, Integrated Waste Management
	Singleton Landfill - total landfill gas flow				13,484,224	scf per year	Environmental Services Department, Sustainability and Compliance
	Singleton Landfill - average landfill gas flow rate	305	89	41		scf per minute	Environmental Services Department, Sustainability and Compliance
	Singleton Landfill - average fraction of methane in landfill gas	32%	28%	29%	19%	percent	Environmental Services Department, Sustainability and Compliance
	Singleton Landfill - methane destruction efficiency of flare	99%	99%	99%	99%	percent	Environmental Services Department, Sustainability and Compliance
Emission factors	Biosolids in landfill - CH4	30				kg CH4 per wet short ton	ICLEI ClearPath inventory tool
	Grit, grease, and screenings in landfill - CH4	60				kg CH4 per wet short ton	ICLEI ClearPath inventory tool
	Mixed Municipal Solid Waste (MSW) in landfill - CH4	60				kg CH4 per wet short ton	ICLEI ClearPath inventory tool
	Composted green waste - CH4	0.00056				MT CH4 per short ton	ICLEI ClearPath inventory tool
	Composted green waste - N2O	0.00020				MT N2O per short ton	ICLEI ClearPath inventory tool
	Composted biowaste - CH4	0.00022				MT CH4 per short ton	ICLEI ClearPath inventory tool
	Composted biowaste - N2O	0.00013				MT N2O per short ton	ICLEI ClearPath inventory tool

Table A-6 *Street trees*

		2005	2010	2018	2020	Units	Source
Activity data	Total number street trees	no data	no data	269,408	269,458	trees	City arborist
	Total street tree carbon stock	no data	no data	96,432	97,909	short tons C	iTree Eco analysis
	Annual street tree removal rate	no data	no data	1,000	1,000	number of trees removed per year	City arborist
Conversion factors	molecular weight ratio of CO2 to C	3.67					LGO Protocol 1.1, Appendix F
Sequest-ration data	Total carbon sequestration	no data	no data	3,180	3,201	MT C per year	iTree Eco analysis

Table A-7 *Vehicle fleet*

		2005	2010	2018	2020	Units	Source
Activity data	Fuel use						
	Biodiesel use	no data	209,401			gallons	City fleet manager
	Diesel use	no data	6,730			gallons	City fleet manager
	LPG use	no data	322	543	484	gallons	City fleet manager
	Methanol use	no data	518			gallons	City fleet manager
	On-road passenger gasoline use	no data			179,065	gallons	City fleet manager
	On-road light-duty gasoline use	no data			777,315	gallons	City fleet manager
	On-road heavy-duty gasoline use	no data			78,957	gallons	City fleet manager
	On-road non-hybrid gasoline use	no data		799,968		gallons	City fleet manager
	On-road hybrid gasoline use	no data		44,321		gallons	City fleet manager
	Off-road large utility gasoline use	no data		264	31	gallons	City fleet manager
	Off-road small utility gasoline use	no data		4,311	5,774	gallons	City fleet manager
	Off-road boat gasoline use	no data		293	283	gallons	City fleet manager
	Miscellaneous gasoline use	no data			9,345	gallons	City fleet manager
	Gasoline use (total)	**no data**	**1,166,267**	**849,157**	**1,050,770**	**gallons**	City fleet manager
	On-road light duty renewable diesel use	no data			1,214	gallons	City fleet manager
	On-road heavy duty renewable diesel use (inc	no data			271,781	gallons	City fleet manager
	On-road non-hybrid renewable diesel use	no data		277,987		gallons	City fleet manager
	On-road hybrid renewable diesel use	no data		315		gallons	City fleet manager
	Off-road large utility renewable diesel use	no data		8,084	9,393	gallons	City fleet manager
	Off-road small utility renewable diesel use	no data		10,889	14,107	gallons	City fleet manager
	Off-road boat renewable diesel use	no data		611	0	gallons	City fleet manager
	Miscellaneous renewable diesel use	no data		0	19,167	gallons	City fleet manager
	Renewable diesel use (total)	**no data**		**297,886**	**315,661**	**gallons**	**City fleet manager**
	Airport shuttles CNG use	no data	no data	154,522	31,177	GGE	Airport
	Fleet characteristics						
	Average vehicle fuel efficiency	no data	24.7			miles per gallon	City fleet manager
	Share of on-road gasoline vehicles that are passenger vehicles	no data		33.1%		percent	City fleet manager
	Share of on-road gasoline vehicles that are light trucks	no data		49.7%		percent	City fleet manager
	Share of on-road gasoline vehicles that are heavy trucks	no data		17.3%		percent	City fleet manager
	Share of on-road diesel vehicles that are light trucks	no data		1.0%		percent	City fleet manager
	Share of on-road diesel vehicles that are heavy trucks	no data		99.0%		percent	City fleet manager
	Share of on-road hybrid gas vehicles that are passenger vehicles	no data		64.8%		percent	City fleet manager
	Share of on-road hybrid gasoline vehicles that are light trucks	no data		35.2%		percent	City fleet manager
	Share of on-road hybrid diesel vehicles that are heavy trucks	no data		100.0%		percent	City fleet manager
	Vehicle miles traveled						
	LPG VMT	no data	no data	1,336	1,308	miles	City fleet manager
	On-road passenger gasoline VMT	no data	no data		2,818,754	miles	City fleet manager
	On-road light-duty gasoline VMT	no data	no data		7,633,603	miles	City fleet manager
	On-road heavy-duty gasoline VMT	no data	no data		699,139	miles	City fleet manager
	On-road non-hybrid gasoline VMT	no data	no data	8,765,533		miles	City fleet manager
	On-road hybrid gasoline VMT	no data	no data	1,320,294		miles	City fleet manager
	Off-road large utility gasoline VMT	no data	no data	74	25	miles	City fleet manager
	Off-road small utility gasoline VMT	no data	no data	33,835	3,435	miles	City fleet manager
	Off-road boat gasoline VMT	no data	no data	28	28	miles	City fleet manager
	On-road light duty renewable diesel VMT	no data	no data		16,895	miles	City fleet manager
	On-road heavy duty renewable diesel VMT	no data	no data		2,373,752	miles	City fleet manager
	On-road non-hybrid renewable diesel VMT	no data	no data	2,252,647		miles	City fleet manager
	On-road hybrid renewable diesel VMT	no data	no data	1,301		miles	City fleet manager
	Off-road large utility renewable diesel VMT	no data	no data	6,277	119,426	miles	City fleet manager
	Off-road small utility renewable diesel VMT	no data	no data	17,002	20,425	miles	City fleet manager
	Off-road boat renewable diesel VMT	no data	no data	1,809	0	miles	City fleet manager
	Airport shuttles VMT	no data	no data	652,912		miles	Airport
Conversion factors	CNG - MMBtu per gallon gas equivalent	0.12				MMBtu	ICLEI ClearPath inventory tool

***Table A-7** continued*

Emission factors	LPG - CO2	5.79	kg CO2 per gallon	LGOP V1.1 Table G.11
	LPG - light duty vehicles - CH4	0.037	g CH4 per mile	LGOP V1.1 Table G.13
	LPG - light duty vehicles - N2O	0.067	g N2O per mile	LGOP V1.1 Table G.13
	Methanol - CO2	4.10	kg CO2 per gallon	LGOP V1.1 Table G.11
	Methanol - light duty vehicles - CH4	0.018	g CH4 per mile	LGOP V1.1 Table G.13
	Methanol - light duty vehicles - N2O	0.067	g N2O per mile	LGOP V1.1 Table G.13
	CNG - CO2	53.06	kg CO2 per MMBtu	ICLEI ClearPath
	CNG - shuttle bus - CH4	0.002	kg CH4 per mile	LGOP V1.1 Table G.13
	CNG - shuttle bus - N2O	0.0002	kg N2O per mile	LGOP V1.1 Table G.13
	Biodiesel - biogenic CO2	9.45	kg biogenic CO2 per gallon	LGOP V1.1 Table G.11
	Biodiesel - light duty vehicle - CH4	0.000001	kg CH4 per mile	LGOP V1.1 Table G.13
	Biodiesel - light duty vehicle - N2O	0.000001	kg N2O per mile	LGOP V1.1 Table G.13
	Biodiesel - heavy duty vehicle - CH4	0.00001	kg CH4 per mile	LGOP V1.1 Table G.13
	Biodiesel - heavy duty vehicle - N2O	0.00001	kg N2O per mile	LGOP V1.1 Table G.13
	Biodiesel - off-road large utility - CH4	0.0006	kg CH4 per gallon	LGOP V1.1 Table G.14
	Biodiesel - off-road large utility - N2O	0.0003	kg N2O per gallon	LGOP V1.1 Table G.14
	Gasoline - CO2	8.78	kg CO2 per gallon	LGOP V1.1 Table G.11
	Gasoline - light truck, 2006 model year - CH4	0.016	g CH4 per mile	LGOP V1.1 Table G.12
	Gasoline - light truck, 2006 model year - N2O	0.009	g N2O per mile	LGOP V1.1 Table G.12
	Gasoline - passenger, CARB LEVII standard - CH4	0.007	g CH4 per mile	EPA 1990-2020 inventory, Annex 3.2, Table A-88
	Gasoline - passenger, CARB LEVII standard - N2O	0.004	g N2O per mile	EPA 1990-2020 inventory, Annex 3.2, Table A-88
	Gasoline - light-duty truck, CARB LEVII standard - CH4	0.008	g CH4 per mile	EPA 1990-2020 inventory, Annex 3.2, Table A-88
	Gasoline - light-duty truck, CARB LEVII standard - N2O	0.006	g N2O per mile	EPA 1990-2020 inventory, Annex 3.2, Table A-88
	Gasoline - heavy-duty truck, 2007 model year - CH4	0.033	g CH4 per mile	LGOP V1.1 Table G.12
	Gasoline - heavy-duty truck, 2007 model year - N2O	0.017	g N2O per mile	LGOP V1.1 Table G.12
	Gasoline - offroad utility (small or large) - CH4	0.500	g CH4 per gallon	LGOP V1.1 Table G.14
	Gasoline - offroad utility (small or large) - N2O	0.220	g N2O per gallon	LGOP V1.1 Table G.14
	Gasoline - boat - CH4	0.640	g CH4 per gallon	LGOP V1.1 Table G.14
	Gasoline - boat - N2O	0.220	g N2O per gallon	LGOP V1.1 Table G.14
	Diesel - CO2	10.21	kg CO2 per gallon	LGOP V1.1 Table G.11
	Diesel - light truck, 2006 model year - CH4	0.001	g CH4 per mile	LGOP V1.1 Table G.12
	Diesel - light truck, 2006 model year - N2O	0.001	g N2O per mile	LGOP V1.1 Table G.12

***Table A-8** Wastewater treatment*

		2005	2010	2018	2020	Units	Source
Activity data	Electricity use						
	PG&E	7,212,486	23,585,124	27,135,008	0	kWh	PG&E/Wastewater Facility
	SJCE Green Source	0	0	8,347,600	21,641,013	kWh	PG&E
	Total	**7,212,486**	**23,585,124**	**35,482,608**	**21,641,013**	**kWh**	**Calculated**
	Transmission and distribution losses						
	Grid gross loss for CAMX region	5.3%	6.8%	4.8%	5.3%	Percent	eGRID
	Fuel use						
	Digester gas use	1,344,518				scf per day	Wastewater Facility
	Heat content of digester gas	620				Btu per scf	2010 Wastewater Facility Cal e-GGRT report (not expected to change much with time)
	Landfill gas use	1,350,368				scf per day	Wastewater Facility
	Heat content of landfill gas	504				Btu per scf	2010 Wastewater Facility Cal e-GGRT report (not expected to change much with time)
	Natural gas use	4,536,943				therms	Wastewater Facility
	Diesel use	25,413				gallons	Wastewater Facility
	Factors affecting N2O emissions						
	Service population	1,300,000	1,365,000	1,400,000	1,500,000	people	Wastewater Facility
	Inorganic nitrogen load in effluent	4,243	4,293	5,023	4,685	kg per day	Wastewater Facility
Emissions data							
	Digester gas - biogenic CO2		39,989	16,872	18,729	MT	Wastewater Facility Cal e-GGRT reports
	Digester gas - CH4		0.35	1.04	1.15	MT	Wastewater Facility Cal e-GGRT reports
	Digester gas - N2O		0.04	0.20	0.23	MT	Wastewater Facility Cal e-GGRT reports
	Landfill gas - biogenic CO2		12,677	0	0	MT	Wastewater Facility Cal e-GGRT reports
	Landfill gas - CH4		0.11	0	0	MT	Wastewater Facility Cal e-GGRT reports
	Landfill gas - N2O		0.01	0	0	MT	Wastewater Facility Cal e-GGRT reports
	Natural gas - CO2		14,911	19,626	20,419	MT	Wastewater Facility Cal e-GGRT reports
	Natural gas - CH4		0.25	0.37	0.39	MT	Wastewater Facility Cal e-GGRT reports
	Natural gas - N2O		0.03	0.04	0.04	MT	Wastewater Facility Cal e-GGRT reports
	Diesel - CO2		314	160	178	MT	Wastewater Facility Cal e-GGRT reports
	Diesel - CH4		0.013	0.007	0.007	MT	Wastewater Facility Cal e-GGRT reports
	Diesel - N2O		0.003	0.001	0.001	MT	Wastewater Facility Cal e-GGRT reports
Conversion factors							
	Diesel - MMBtu per gallon	0.14				MMBtu	LGO Protocol 1.1, Table G.1
	molecular weight ratio of N2O to N2	1.57					LGO Protocol 1.1, Equation 10.9
Emission factors							
	PG&E - CO2	489.16	444.64	206.29		lbs CO2 per MWh	PG&E
	SJCE - CO2 - Green Source			0.01		MT CO2 per MWh	SJCE 2018 Integrated Resource Plan
	SJCE - CO2e - Green Source				190	lbs CO2e per MWh	SJCE Power Content Label
	CAMX region - CH4	30	29	34		lbs CH4 per GWh	eGRID
	CAMX region - N2O	11	10	4		lbs N2O per GWh	eGRID
	Digester/landfill gas use - biogenic CO2	52.07				kg biogenic CO2 per MMBtu	LGO Protocol 1.1, Table G.2
	Digester/landfill gas use - CH4	0.0032				kg CH4 per MMBtu	LGO Protocol 1.1, Table G.3
	Digester/landfill gas use - N2O	0.0006				kg N2O per MMBtu	LGO Protocol 1.1, Table G.3
	Pipeline gas (US weighted average) - CO2	53.02				kg CO2 per MMBtu	LGO Protocol 1.1, Table G.1
	Industrial natural gas use - CH4	0.0010				kg CH4 per MMBtu	LGO Protocol 1.1, Table G.3
	Natural gas use - N2O	0.0001				kg N2O per MMBtu	LGO Protocol 1.1, Table G.3
	Diesel use - CO2	10.21				kg CO2 per gallon	LGO Protocol 1.1, Table G.1
	Diesel use for stationary combustion - CH4	0.0015				kg CH4 per gallon	LGO Protocol 1.1, Table G.4
	Diesel use for stationary combustion - N2O	0.0001				kg N2O per gallon	LGO Protocol 1.1, Table G.4
	N2O from effluent	0.005				kg N2O-nitrogen per kg nitrogen in effluent	LGO Protocol 1.1, Equation 10.9
	Nitrification/denitrification process - N2O	0.007				kg N2O per person	LGO Protocol 1.1, Equation 10.7

Table A-9 *Water services*

		2005	2010	2018	2020	Units	Source
Activity data	Electricity use						
	PG&E	10,194,492	8,604,318	6,826,595	0	kWh	PG&E
	SJCE Green Source	0	0	1,459,520	8,409,903	kWh	PG&E
	Total	**10,194,492**	**8,604,318**	**8,286,114**	**8,409,903**	**kWh**	**Calculated**
	Transmission and distribution losses						
	Grid gross loss for CAMX region	5.3%	6.8%	4.8%	5.3%	Percent	eGRID
	Fuel use						
	Diesel	no data	265	0	0	kWh	City fleet manager
	Renewable diesel	no data	0	121	1,838	kWh	City fleet manager
Conversion factors							
	Renewable diesel - MMBtu per gallon	0.13				MMBtu	LGO Protocol 1.1, Table G.2
Emission factors							
	PG&E - CO2	489.16	444.64	206.29		lbs CO2 per MWh	PG&E
	SJCE - CO2 - Green Source			0.01		MT CO2 per MWh	SJCE 2018 Integrated Resource Plan
	SJCE - CO2e - Green Source				190	lbs CO2e per MWh	SJCE Power Content Label
	CAMX region - CH4	30	29	34		lbs CH4 per GWh	eGRID
	CAMX region - N2O	11	10	4		lbs N2O per GWh	eGRID
	Diesel use - CO2	10.21				kg CO2 per gallon	LGO Protocol 1.1, Table G.1
	Diesel use for stationary combustion - CH4	0.0015				kg CH4 per gallon	LGO Protocol 1.1, Table G.4
	Diesel use for stationary combustion - N2O	0.0001				kg N2O per gallon	LGO Protocol 1.1, Table G.4
	Renewable diesel use - biogenic CO2	9.45				kg CO2 per gallon	LGO Protocol 1.1, Table G.2
	Renewable diesel use - CH4	0.0011				kg CH4 per MMBtu	LGO Protocol 1.1, Table G.3
	Renewable diesel use - N2O	0.00011				kg N2O per MMBtu	LGO Protocol 1.1, Table G.3

Table A-10 *GWP values*

		2005	2010	2018	2020	Units	Source
GWP values	CH4 from fossil fuel source	30				units CO2e per units CH4	IPCC 6th Assessment Report
	CH4 from non-fossil fuel source	27				units CO2e per units CH4	IPCC 6th Assessment Report
	N2O	273				units CO2e per units N2O	IPCC 6th Assessment Report