City of San José

2017 Inventory of Community Greenhouse Gas Emissions

Produced by ICLEI - Local Governments for Sustainability USA for City of San José through the Statewide Energy Efficiency Collaborative (SEEC)

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ICLEI Local Governments for Sustainability USA

City of San José, Capital of Silicon Valley

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Supporting California local governments

CREDITS AND ACKNOWLEDGEMENTS

City of San José

Julie Benabente, Environmental Programs Manager, Environmental Services Department (ESD)
Phil Cornish, Supervising Environmental Services Specialist, ESD
Agustin Cuello Leon, Engineer, Department of Transportation
Eric Dunlavey, Environmental Program Manager, ESD
Patrick Hansen, Environmental Programs Manager, Mineta San José International Airport
Pedro Hernandez, Supervising Environmental Services Specialist, ESD
Jason Nettleton, Senior Engineer, ESD
Meenaxi Raval, Supervising Environmental Planner, Planning, Building and Code Enforcement

Regional Entities

Ken Betts, Assistant Director, Santa Clara County Airport
Timothy S. Guster, Vice President and General Counsel, Legal and Regulatory Affairs, Great Oaks Water Co.
Mark Taormina, Manager of Operations, San José Water
Gino Yekta, Senior Waste Management Engineer, Waste Permitting, Compliance and Mitigation Division, CalRecycle
Tranika White, Principal Budget and Performance Analyst, Capitol Corridor Joint Powers Authority

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Abbreviations

ACE	Altamont Corridor Express
ADC	Alternative disposal coverage
ATADS	Federal Aviation Administration Air Traffic Activity System
CARB	California Air Resources Board
CH4	Methane
CO2	Carbon dioxide
CPUC	California Public Utility Commission
GHG	Greenhouse gas
GPC	Global Protocol for Community Scale GHG Inventories
GOW	Great Oaks Water Company
IPCC	Intergovernmental Panel on Climate Change
MWS	San José Municipal Water System (City-owned)
N2O	Nitrous oxide
PG&E	Pacific Gas and Electric
SJWC	San José Water Company
VMT	Vehicle miles traveled
VTA	Santa Clara Valley Transportation Authority
US EIA	United States Energy Information Administration

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Introduction

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases (GHGs) and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other GHGs into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

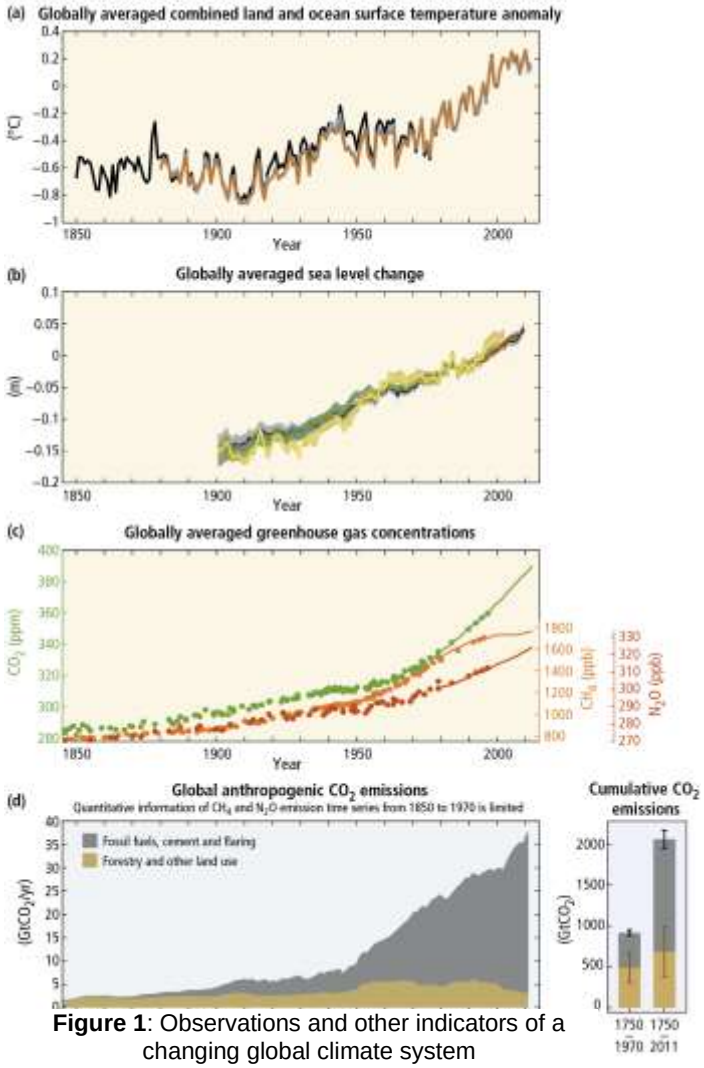

Figure 1: Observations and other indicators of a changing global climate system

The City of San José is likely to be impacted by climate change: San José already experiences an average of four extreme heat days a year and that number is modeled to go up to 15 days a year by 2070[1]. Like the rest of California, San José may expect increased upstream water shortages, air pollution from wildfire, flooding, and the disruption of ecosystems, habitats, and agricultural activities.

Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

[1] Cal Adapt 2019

EVIDENCE OF HUMAN-CAUSED CLIMATE CHANGE

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fifth Assessment (2013) asserts that:

> "It is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together. Globally, economic and population growth continued to be the most important drivers of increases in CO2 emissions from fossil fuel combustion. Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions."

In short, the Earth is already responding to climate change drivers introduced by mankind.

Inventory Methodology

UNDERSTANDING A GREENHOUSE GAS EMISSIONS INVENTORY

The first step requires identifying baseline emissions levels and the sources and activities generating emissions in the community. This report presents emissions from the San José community as a whole. A separate municipal operations inventory will be prepared in the future.

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the Global Protocol for Community Scale GHG Inventories (GPC). The GPC was developed in 2014 by C4O, ICLEI, and the World Resources Institute as a global standard protocol for GHG inventorying. The GPC is the official protocol specified by the Global Covenant of Mayors, and defines what emissions must be reported and how. In addition, this inventory draws on methods from the U.S. Community Protocol[2], which provides more detailed methodology specific to U.S. communities. Inventory calculations were performed using the ClearPath[3] tool.

QUANTIFYING GREENHOUSE GAS EMISSIONS

Emissions Scopes

There are three emissions scopes for community emissions:

- **Scope 1:** GHG emissions from sources located within the city boundary, such as stationary fuel consumption.
- **Scope 2:** GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary
- **Scope 3:** All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

This inventory follows the city-inducted framework in the GPC, which totals GHG emissions attributable to activities taking place within the geographic boundary of the city. Under the BASIC reporting level as defined by GPC, the inventory requirements covers scope 1 and scope 2 emissions from stationary energy and transportation, as well as all emissions resulting from waste generating within the city boundary.

[2] http://icleiusa.org/publications/us-community-protocol/
[3] http://icleiusa.org/clearpath/

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. San José's community GHG emissions inventory utilizes 2008 as its base year. The City of San José worked with AECOM to conduct its inventories in 2008 and 2014.

Quantification Methods

GHG emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of GHG emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

Emissions sources in this inventory are quantified using calculation-based methodologies, consistent with previous inventories. Activity data refer to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs. CO_2/kWh of electricity).

WHAT IS THE FIVE MILESTONES FRAMEWORK?

The Five Milestones build on ICLEI's over 20 years of experience as the leader in local emissions management. Over 1000 communities nationwide have benefited from ICLEI's well-managed approach to building more sustainable, climate-friendly communities. The proven Five Milestones framework offers a systematic approach for analyzing baseline greenhouse gas emissions, developing an emissions reduction target, developing and implementing a climate action plan, and monitoring emissions reduction progress. This framework helps you reduce energy costs, be a responsible steward of the global environment, and improve quality of life for your community.

ICLEI's Five Milestones program provides a framework, methodology, and comprehensive assistance for local governments to identify and reduce greenhouse gas emissions.

1. **Conduct an inventory and forecast of local greenhouse gas emissions;**
2. **Establish a greenhouse gas emissions reduction target;**
3. **Develop a climate action plan for achieving the emissions reduction target;**
4. **Implement the climate action plan; and,**
5. **Monitor and report on progress.**

INVENTORY DATA SOURCES

For the sake of standardizing the inventory and comparison with the Community-Wide GHG Emissions Inventory and Forecast prepared by AECOM in 2016, the emission sources for this inventory (2017 Inventory) were matched as closely as possible to past data sources. Since the Community-Wide GHG Emissions Inventory and Forecast was prepared using 2014 data, it will be referred to as 2014 Inventory in this Report.

In the cases where data specific to the City or the inventory year was not available, census data such as population or housing was used to scale regional data or previous inventory data to the appropriate time and location. Table 1 lists the census data used.

Table 1: Population and Housing Data for the City of San José

Sector	Year: 2014	Year: 2017
Population	986,320	1,023,031
Housing	322,187	331,510
Source	American Factfinder	American Factfinder

Energy

Electricity and natural gas usage data was obtained from PG&E. The commercial and industrial non-governmental electricity usage was combined together under the 15/15 privacy rule ("15/15 rule"). Agricultural electricity was also included in the commercial non-governmental usage.

Direct access county and city usage was provided, but direct access non-governmental electricity failed the 15/15 rule and was not included with the 2017 PG&E data. To have a more consistent comparison with 2014, the county and city direct access data provided by PG&E was discarded in lieu of an average of previous PG&E data from 2014-2016, which included county, city, district, and non-governmental direct access usage. While customer count likely decreased from 2014, causing the privacy test failure, total usage may follow a different trend; in lieu of other data, it is assumed that the direct access is within the order of magnitude of previous years. Direct access electricity aggregated all sectors, but was entered as industrial electricity in ClearPath due to a lack of a direct access or combined sector calculator. Since PG&E transmits but does not generate electricity consumed by those customers, it was not appropriate to apply the PG&E electricity emission factor to the direct access data. Instead, the regional eGRID electricity emission factor for WECC California was used instead, following the methodology in the 2014 inventory.

In AECOM's 2014 Inventory, the 2014 PG&E data was not yet available and the energy emissions were calculated using the 2013 PG&E emission factor (499 lb CO2/MWh). The 2017 inventory used the recently published 2017 PG&E emission factor (210 lb CO2/MWh).

Table 2: Energy Emissions Factors for 2017 Inventory

Sector	Emission Factor	Unit	Reference
Electricity – Residential, Commercial, Industrial	210	CO2 lb/MWh	PG&E 2017
Natural Gas	53.02	CO2 kg/MMBtu	US Community Protocol
Electricity – Direct Access, Potable Water	527.862	CO2 lb/MWh	eGRID 2016 (WECC California)
Electricity – All	33	CH4 lb/GWh	eGRID 2016 (WECC California)
Electricity – All	4	N2O lb/GWh	eGRID 2016 (WECC California)

Waste

Solid waste emissions were calculated based on the methane commitment model outlined in the GPC. Solid waste disposal totals and the waste characterization data were obtained from California's statewide waste agency, CalRecycle. Disposal data is reported from each landfill.

The waste characterization data comes from a statewide survey and is likely not specific to the City of San José beyond population proportion and the type of industries operating in the area. The waste categories listed in Table 3 are categories that appear from CalRecycle's profile. However, ClearPath's waste characterization profile has slightly different sectors, so some of the categories were aggregated based on best fit. The CalRecycle waste characterization profile is not updated on an annual basis, so the data in Table 3 reflects 2014 statewide data as retrieved from the website in 2018. The residential and commercial reports were aggregated together for overall sector totals seen in Table 3.

ICLEI corresponded with CalRecycle to determine which landfills had methane capture and which did not. ClearPath adjusted for reduced methane emissions for those that had methane capture. See Table A-12 for the specific landfill sites with and without methane capture.

Table 3: CalRecycle Waste Characterization Profile

Sector	Percentage	Included Categories
Newspaper	2.05%	Newspaper
Office paper	2.37%	White Ledger Paper
		Other Office Paper
Magazines/Third Mail	13.96%	Magazines and Catalogs
		Phone Books and Directories
		Other Miscellaneous Paper - Compostable
		Other Miscellaneous Paper - Other
		Remainder / Composite Paper - Compostable
		Remainder / Composite Paper - Other

		Paper Bags
Cardboard	8.86%	Cardboard
Food scraps	20.64%	Food scraps
Grass	5.81%	Leaves and Grass
Leaves	1.71%	Prunings and Trimmings
Branches	0.26%	Branches and Stumps
Lumber	5.84%	Clean Dimensional Lumber
		Clean Engineered Wood
		Clean Pallets & Crates
		Other Wood Waste
Other Inert Material*	38.50%	Electronics category, Household Hazardous Waste (HHW) category, Mixed Residue category, Inerts and Other category (minus Lumber and Gypsum Board sub-types), and Special Waste category (minus Tires sub-type)

***Not included in ClearPath

Transportation & Mobile Sources

On Road Passenger and Commercial Transportation

Total daily vehicle miles traveled (VMT) for City of San José was obtained from the City's travel demand model[4] for passenger and commercial vehicles. This origin-destination VMT model is used for the City's General Plan and other plans and it was deemed best to be consistent internally rather than use other regional travel demand models. As in previous inventories, the annualization factor is 347; alternative factors were considered but no factor emerged as a superior choice.

The On-Road Factor calculation method from ClearPath was used for the transportation calculations, requiring breakdown of the VMT by vehicle and fuel type and assigning a CO2, CH4, and N2O emission factor per set. The CO2, CH4, and N2O transportation emission factors were calculated for Santa Clara County in 2017 using the EMFAC2017 statewide database and are detailed in Table 4. Since the VMT model is broken down by speed bins, the emission factors were also broken down by speed bin up until 65 MPH. Emissions factors for vehicle classes that represent a higher percentage of VMT for a particular speed bin were weighted according to their relative VMT proportion for that speed bin. The result was a weighted emission factor for each speed bin that represents all vehicle classes weighted by VMT within the County.

Table 4: Transportation CO2, N20, and CH4 Emissions Factors Calculated from EMFAC2017

Speed Bin	Emission Factor CO2 g/mile	Emission Factor CH4 g/mile	Emission Factor N2O g/mile
5	1772.3812	0.13002257	0.17746873

[4] In December 2017, the City completed the update and validation of the City's travel demand model. The 2017 inventory uses this updated model, which provides a more accurate estimate of annual VMT in San José. Although both 2014 and 2017 inventories use a consistent methodology to estimate VMT, the changes made to the travel demand model may explain part of the differences between them.

10	1752.8843	0.14126494	0.18216312
15	1048.4531	0.06097761	0.07849646
20	733.86536	0.07625292	0.05493624
25	480.88704	0.01539967	0.02579484
30	351.14484	0.0103032	0.01266186
35	358.65625	0.00961798	0.01755909
40	339.27345	0.00846879	0.01571957
45	321.80778	0.00723228	0.0124594
50	390.88388	0.00758924	0.02126992
55	380.84586	0.00724264	0.01990702
60	377.30713	0.00744519	0.01746956
65	437.29405	0.00804096	0.02795722

Public Transit Buses

Public transit bus and light rail annual VMT and fuel usage data for the Santa Clara Valley Transportation Authority (VTA), which serves the municipalities of Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San José, Santa Clara, Saratoga and Sunnyvale, was obtained from the National Transit Database agency profile and fuel report for 2017. The annual revenue VMT and fuel usage for the service area was proportioned down to City of San José by population. The bus MPG, CH4 and N2O emission factors were obtained from the US Energy Information Administration (US EIA) (Table 5). It was assumed that PG&E provided the light rail electricity for the VTA.

Table 5: Transportation Emission Factors for Buses and Light Rail

Sector		Electricity	Gas	Diesel	Unit	Reference
Buses	MPG		17.34141	17.34141	miles per gallon	US EIA 2015
	CO2		0.07024	0.073934	MT/MMBtu	US Community Protocol
	CH4		0.0201	0.001	g/mile	US EIA 2015
	N2O		0.017	0.0015	g/mile	US EIA 2015
Light Rail		210			CO2 lb/MWh	PG&E 2017

Commuter Trains

The City of San José has train stations that serve the San Joaquin, Altamont Corridor Express (ACE), Capitol Corridor, and other Amtrak lines. Fuel usage and total system mileage was obtained from annual sustainability or financial reports from Caltrains, Amtrak, and ACE for FY16. The total revenue vehicle fuel usage for Caltrains was expressed as kBtu in the sustainability report due to the fuel mixture for the vehicles; this was converted into diesel gallons for emissions calculations. The track mileage within San

José was used to calculate the proportion of train fuel usage within the city boundaries. This methodology differs from the 2014 and 2008 Inventories which used ridership to estimate emissions.

Airport Local Flights

The City of San José has two airports within its jurisdiction, the Mineta San José International Airport (SJC) and the Reid-Hillview County Airport. Emissions from local flights that begin and end their trips within the city boundaries were calculated for this community inventory. Total fuel usage data was obtained from SJC and Reid-Hillview County Airport staff. Total flight count and local flight count for the two airports were obtained from the Federal Aviation Administration's Air Traffic Activity System (ATADS) Airport Operations (Table A-11). Using the proportion of local flights to total flights, the total fuel usage attributable to local flights was calculated for each airport.

Off-Road Mobile Emissions

The off-road transportation results from California Air Resources Board (CARB)'s OFFROAD2017 model were used. Model results were calculated for Santa Clara County and scaled down to City of San José via population. These account for emissions from sources such as construction equipment, lawn and garden equipment, agricultural vehicles, industrial equipment, and other vehicles. The off-road transportation model from CARB is a coarse model and it is expected that the model results are a broad estimate for the sector. The pleasure boating and airport ground support equipment emissions were aggregated with the off-road mobile emissions into one total.

Pleasure Boating

Pleasure boats and power boats attendance in the various park marinas in Santa Clara County and within City of San José were estimated. This provided the ratio of boat attendance by boat type in Santa Clara County to City of San José. The ratio was applied to the CARB's OFFROAD model. Due to a lack of updated data, the 2014 total annual boat attendances by boat type and park and overall total emissions were scaled up by population for 2017.

Airport Ground Support Equipment and Other Vehicles

Mineta San José International Airport provided the total fuel usage and emissions calculated for all vehicles, including airside transport, machinery, ground service equipment (GSE), and de-icing trucks for 2017. Airport ground support equipment fuel usage by itself was not specifically tracked by SJC. Total emissions of 1419.3 MTCO2e from all airport equipment fuel usage were entered as a coarse estimate

for ground airport support equipment usage. Airport ground support equipment data was not requested from Reid-Hillview County Airport to keep consistent with the 2014 Inventory methodology.

Water and Wastewater

Wastewater

Wastewater generated within the City is treated at the San José-Santa Clara Regional Wastewater Facility (SJSC-RWF), which is operated, managed, and maintained by the City of San José Environmental Services Department. Wastewater treatment process emissions include fugitive methane and nitrous oxide (N2O) emissions during combustion of digester gas, the nitrification/denitrification treatment process, and effluent discharge. These process emissions are considered indirect emissions associated with the community-wide inventory. Energy related emissions for the facility operation are included in the PG&E-provided energy data (i.e., electricity and natural gas) and represented in the energy sector.

The Environmental Services Department indicated that digester gas produced in the process was combusted on site. Emissions from the digester gas combusted were calculated based on the volume of digester gas combusted daily (1,456,584 scf) and the energy content of the gas (0.00061 MMBtu/scf).

The N2O emissions from the nitrification/denitrification process were calculated based on a default assumption of 1.25 multiplier of residential to industrial/commercial wastewater discharges into the RWCF and a service population of 1.4 million.

The N2O emissions from the effluent discharge were calculated based on the daily N load from the effluent (5,472 kg N/day) and the service population of 1.4 million.

Since lagoons are not part of the active wastewater treatment system, lagoon influent emissions were not included.

Potable Water Energy

The water emissions sector includes energy-related emissions associated with the pumping, treatment, conveyance, and distribution of potable water for land uses within the city. Three water companies provide potable water service to the city's residents and businesses, including the City-owned Municipal Water System (MWS), the privately-owned Great Oaks Water Company (GOWC), and the privately-owned San José Water Company (SJWC). Potable water consumption data was obtained from each of the three water agencies.

Potable water process energy intensity values were obtained from the 2010 report *Embedded Energy in Water Studies – Study 2: Water Agency Function Component Study and Embedded Energy-Water Load*

Profiles prepared by GEI Consultants/Navigant Consulting for the California Public Utilities Commission (CPUC). Appendix B of the report provides water agency profiles. Water energy intensity values were only available for SJWC, so it was assumed that the water intensity for the other agencies would be similar. Furthermore, the water intensity methodology encapsulates more of the upstream extraction and distribution process than what energy is used on-site and directly reported from the agency. However, in lieu of more updated data and to remain consistent with past inventories, this water intensity methodology and 2010 water intensity values were used. The groundwater and surface water source breakdowns were obtained from the Urban Water Management Plans for each water agency (Table A-13).

Total water consumption was multiplied to the annual water intensity factor for extraction, treatment, and distribution, as seen in Table A-14. Extraction processes applied to groundwater; treatment processes applied to surface water and recycled water; and distribution processes applied to the total water volume. The electricity emission factor was then multiplied to calculate the total emissions. Given the upstream processes included, it cannot be guaranteed that all the processes occurred within the PG&E grid territory. Therefore, the electricity emissions factor applied to the potable water sector comes from the US EPA's eGRID 2016 analysis for the CAMX subregion (WECC California), as seen in Table 2.

Process & Fugitive Emissions

Fugitive emissions from natural gas distribution were calculated from the ClearPath calculator, following a default 0.3% leakage rate. The total natural gas usage from the residential, commercial, and industrial sectors was used as the input. This sector was not included in the 2014 Inventory. Since this sector is a requirement for GPC compliance, it was added to this inventory and to the updated 2014 Inventory number shown in this report. The formally adopted 2014 Inventory will not be amended to include this sector.

INVENTORY SECTORS NOT INCLUDED

District Heating and Cooling

District heating and cooling do not occur in San José.

Agricultural Livestock and Fertilizer Emissions

San José does not have any animal production or manure usage.

Septic Tanks

In an urban area such as San José, it is unlikely that there are households or facilities using septic tanks. Furthermore, data on septic tank usage is scarce – the most recent statewide data is from a 1990 survey and the San Joaquin County wastewater department does not track septic tank permits on a city-by-city basis.

INVENTORY CALCULATIONS

The 2017 Inventory was calculated following the US Community Protocol and ICLEI's ClearPath software, which City of San José has used before. To be consistent with the past inventories, the 4th IPCC Climate Assessment was used for the methane conversion for all inventories. ClearPath's inventory calculators allow for input of the sector activity (ie kWh or VMT) and emission factor to calculate the final CO2e emissions.

2017 Inventory Key Findings

The total emissions for the 2017 inventory were calculated at 5,711,665MTCO2e (Table 6). This represents a just over 17% decrease (-1,226,130MTCO2) from the 2014 Inventory. The greatest declines from 2014-2017 were seen in residential, commercial, and industrial energy sectors, likely from PG&E's significantly cleaner electricity grid (Figure 2) as well as reduced energy consumption (Table 7). Transportation emissions declined, but transportation remained the biggest contributor of emissions at 63% of the inventory total. The dominance of transportation emissions is consistent with the trend seen in other urban areas in California.

Table 6: Inventory Comparisons 2014-2017

Sector	Sub Sector	MT CO2e 2014	MT CO2e 2017	Change	% Change
Residential Energy		1,096,851	763,961	-332,890	-30.35%
	Residential Electricity	426,701	172,589	-254,112	-59.55%
	Residential Natural Gas	670,150	591,372	-78,778	-11.76%
Commercial Energy		879,322	627,496	-251,826	-28.64%
	Commercial Electricity	486,131	204,923	-281,208	-57.85%
	Commercial Natural Gas	393,191	422,573	29,382	7.47%
Industrial Energy		600,300	399,690	-200,610	-33.42%
	Industrial Electricity	179,530	69,558	-109,972	-61.26%
	Industrial Natural Gas	33,888	24,777	-9,111	-26.89%
	Direct Access*	386,882	305,355	-81,527	-21.07%
Transportation & Mobile Sources		4,056,979	3,589,159	-467,820	-11.53%
	On Road	3,745,113	3,325,912	-419,201	-11.19%
	Trains/Heavy Rail (all)**	19,662	22,873	3,211	16.33%
	Light Rail	-***	1,214	1,214	n/a
	Public Buses	-***	22,294	22,294	n/a
	City and County Airport In-Boundary Flights	-***	28,310	28,310	n/a
	Off Road (all)	292,204	188,555	-103,649	-35.47%
Solid Waste		234,620	271,862	37,242	15.87%
Water and Wastewater		37,788	29,235	-8,553	-22.63%
	Water Energy	29,530	20,822	-8,708	-29.49%
	Nitrification/Denitrification Process N2O Emissions****	3,651	3,651	0	
	Combustion of Digester Gas****	91	87	-4	-4.40%

	Process N2O from Effluent Discharge	4,516	4,675	159	3.53%
Process & Fugitive Emissions		31,935*****	30,262	-1,673	-5.24%
Total		6,937,796	5,711,665	-1,226,130	-17.67%

*Direct access includes industrial electricity usage as well as other usage. Using the sector categories from ClearPath, all direct access is grouped under Industrial Energy.

**2017 Inventory methodology differs from 2014 Inventory for heavy rail emissions

***Light rail, public transit buses, and in-boundary airport flights were not included in the 2014 Inventory.

****The Wastewater Treatment sector for 2014 was updated to remove the lagoon treatment emissions, correct biogas processing, and add the nitrification/denitrification process. More details are provided in the Interpretation section below. Approximately 70% of the N2O from the wastewater facility originates from City of San José while the remaining 30% originates from other municipalities in the facility service area.

****The fugitive emissions sector was not included in the previous inventory but was calculated as part of this inventory update for an apples-to-apples comparison.

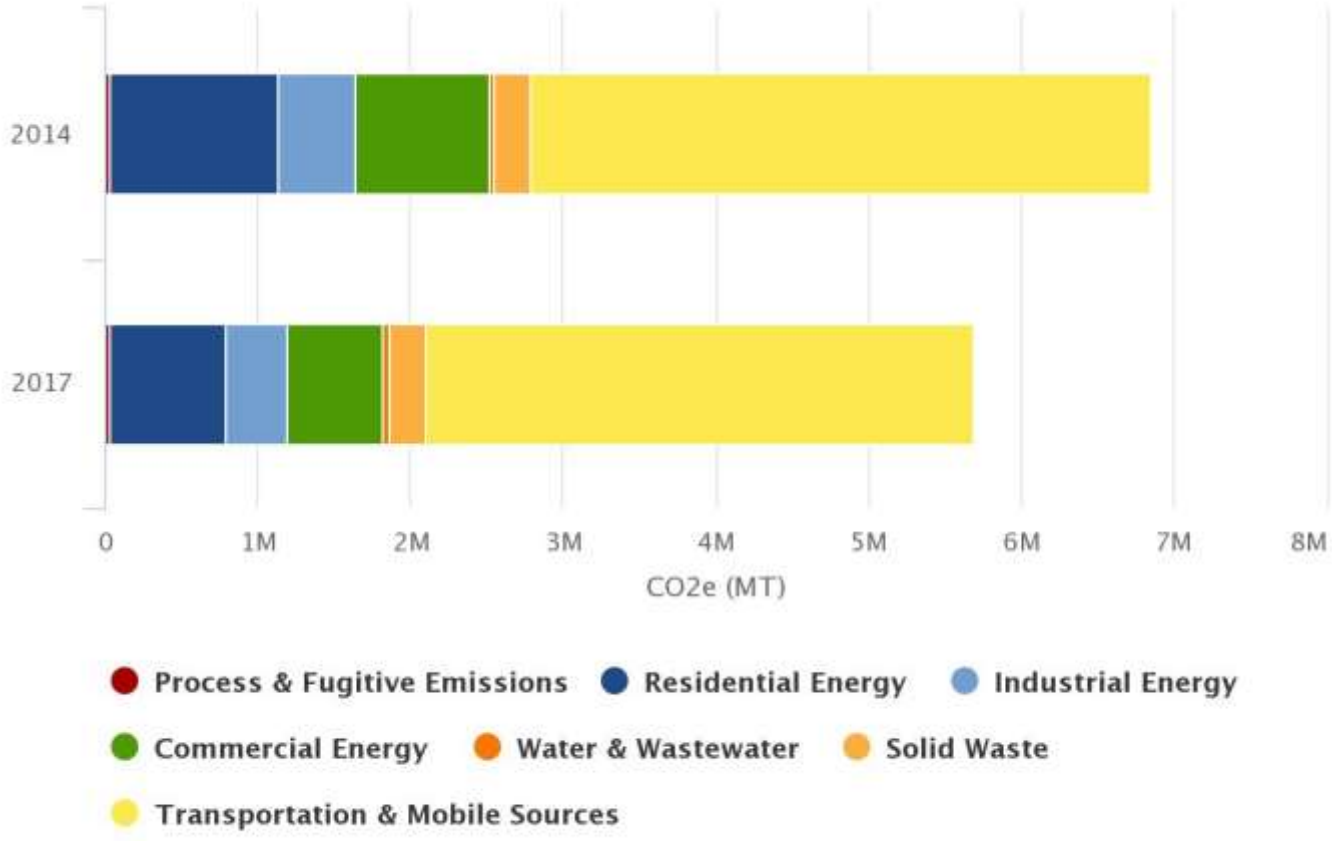

Figure 2: City of San José 2014 and 2017 GHG Inventories

Table 7 shows the comparison of inventory sector activities for select sectors where similar data was collected for 2014 and 2017.

Table 7: Select 2017 Inventory Activities by Sector

Sector	Sub Sector	2014 Activity	2017 Activity	Unit	Change	% Change
Residential Energy	Residential Electricity	1,875,919,122	1,794,638,836	kWh	-81,280,286	-4.33%
	Residential Natural Gas	125,908,563	111,212,910	therms	-14,695,653	-11.67%
Commercial Energy	Commercial Electricity	2,137,197,590	2,130,855,532	kWh	-6,342,058	-0.30%
	Commercial Natural Gas	73,873,260	79,468,661	therms	5,595,401	7.57%
Industrial	Industrial Electricity	721,229,093	723,290,596	kWh	2,061,503	0.29%
	Industrial Natural Gas	6,366,849	4,668,285	therms	-1,698,564	-26.68%
	Direct Access	1,274,752,335	1,270,463,928	kWh	-4,288,407	-0.34%
Transportation & Mobile Sources	On Road (all)	6,997,490,044	6,361,979,892	annual VMT	-635,510,152	-9.08%
Solid Waste		661,857	844,152	solid waste tonnage	182,295	27.54%
Water and Wastewater	Water Energy	99,836,072	86,616,598	combined kWh	-13,219,474	-13.24%
Process &Fugitive Emissions		206,148,672	195,349,856	total therms	-10,798,816	-5.24%

INTERPRETATION

Comparison with 2014 Inventory

Energy

The overall reduction trends for the residential, commercial, and industrial sectors are encouraging. The change in the electricity emission factor points to the cleaner electricity grid while the reduction in energy usages indicates impactful energy efficiency programs, behavior shifts, building/technological upgrades, or other policies. The cleaner grid may have played a greater role than the usage change, but doing a contribution analysis will be able to determine quantitatively the driver of change.

Transportation

GHG emissions from the transportation sector declined by roughly 11%, despite the inclusion of new categories (buses, light rail, and in-boundary flights). However, transportation remained the largest contributor to climate change in San José, growing to 63% of the total GHG emissions.

The on-road sub-sector contributes the bulk of the transportation emissions. The 2017 inventory uses an updated version of the City of San José Travel Forecasting Model that provides a more accurate

estimate of annual VMT than the one used for the 2014 inventory. The change in the modeling tool used to measure VMT explains the majority of the transportation emissions reductions. However, there is also a 9% reduction in overall VMT from 2014 to 2017 that contributes to emission reductions. The American Community Survey provides a useful insight on commuter behavior: In 2017, 75.4% of workers in San José drove alone in their daily commute to work, that percentage represents a 2.1% reduction from 2014. This trend is encouraging and potentially indicates that mode shifts to public transit or carpooling are occurring.

The 2014 Inventory was designed to align with the baseline 2008 Inventory and did not include in-boundary flights, light rail, or public buses in the transportation sector. Since 2008, inventory methodologies have evolved and given that those activities are occurring within the boundary, it is best practice to include them in the community inventory. These new sub-sectors only make up 1.4% of the transportation sector emissions.

A new methodology was used to calculate the heavy rail trains with fuel usage rather than average ridership. The previous methodology came from the first iterations of inventorying and the updated methodology is more reflective of train emissions. This methodology change is likely the main contributor to emissions increases seen in the train sub-sector.

The combined off-road emissions, which includes the marina boating, airport ground support equipment, and other off-road equipment emissions, dropped by 35%. This is likely primarily driven by the change in the off road model by CARB; an older model OFFROAD2007 was used in the 2014 Inventory while a newer updated model OFFROAD2017 was available for the 2017 inventory. The change in those model outputs alone was a 38% reduction. These off-road models tend to be coarse models at the county level however and may not reflect the precise changes in industry or behaviors at the city scale. Overall, the marina boating emissions increased by 1% due to higher population in San José. The airport ground support emissions increased but this is due to the ground support equipment fuel usage aggregated with all other airport fuel usage (gasoline, diesel, CNG). The actual ground support fuel usage likely did not change significantly, but due to a lack of more disaggregated data, it is not possible to get a more representative number.

Solid Waste

There was a 27% increase in tonnage of solid waste disposal, which included alternative disposal cover (ADC) and transformation, and 15% increase in emissions. At time of writing, it is unclear whether the 2014 Inventory total tonnage included ADC and transformation. However, given that the 2014 total from CalRecycle including all three categories was 679,535 tons, this indicates that the combined total of solid waste disposal, ADC, and transformation did increase in 2017 (Table 7).

In addition to tonnage changes, methane capture from landfill was tracked for 2017. The disposal data was entered into ClearPath by whether the collecting landfill had methane gas collection or not, rather than a blanket assumption that all the landfills had methane collection. It is unclear from the 2014 methodology whether landfill methane collection was assumed or not in the past. However, given that the sector total is within the order of magnitude, the difference is a reasonable one for year-to-year changes regardless.

Potable Water

The electricity used for supply and distribution of potable water decreased, as did the overall water usage city-wide. The water intensities used in this inventory are older ones and may not reflect the true electricity usage on site and upstream. Newer water intensity factors are anticipated in the coming years through efforts with the California Public Utilities Commission (CPUC), which will help with more precise reporting.

Wastewater

In the 2008 Inventory, wastewater lagoons were accidentally included as part of the active treatment system even though the use of the lagoons is only for storage at the San José-Santa Clara Regional Wastewater Facility (SJSC-RWF). This was carried forward in the 2014 inventory as well. This inaccuracy was only discovered in the 2017 inventory update when it was realized that lagoons are no longer a part of the SJSC-RWF active treatment process and emissions associated with the lagoons should not be included. Lagoon emissions, calculated through the influent biochemical oxygen demand (BOD), were excluded from this inventory and the updated 2014 inventory total is shown in Table 6 and Figure 2 for direct comparison.

The past inventories did not include nitrification/denitrification process emissions as they were only accounting for lagoon processes, fugitive digester gases, and discharge of effluent. Since the wastewater treatment facility does have this treatment process, it was necessary to include in the inventory. Furthermore, the 2014 Inventory included emissions from flaring digester gas. This overestimates the wastewater emissions as the digester gas is combusted instead. Overall, the sector saw an increase in emissions when compared to the corrected 2014 number.

Process and Fugitive Emissions

Fugitive emissions were added to the 2014 Inventory shown in this report for apples-to-apples comparison with the 2017 Inventory and GPC compliance. The formally adopted 2014 inventory will not

be amended to show these emissions. The fugitive emissions scale with the overall natural gas usage. Since natural gas usage declined in 2017, the fugitive emissions declined by 5% as well.

Contribution Analysis

ICLEI recommends that a contribution analysis is done for a more thorough comparison between inventory years and understanding of what drives emission changes, be it the increased renewable energy in the grid, weather, or population**.** The contribution analysis will allow for breakdown of each sector by drivers like weather or population. Such an analysis can also account for differences in methodology since multiple consultants have worked on San José's inventories with potentially different methodologies or data sources. It is important to recognize if a decline in emissions is due to policy implementation, external forces like weather/population, or changes in methodology/data sources. Resources for doing the contribution analysis are available publicly on ICLEI USA's website under the Department of Energy's Cities Leading on Energy Analysis Program (CLEAP).

Conclusion

This inventory marks completion of Milestone Five, Monitor and Verify Emissions Reductions, of the Five Milestones for Climate Mitigation. The City of San José's 2014 inventory (Milestone 1) was used to set emissions reduction targets (Milestone2) during development of Climate Smart San José (Milestone 3). Milestone 4, implementation, is now underway focusing on energy efficiency, renewable energy and electrification, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning. Solid waste reduction and natural working lands will be incorporated into Climate Smart in the coming years. Through these efforts and others, the City of San José can achieve additional benefits beyond reducing emissions, including saving money and improving City of San José's economic vitality and its quality of life. San José intends to complete a GHG inventory annually, as well as a government operations GHG inventory on a regular basis.

Appendix A: Community Inventory Details

Table A-1: PG&E 2017 Energy Data

	ELECTRICITY (kWh)	NATURAL GAS (Therms)
RESIDENTIAL		
(3) COUNTY	69,360	34,701
(4) CITY	93,481	1,306
(5) DISTRICT	116	15
NONGOVENT	1,794,475,879	111,176,888
COMMERICAL		
(3) COUNTY	37,365,217	246,9990
(4) CITY	75,461,858	1,696,429
(5) DISTRICT	83,844,688	2,470,795
NONGOVENT	1,934,183,769	72,831,447
INDUSTRIAL		
(3) COUNTY	14,251,104	380,512
(4) CITY	84,662,013	3,684,047
(5) DISTRICT	28,158,028	603,726
NONGOVENT	596,219,451	IN COMMERCIAL
AGRICULTURAL		
(3) COUNTY	-	-
(4) CITY	-	-
(5) DISTRICT	-	-
NONGOVENT	IN COMMERCIAL	-
DIRECT ACCESS		
(3) COUNTY	-	-
(4) CITY	1,839	-
(5) DISTRICT	8,694,470	-
NONGOVENT	FAIL 15/15 RULE; EXCLUDED	-

Table A-2: Past Direct Access Electricity

Year	Direct Access Electricity (kWh)
2014	1,306,615,167
2015	1,270,578,284
2016	1,234,198,333
Average	1,270,463,928

Includes county, city, district, and non-government usage

Table A-3: On-Road Transportation Data and Emission Factors

Speed Bin	Emission Factor CO2 g/mile	Emission Factor CH4 g/mile	Emission Factor N2O g/mile	Citywide DVMT (miles/day)	Annualization Factor (days/year)	Annual Citywide VMT (miles/year)	Emissions (MT CO2e/yr)
5	1772.3812	0.13002257	0.17746873	116,239	347	40,334,933	73,753
10	1752.8843	0.14126494	0.18216312	404,091	347	140,219,577	253,896
15	1048.4531	0.06097761	0.07849646	1,101,877	347	382,351,319	410,404
20	733.86536	0.07625292	0.05493624	2,114,675	347	733,792,225	551,916
25	480.88704	0.01539967	0.02579484	3,736,445	347	1,296,546,415	633,958
30	351.14484	0.0103032	0.01266186	3,172,018	347	1,100,690,246	390,938
35	358.65625	0.00961798	0.01755909	1,517,751	347	526,659,597	191,772
40	339.27345	0.00846879	0.01571957	955,539	347	331,572,033	114,117
45	321.80778	0.00723228	0.0124594	892,996	347	309,869,612	100,925
50	390.88388	0.00758924	0.02126992	642,645	347	222,997,815	88,622
55	380.84586	0.00724264	0.01990702	800,497	347	277,772,459	107,487
60	377.30713	0.00744519	0.01746956	1,704,337	347	591,404,939	226,330
65	437.29405	0.00804096	0.02795722	1,175,126	347	407,768,722	181,794
Total				18,334,236		6,361,979,892	3,325,912

Emission factors calculated from EMFAC2017 for Santa Clara County by speed bin and weighted by VMT
Daily VMT provided by the City's VMT model

Table A-4: City VMT Model Outputs

Speed Interval	Morning	Midday	Afternoon	Night	Daily VMT	Annualization Factor
0.000 - 5.000	26,576	14,675	68,853	6,135	116,239	347
5.001 - 10.00	134,856	7,248	261,955	32	404,091	347
10.001 - 15.00	469,170	20,325	609,888	2,493	1,101,877	347
15.001 - 20.00	728,044	225,043	1,071,634	89,955	2,114,675	347
20.001 - 25.00	998,678	1,060,524	1,209,683	467,560	3,736,445	347
25.001 - 30.00	828,951	929,949	1,001,698	411,419	3,172,018	347
30.001 - 35.00	409,056	463,669	468,145	176,881	1,517,751	347
35.001 - 40.00	293,428	313,957	289,720	58,435	955,539	347
40.001 - 45.00	228,728	350,695	251,914	61,659	892,996	347
45.001 - 50.00	147,170	346,860	145,079	3,536	642,645	347
50.001 - 55.00	150,077	520,908	120,391	9,122	800,497	347
55.001 - 60.00	196,899	730,774	136,642	640,022	1,704,337	347
60.001 - 65.00	115,927	451,336	101,536	506,326	1,175,126	347
TOTAL	4,727,561	5,435,962	5,737,138	2,433,575	18,334,236	347

Table A-5: ORION2017 Off Road Results

OFFROAD Category	Metric	County Households/Jobs	San José Households/Jobs	San José Proportion	County Daily CO2	San José Daily CO2	San José Annual CO2
Lawn and Garden Equipment	Household	651,905	328,185	0.503425	0	0	0
Construction and Mining Equipment	Jobs	933,565	375,498	0.402219	277	111	40,650
Industrial Equipment	Jobs	933,565	375,498	0.402219	582	234	85,428
Light Commercial Equipment	Jobs	933,565	375,498	0.402219	86	35	12,595
Agricultural	Jobs	933,565	375,498	0.402219	7	3	995
Oil Drilling	Jobs	933,565	375,498	0.402219	0	0	9
Portable Equipment	Jobs	933,565	375,498	0.402219	253	102	37,203
Transportation Refrigeration	Jobs	933,565	375,498	0.402219	13	5	1,842
Locomotive - Line Haul	Jobs	933,565	375,498	0.402219	0	0	0
Total CO2							178,721

Table A-6: SJC Fuel Usage and Emissions in Vehicles, Including Airport Ground Support Equipment

Total Fuel used in Vehicles	Airport Owned Vehicles	Unit
Gasoline	78,304	Litre
Diesel	29,935	Litre
CNG	397,713	Kg
Propane	0	Litre
Total Emissions	1,418	MTCO2e

***Emission factors derived from EMEP-EEA

Table A-7: 2014 Pleasure Boating Attendance and Emissions

Park Name	Within City	# Power Boats	PB Attn.	# Pleasure Watercraft	PWC Attn.	# Non-Power Boats	NPB Attn.	Special Permit Boats	Special Permit Boat Attn.	Total Attn.	Total Launches
Alviso Marina	0%	6,800	23,800			2,342	3,513			27,313	9,142
Anderson Lake	50%	5,054	17,689	639	959	277	416			19,064	5,970
Calero	100%	2,709	9,482	884	1,326	798	1,197			12,005	4,391
Coyote Lake	0%	689	2,412	151	227	162	243			2,882	1,002

Lexington	0%							4,490	35,920	35,920	4,490
Stevens Creek	0%									-	
Vasona	0%	100	350					3,744	7,488	7,838	3,844
Santa Clara County Total		15,352	53,733	1,674	2,512	3,579	5,369	8,234	43,408	105,022	28,839
City of San José Total		5,236	18,327	1,204	1,806	937	1,405	-	-		
City of San José Allocation		34%		72%	26%						
Activity Data											
Boat Type	Santa Clara County	City of San José	Percent	Santa Clara County Total (MT CO2/yr)	Santa Clara County Total (MT CH4/yr)	Santa Clara County Total (MT N2O/yr)	Santa Clara County Total (MT CO2e/yr)		City of San José (MT CO2e/yr)		
Personal Watercraft (PWC)	2,512	1,806	72%	788.08	1.15	0.17	868.65	624.34			
Non-Power Boat (NPB)	5,369	1,405	26%	6.9	0.01	0	7.5	1.96			
Power Boat (PB)	53,733	18,327	34%	20,471.81	7.23	4.36	21,950.73	7,486.65			
Total	61,614	21,537	35%	21,266.79	8.38	4.53	22,826.88	8,112.95			
2017 to 2014 Population Ratio	1.03722										
2017 Adjusted Total Emissions	8,414.91										

Table A-8: Regional Trains 2017 Fuel Usage

Agency	Transit Name	Transit Line	Daily Activity	Train Miles in City	Total System track	San José Mileage Proportion	System Diesel Usage	San José Diesel Proportion
			Passby Trips	Miles	Miles	%	Gallons	Gallons
Caltrain	Diridon	North	92	2.4	51	4.71%	4,921,335	231,592.241
	Tamien	North	40	4.13	51	8.10%	4,921,335	398,531.649
	Tamien	South	6	15.87	51	31.12%	4,921,335	1,531,403.7
ACE	Diridon		8	3.27	85	3.85%	462,433	17,790.0695
Capitol	Diridon		14	3.27	170	1.92%	2067338	39,765.8545

Corridor		
	Total	2,219,083.51

Fuel and mileage data provided by Caltrain, ACE, Amtrak

Table A-9: Bus and Light Rail 2017 Fuel Usage

Fuel and VMT	Santa Clara Valley Transportation Authority service population	City of San José population proportion	Santa Clara Valley Transportation Authority	City of San José
Diesel Fuel (gallons)	1,938,180	53.42%	3,818,874	2,039,926.721
Electric Propulsion (kWh)	1,938,180	53.42%	23,638,596	12,627,021.38
Gasoline (gallons)	1,938,180	53.42%	271,959	145,272.2534
Liquified Petroleum Gas	1,938,180	53.42%	61,716	32,966.81628
Light Rail (VMT)	1,938,180	53.42%	3,349,372	1,789,132.986
Bus Mileage (VMT)	1,938,180	53.42%	15,902,113	8,494,426.691

Table A-10: ATADS Airport Operations for Reid-Hillview and Mineta San José Airports

Category	Sector	Reid-Hillview	Mineta San José
Itinerant	Air Carrier	7	120,650
	Air Taxi	323	23,211
	General Aviation	72,199	30,072
	Military	48	216
Total Itinerant		72,577	174,149
Local	Civil	90,071	4,442
	Military	0	4
Total Local		90,071	4,446
Total Operations		162,648	178,595
Local Flight Proportion		55.38%	2.49%

Table A-11: Airport Local Flight Data 2017

San José Airport			Reid-Hillview County Airport		
Total Local Flights	4,446		**Total Local Flights**	90,071	
Total Flights	178,595		**Total Flights**	162,648	
Local Flight Proportion	2.49%		**Local Flight Proportion**	55.38%	
Fuels	**Airport Total**	**Local Flights Only**	**Fuels**	**Airport Total**	**Local Flights Only**
Retail AV Gas (gallons)	64,383	1,603	100LL (gallons)	272,978	151,169.4
Retail Jet	11,817,158	294,180	Jet-A (gallons)	44,389	24,581.68
Contract Jet (gallons)	100,547,632	2,503,064			

Table A-12: CalRecycle Disposal Report 2017 for City of San José

Destination Facility	SWISNo	Instate Ton	Transform Ton	Total ADC	Methane Capture?
Billy Wright Disposal Site	24-AA-0002	66,327		180	N
Zanker Material Processing Facility	43-AN-0001	2,268		1,849	N
Zanker Road Class III Landfill	43-AN-0007				N
Yolo County Central Landfill	57-AA-0001	3		0	Y
Altamont Landfill & Resource Recovery	01-AA-0009	2,104		424	Y
Azusa Land Reclamation Co. Landfill	19-AA-0013	71			Y
Corinda Los Trancos Landfill (Ox Mtn)	41-AA-0002	688		89	Y
Fink Road Landfill	50-AA-0001	722		29	Y
Foothill Sanitary Landfill	39-AA-0004	80			Y
Forward Landfill, Inc.	39-AA-0015	11			Y
John Smith Road Landfill	35-AA-0001	72,114			Y
Keller Canyon Landfill	07-AA-0032	552		55	Y
L and D Landfill	34-AA-0020	5		8	Y
Monterey Peninsula Landfill	27-AA-0010	160,539		7	Y
Redwood Landfill	21-AA-0001	28		3	Y
Vasco Road Sanitary Landfill	01-AA-0010	478		10,468	Y
Covanta Stanislaus, Inc.	50-AA-0009		389		
Guadalupe Sanitary Landfill	43-AN-0015	67,535		41,972	

Kettleman Hills - B18 Nonhaz Codisposal	16-AA-0023	7		
Kirby Canyon Recycl.& Disp. Facility	43-AN-0008	13,161		1,295
McKittrick Waste Treatment Site	15-AA-0105	90		
Newby Island Sanitary Landfill	43-AN-0003	315,644		70,714
North County Landfill & Recycling Center	39-AA-0022	2		
Potrero Hills Landfill	48-AA-0075	12,812		3
Recology Hay Road	48-AA-0002	1,423		
Sacramento County Landfill (Kiefer)	34-AA-0001	2		
West Central Landfill	45-AA-0043	0		
Yearly Totals:		716,666	389	127,097

Table A-13: Water Source Breakdown from Urban Water Management Plans 2015

Company	Groundwater	Surface Water + Recycled*
San José Water Company	38%	62%
Great Water Company	100%	0
MWS	7%	93%

*MWS had 18% recycled water and 75% surface water; San José Water Company had 62% surface water. However, the US Community Protocol does not indicate how to treat recycled water. For purposes of this energy analysis, recycled water is combined with surface water since it does not require energy use associated with groundwater pumping.

Table A-14: Water Energy Intensity Factors for San José Water Company

Segment	ICLEI Equation Term	Avg Summer (kWh/MG)	Avg Winter (kWh/MG)	Annual Average (kWh/MG)
Groundwater	Extraction	1,548	3,421	2,485
Booster Pumps	Distribution/Conveyance	1,340	533	937
Raw Water Pump	Distribution/Conveyance	3		2
Water Treatment	Treatment	39	26	33
Pressure System Pumps	Distribution/Conveyance	48	9	29
TOTAL		2 ,978	3,989	3,484

Source: Embedded Energy in Water Studies, Study 2: Water Agency and Function Component Study and Embedded Energy-Water Load Profiles, Appendix B

Note: Per ICLEI Community Protocol guidance, the above energy intensity information was collected from a study of California water providers. Of the City's three water providers, only the San José Water Company (SJWC) was profiled in the study. This analysis assumes that the energy intensities provided for SJWC are representative of the other two water providers. Further, the study provides information on five segments of the water process (shown in the above table in the Segment column). The ICLEI equation references four segments: extraction, conveyance, treatment, and distribution. For purposes of this analysis, the "Groundwater" segment was applied to the extraction phase; the "Water Treatment" segment was applied to the treatment phase; and the "Booster Pump", "Raw Water Pump", and "Pressure System Pumps" were applied to the distribution/conveyance phase. Also, the study did not provide annual averages for energy intensity by water process phase, but rather provided summer and winter information as High Water Demand Day, Low Water Demand Day, and Average Water Demand Day, as well as

Summer Peak Energy Demand Day. For purposes of this analysis, the summer and winter Average Water Demand Day information was averaged to create an annual Average Water Demand Day.

Table A-15: 2017 Water Energy and Emissions Data

Source	Volume (MG)	Water Intensity Estimated Electricity (kWh)	Natural Gas (therms)	Emissions (MTCO2e)
Municipal Water	5,496.161	6,382,381	788	1538.2
San José Water Company	35,546.92	68,703,657	n/a	16513
Great Water Company	3,339.29	11,530,559	n/a	2771.4

Table A-16: Wastewater Facility Emissions

Protocol Equation	Category	Activity	Total
WW.7 US Community Protocol	Nitrification/Denitrification N2O emissions	Service population	1,400,000
		Industrial multiplier	1.25
		Total N2O emissions	12.25
		Total CO2e emissions	3,650.5
WW.1.b (CH4), WW.2.b (N2O), WW.3 (CO2) US Community Protocol	Combustion of Anaerobic Digester Gas	Total CO2e emissions	1,456,584
		Heat content (btu/scf)	610
		Service population	1,400,000
		Energy recovered from site	Yes
		Total CO2e emissions	86.890
WW. 12 US Community Protocol	Fugitive N2O Emissions from Effluent Discharge	Daily N load (kg N/day)	5,472
		Service population	1,400,000
		Total N2O emissions	15.689
		Total CO2e emissions	4,675.4