Attachment A
Green House Gas Inventory

The City hired AECOM to prepare an updated greenhouse gas (GHG) emissions inventory for the City of San Jose that complies with current practice. The attached memorandum presents the updated GHG inventory and presents a comparison to the 2008 GHG inventory prepared as part of the Envision San Jose 2040 update planning process. The analysis allows for a sector-by-sector comparison of GHG emissions in 2008 and in 2014. The key finding was that GHG emissions have decreased by approximately 2% community-wide since 2008, which indicates the City has been able to accommodate residential and employment growth more efficiently, with fewer emissions generated per unit of growth. Based on the City's progress in reducing GHG emissions, the City is on track to meet its and the State's GHG emission reduction target for 2020.

AECOM will present findings from their "*Community-wide Emissions Inventory Memorandum"* memo (see attached) at the April 7, 2016 Task Force meeting. Staff is not recommending any General Plan policy changes as an outcome of the updated GHG inventory. Contextual background from the City's Greenhouse Gas Reduction Strategy is provided below. The City's Greenhouse Gas Reduction Strategy in its entirety can be viewed on the Planning Division website (http://www.sanjoseca.gov/documentcenter/view/9388).

Climate Science Overview

Unlike emissions of criteria pollutants (six common air pollutants including nitrogen dioxide, carbon monoxide, ozone, sulfur dioxide, particulate matter and lead) and toxic air pollutants, which have local or regional impacts, emissions of GHGs have a broader, global impact. Global warming is a process whereby GHGs accumulating in the atmosphere contribute to an increase in the temperature of the earth's atmosphere. The principal GHGs contributing to global warming are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated compounds.

Greenhouse gases allow visible and ultraviolet light from the sun to pass through the atmosphere, but they prevent heat from escaping back out into space, a process known as the 'greenhouse effect'. Human-caused emissions of these GHGs in excess of natural ambient concentrations are understood to be responsible for intensifying the greenhouse effect and have led to an alteration of the balance of energy transfers between the atmosphere, space, land, and the oceans and a trend of unnatural warming of the earth's climate. According to the Intergovernmental Panel on Climate Change (IPCC), it is extremely unlikely that global climate change of the past 50 years can be explained without the contribution from human activities.

Greenhouse Gas Reduction Strategy

In 2006, the State of California adopted State Senate Bill AB 32 – the California Global Warming Solutions Act, which requires by law a reduction in greenhouse gas emissions

throughout the state to 1990 levels by the year 2020 and to 80% below 1990 levels by the year 2050. In 2007, State Senate Bill 97 established regulations requiring potential greenhouse gas emissions created as a result of a project be analyzed during the California Environmental Quality Act (CEQA) review process. The Bay Area Air Quality Management District (Air District) is the local agency authorized to regulate greenhouse gases in the San Francisco Bay Area Air Basin. In 2010, the Air District released the Air Quality CEQA Guidelines which outline the Air District's recommended procedures for evaluating greenhouse gas emissions during the environmental review process. The Guidelines encouraged local jurisdictions to adopt a Greenhouse Gas Reduction Strategy to demonstrate a method to meet the goals of AB 32 and to conform to CEQA requirements.

In November 2011, the City adopted the Envision San José 2040 General Plan and certified an associated Program Environmental Impact Report (EIR). The potential impact of greenhouse gas emissions and climate change related to the implementation of the General Plan were analyzed in the EIR. The EIR studied the underlying causes of climate change; included forecasts of the City's potential future greenhouse gas emissions; and identified measures the City is taking to limit its contribution to cumulative greenhouse gas emissions. As a result of this analysis, the City adopted a Greenhouse Gas Reduction Strategy as a part of the General Plan.

The Greenhouse Gas Reduction Strategy establishes the City of San Jose's approach to establishing greenhouse gas reduction targets, including reduction measures and actions largely contained in the Envision San José 2040 General Plan.

Envision San Jose 2040 General Plan 4-Year Review

Per Implementation Policy IP-2.4 of the Envision San Jose 2040 General Plan, the City's achievement of greenhouse gas emission reduction goals and targets should be evaluated during the 4-Year Review. As mentioned above, the attached memo compares San Jose's GHG emissions in 2008, prepared during the Envision San Jose 2040 General Plan update process, and in 2014, after four years of implementing the Plan.

Additionally, as part of the California Environmental Quality Act (CEQA) analysis for the General Plan 4-Year Review, AECOM will project greenhouse gas emissions under the adjusted 2040 proposed land use scenario recommended by the 4-Year Review Task Force (e.g., Jobs to Employed Resident Ratio of 1.1). In the event the results of the GHG projections do not meet the City targets for greenhouse gas reductions, mitigation measures, in the form of additional high-level greenhouse gas reduction strategies, will be identified to help achieve the City's long-term greenhouse gas emissions target.

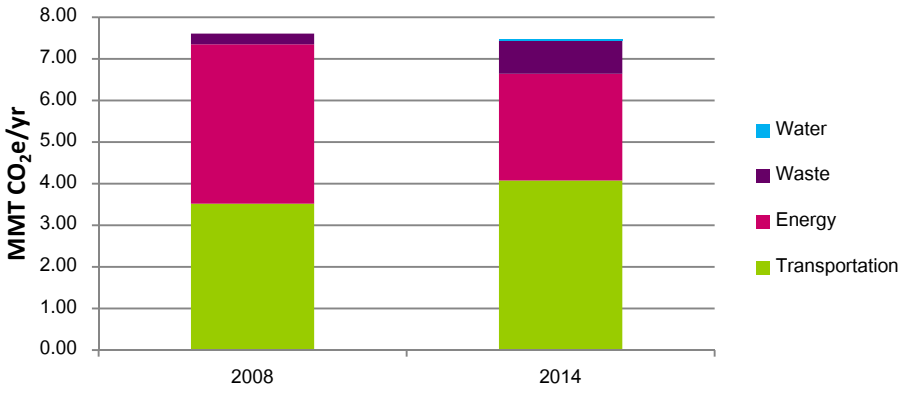
City of San José:
Draft Community-wide Emissions Inventory Memorandum

This memorandum describes the draft 2014 San José community-wide greenhouse gas (GHG) inventory update.[1] Staff from AECOM, David J. Powers & Associates, and Hexagon Transportation Consultants (collectively referred to as the project team) worked with City of San José staff to develop the inventory presented herein. This memo first presents a summary of the inventory results and their comparison to the 2008 inventory. It then describes the technical methodologies applied to develop emissions estimates for each sector, including data sources and collection and the quantification methodologies. The memo then presents the 2014 inventory in greater detail with figures, tables, and narrative text. Finally, the memo presents a comparison of the 2008 and 2014 inventories, with a sector-by-sector description of where technological methodologies varied in the two inventories. Appendix A provides data tables that support quantification of the emissions estimates presented throughout this memo.

INVENTORY SUMMARY

San José's 2014 community inventory totals 7.47 million metric tons of carbon dioxide equivalent (MMT CO_2e). More than half of the emissions come from vehicle use within the community. Another one-third of emissions come from community-wide energy use. Together these two sectors represent nearly 90% of total emissions. Waste emissions (including solid waste disposal and wastewater treatment) contribute approximately 10% of total emissions, while potable water consumption provides the remainder. In 2008, San José's community inventory totaled 7.61 MMT CO_2e/yr. As shown in Figure 1, transportation emissions increased 16% from 2008 to 2014, primarily as a result of population and employment growth. Energy emissions decreased by 33% through implementation of energy efficiency programs and use of cleaner electricity sources. Waste emissions also increased since 2008, although discrepancies in the underlying emissions calculations from 2008 explain much of the difference. Finally, the 2008 inventory did not include water-related emissions, which were added for 2014 to provide a more complete assessment of community-generated emissions. Since 2008, community emissions have decreased 1.8%, while population has increased 3.2% and local jobs have increased 7.4%.

Figure 1 – 2008 and 2014 Community Inventory Comparison



Note: MMT CO_2e/yr = million metric tons of carbon dioxide equivalent per year

[1] This inventory update is based on 2014 activity data and modeling estimates with the exception of the energy sector, which is based on 2013 community energy consumption data from the Pacific Gas and Electric (PG&E) company. PG&E had not released the 2014 community energy data prior to development of this memo, so 2013 data was used in the interim as a placeholder. The City will revise this inventory with 2014 energy consumption data and emissions factors when made available from PG&E.

METHODOLOGY

Data Collection and Analysis

The project team and staff from the City of San José collected data from various City departments, private entities (e.g., PG&E), and other government entities (e.g., Association of Bay Area Governments [ABAG]) that provide services within the community. Data collection efforts were focused on community-wide activities (e.g., electricity consumption within the city) that occurred in 2014. Community-wide activities span all land uses (e.g., residential, commercial, and industrial) located within the legal boundaries of the city.

The project team used emissions factors recommended by California Air Resources Board (ARB), Bay Area Air Quality Management District (BAAQMD), the California Climate Action Registry, US Environmental Protection Agency (EPA), the Intergovernmental Panel on Climate Change (IPCC), and the Pacific Gas and Electric Company (PG&E), to estimate community-wide emissions. It should be noted that emission factors are continually refined and improved to reflect better measurement technology and research; these factors reflect the best available information at the time the inventory was prepared and in some instances differ from those used in the 2008 inventory. As shown in Appendix A, data supporting the community-wide inventory are provided to assist with future inventory update comparisons.

Emission Sectors

This 2014 inventory update was prepared based on guidance provided in the ICLEI *U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions Version 1.1* (Community Protocol). The Community Protocol defines five basic emissions generating activities that must be included in all protocol-compliant emissions inventory reports. These required activities include:

- Use of electricity by the community,
- Use of fuel in residential and commercial stationary combustion equipment,
- On-road passenger and freight motor vehicle travel,
- Use of energy in potable water and wastewater treatment and distribution, and
- Generation of solid waste by the community.

In addition to these five required activities, cities may optionally include other emissions activities in their inventory as deemed relevant to their community. To allow closer comparison to the City's previous community inventory, the 2014 inventory update includes several additional emissions activities that were included in the 2008 community inventory, including:

- Off-road vehicles (boats, aircraft support equipment, public transit trains),
- Off-road equipment (e.g., forklifts, lawn mowers), and
- Wastewater treatment process emissions.

The following sections describe the data sources, quantification methods, and data limitations within each emission sector included in the 2014 inventory update.

Energy Consumption – Electricity and Natural Gas

The energy consumption sector includes the use of electricity and natural gas by all land uses within the legal boundaries of the city. Although emissions associated with electricity production are likely to occur in a different jurisdiction, consumers are considered accountable for the generation of those emissions. Therefore, electricity related GHGs are considered

indirect emissions. For example, a San José resident may consume electricity within the city that was generated in a different region. Natural gas emissions, however, are considered a direct emission because the combustion activity directly generates the emissions at the point of consumption (e.g., within a home for heating or cooling purposes).

Data Sources

PG&E provides electricity and natural gas to residents and businesses in San José, and provided electricity and natural gas consumption data to the project team for the 2013 calendar year. Though the inventory update was prepared for the 2014 calendar year, PG&E's 2014 data was not available at the time of inventory preparation. PG&E provided all electricity and natural gas consumption data in the form of kilowatt-hours per year (kWh/yr) and therms per year (therms/yr). PG&E also provided electricity and natural gas emissions factors specific to the data year (i.e., 2013). See Appendix A for the 2013 PG&E energy consumption data and emissions factors used in this inventory update.

Quantification Methodology

The non-direct access electricity-related GHG emissions were quantified using a PG&E-specific emission factor that accounts for the 2013 PG&E electricity production portfolio. PG&E provided a 2013 emissions factor expressed as pounds of carbon dioxide per kWh (lbs CO_2/kWh). The project team collected additional information to account for electricity-related methane (CH_4) and nitrous oxide (N_2O) emissions. The project team collected CH_4 and N_2O emissions factors from the eGRID 2012 dataset (the most current dataset available at time of inventory preparation) for the CAMX-WECC California subregion. These factors were expressed as lbs/gigawatt hour (lbs/GWh). The project team used global warming potential (GWP) factors from the UN International Panel on Climate Change (IPCC) Fourth Assessment Report to convert the CH_4 and N_2O emissions factors into carbon dioxide equivalent (CO_2e)[2]; GWP values of 25 and 298 were applied to the CH_4 and N_2O emissions factors, respectively.[3] Finally, the project team added the emissions factors from each of the three chemicals to calculate a 2013 electricity factor expressed in terms of CO_2e/kWh.

The project team developed a second electricity emissions factor using the same process described above with all three inputs (i.e., CO_2, CH_4, N_2O) collected from eGRID 2012 for the CAMX-WECC California subregion. This regional electricity factor was applied to the direct access electricity category because PG&E transmits but does not generate electricity consumed by those customers. While the precise source of electricity used in the direct access segment is unknowable, the CAMX-WECC factor was selected as a proxy for this segment following discussions with PG&E staff.

Natural gas GHG emissions were also quantified using a PG&E-specific natural gas emission factor.

Electricity and natural gas activity data (e.g., kWh/yr and therms/yr) were then multiplied by their corresponding emissions factors to calculate total emissions from each energy source expressed as metric tons of carbon dioxide equivalent (MT CO_2e).

Mobile Sources

The mobile sources sector includes the on-road transportation and off-road vehicle and equipment subsectors. The on-road transportation subsector consists of on-road vehicles that would travel along local roadways and freeways. Off-road vehicles, which are discussed in greater detail below, include boating, public transit trains, and airport ground support equipment (GSE) (excluding aircraft operations). The off-road equipment subsector represents equipment use for lawn and garden, construction, industrial, and light commercial applications.

[2] CH_4 and N_2O have significantly stronger greenhouse gas effects than CO_2.

[3] The 2008 inventory used the following GWP values from the IPCC Second Assessment Report: CH_4 = 21; N_2O = 310

On-Road Vehicles

The on-road vehicles sub-sector includes exhaust-related GHG emissions associated with on-road vehicles coming to and leaving from the City of San José. Vehicle trips were distinguished by their origin and destination as being internal (i.e., within city limits) or external (i.e., outside of city limits). For the purposes of this GHG inventory and pursuant to the California Air Resources Board (ARB) Regional Targets Advisory Committee (RTAC) prescribed methods, only the internal-internal and external-internal vehicle trips were included in the City's inventory.[4] That is, if a vehicle trip originated and terminated within city limits, it would be considered an internal-internal trip. If a trip originated within city limits and terminated outside of city limits, or vice versa, it would be considered an internal-external trip (or an external-internal trip). If a trip neither originated nor terminated within city limits, but passed through city limits, the vehicle miles traveled (VMT) associated with this external-external trip would be omitted from the inventory because the jurisdiction has no control over the trip, and therefore is not responsible.

One hundred percent of VMT associated with internal-internal trips were included in the inventory. RTAC recommends that a jurisdiction take responsibility for half of the VMT if a trip would originate or terminate in its jurisdiction. Therefore, 50% of the internal-external and external-internal VMT were included in the inventory. All external-external trips and VMT were omitted from San José's inventory.

Data Sources

The project team's transportation planning consultant, Hexagon, developed VMT data for the inventory update based on a city-specific traffic model developed in support of the City's ongoing General Plan 4-Year Review. The travel demand model was developed to determine the VMT from the three previously described vehicle trip types: Internal-Internal (I-I), Internal-External (I-E), and External-Internal (E-I), where "internal" represents an origin or destination within the city and "external" represents any origin or destination outside of the city boundaries. The project team processed the travel demand model outputs to include all I-I VMT and 50% of I-E and E-I VMT pursuant to the previously described RTAC methodology. As discussed above, all External-External VMT (i.e., pass-through trips) were excluded from the inventory in order to avoid counting pass-through trips for which jurisdictions are not responsible and over which they have no control. The project team developed annual VMT by speed bin for year 2015 (corresponding with the base year in the General Plan update traffic demand model) and the previous 2008 baseline inventory year. The City's on-road transportation annual VMT was interpolated between the 2008 and 2015 VMT data points to estimate a 2014 VMT value to align with the inventory update year. The interpolation assumed linear growth from 2008 through 2015, and year 2015 speed bin distributions were used to estimate 2014 on-road transportation emissions.

Quantification Methodology

Emission factors for the on-road transportation sector were obtained from ARB's vehicle emissions model, EMFAC2014. EMFAC2014 is a mobile source emission model for California which provides vehicle emission factors by county, vehicle class, operational year, and speed bin. For the emissions inventory, Santa Clara County emission factors for operational year 2014 were used. County-wide fleet emission factors for each speed bin were weighted by VMT for each vehicle class. In other words, emissions factors for vehicle classes that represent a higher percentage of VMT for a particular speed bin would be 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. Pursuant to US Environmental Protection Agency

[4] Regional Targets Advisory Committee (RTAC). 2009. Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375: Report to the California Air Resources Board. Available: <http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf>

guidance, CO_2e emissions were calculated by dividing CO_2 emissions by 0.95, which accounts for other GHGs such as nitrous oxide (N_2O), methane (CH_4), and other high global warming potential gases.[5]

Off-Road Vehicles

The off-road vehicles subsector includes boating activities, airport GSE, and public transit trains.

Data Sources

For boating activities, City staff provided total Santa Clara County boating activities occurring in 2014. Activities included annual attendance records at the various parks for power boats, personal watercrafts, and non-power boats. The parks that are located within city limits include all of Calero Park and half of Anderson Lake.

For airport GSE, City staff provided 2014 annual fuel consumption for GSE at the Norman Y. Mineta San Jose International Airport (SJC).

For public transit trains (i.e., Caltrain, Alamont Corridor Express [ACE], and Amtrak [Capitol Corridor]), City staff provided 2014 activities and infrastructure for the trains, including pass-by trips and train miles within city limits. The average daily ridership per train for each of the three public transit trains was obtained from the respective operating company websites.[6,7,8] The project team updated the associated emissions factor that was used in the 2008 inventory with a current value (expressed as lb CO_2e/passenger mile).

Quantification Methodology

ARB's off-road equipment emissions model, OFFROAD, was used to estimate total GHG emissions associated with boating in Santa Clara County in year 2014. OFFROAD provides emissions for CO_2, N_2O, and CH_4 by boat type. The total Santa Clara County boating emissions for power boats, personal watercrafts, and non-power boats were allocated to the City using the proportion of recorded attendances at parks located within the city out of the total Santa Clara County.

For airport GSE, emission factors for diesel and gasoline fuel combustion were obtained from the California Climate Action Registry's (CCAR) General Reporting Protocol Version 3.1.[9] Annual fuel consumption was multiplied by the corresponding emission factors for CO_2, N_2O, and CH_4.

Train emissions were developed using the same methods as those described for the City's 2008 Emissions Inventory. 2014 activity and infrastructure parameters, including pass-by trips, average daily ridership, and train miles within city limits, were multiplied by a passenger mile CO_2e emissions factor.

Off-Road Equipment

This sub-sector includes emissions associated with off-road equipment used in construction, light commercial, industrial, and lawn and gardening operations.

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[5] USEPA. 2005. Emission Facts: Greenhouse Gas Emission from a Typical Passenger Vehicle. Available: <http://www.epa.gov/oms/climate/420f05004.htm>.

[6] Caltrain. 2014. February 2014 Caltrain Annual Passenger Counts Key Findings. Available: <http://www.caltrain.com/Assets/_MarketDevelopment/pdf/2014+Annual+Passenger+Count+Key+Findings.pdf>. Accessed March 2, 2016.

[7] Santa Clara Valley Transportation Authority. 2014. Transit Operations Performance Report: 2014 Annual Report. Available: <http://www.vta.org/sfc/servlet.shepherd/document/download/069A0000001ePEjIAM>. Accessed March 2, 2016.

[8] Capitol Corridor Joint Powers Authority. 2015. Capitol Corridor Performance Report 2015. Available: <http://www.capitolcorridor.org/downloads/performance_reports/CCJPA_Performance2015.pdf>. Accessed March 2, 2016.

[9] California Climate Action Registry (CCAR). General Reporting Protocol, Version 3.1. Available: <http://sfenvironment.org/sites/default/files/fliers/files/ccar_grp_3-1_january2009_sfe-web.pdf>. Accessed March 2, 2016.

Data Sources

Data for construction, light commercial, industrial, and lawn and gardening equipment were obtained from the ARB model OFFROAD2007, which provides county-level emissions factors for off-road equipment.[10] OFFROAD uses a multitude of factors and indicators to estimate and project off-road equipment activity levels. This includes, but is not limited to population, statewide rules and regulations, academic studies, growth forecasts, existing ARB reporting systems (e.g., Diesel Off-Road On-Line Reporting System [DOORS]), and non-compliance estimates.[11] The project team collected demographic data describing city and county population, households, and local jobs.

Quantification Methodology

ARB's OFFROAD2007 model was used to quantify GHG emissions associated with the previously identified off-road equipment sources. Demographic and economic indicators were used to allocate San José's proportional share of total county-wide emissions for each of the four off-road equipment sources included in the inventory update. The ratio of San José's households plus jobs compared to county-wide values was used to allocate the city's share of emissions from lawn and garden equipment. The ratio of jobs in the city compared to the entire county was used to allocate emissions from construction, industrial, and light commercial equipment.

Wastewater Treatment

The wastewater sector includes emissions resulting from wastewater treatment processes and discharge of treated wastewater. Wastewater treatment process emissions include methane emissions from treatment of influent biochemical oxygen demand (BOD) in the wastewater treatment lagoons and fugitive methane and nitrous oxide (N_20) emissions during combustion of digester gas. Following treatment, discharged effluent contains nitrogen that can form N_2O emissions. These process emissions are considered indirect, Scope 2 emissions associated with the community-wide inventory. Energy-related emissions for the operation of the San Jose-Santa Clara Regional Wastewater Facility (SJSC-RWF) are included in the PG&E-provided energy data (i.e., electricity and natural gas) and represented in the previously described energy consumption sector.

Data Sources

City staff provided annual influent and effluent volumes, average influent BOD, and average effluent nitrogen content data for the 2014 base year. City staff provided these data for the entire SJSC-RWF, which also serves residents and businesses in the City of Santa Clara and other jurisdictions, in addition to San José's residents and businesses. The population estimate used to calculate digester gas production represents the total population served by the SJSC-RWF and is reported on the SJSC-RWF website.[12]

Quantification Methodology

The Community Protocol equations WW.6 and WW.12 were used to quantify CH_4 and N_2O emissions from influent BOD treatment at lagoons and discharged effluent, respectively. Generation of CH_4 depends on the BOD of influent liquid and the type of treatment system, while generation of N_2O depends on the nitrogen content of effluent discharged from the facility. Generation of both types of emissions also depend on the amount of annual influent and effluent (i.e., volume of wastewater received and discharged, respectively).

[10] CARB. 2006 (December). Off-Road Emissions Inventory. Available: <http://www.arb.ca.gov/msei/offroad/offroad.htm>.

[11] Additional information regarding the assumptions and factors used to estimate OFFROAD activity levels can be found at: <http://www.arb.ca.gov/msei/categories.htm>

[12] City of San José. 2016. San José-Santa Clara Regional Wastewater Facility. Available: <https://www.sanjoseca.gov/Index.aspx?NID=1663>. Accessed March 7, 2016.

Community Protocol equations WW.1.(alt) and WW.2.(alt) were used to calculate fugitive methane and nitrous oxide emissions resulting from incomplete digester gas combustion. The equations include several default inputs to estimate digester gas production based on the service population of the wastewater facility. Digester gas is combusted in engines that primarily generate biogenic CO_2 emissions, which are not included in GHG inventories; however, a small portion of digester gas escapes as fugitive emissions. Default values from the Community Protocol equations were used to estimate digester gas generation and the destruction efficiency of engines combusting the digester gas.

Solid Waste

The solid waste sector includes CO_2 and CH_4 emissions associated with solid waste disposal. During the solid waste decomposition process, CO_2 emissions are generated under aerobic conditions (i.e., in the presence of oxygen) and CH_4 emissions are generated under anaerobic conditions (i.e., in the absence of oxygen). Solid waste disposal activities also generate GHG exhaust emissions associated with waste management vehicles; however, these vehicle-related emissions are represented in the mobile sources sector.

Data Sources

City staff provided San José's baseline solid waste disposal data in tons per year. Historic population estimates were used to estimate past solid waste generation amounts. Historic population estimates were collected from decennial US Census data (via the Bay Area Census website: http://www.bayareacensus.ca.gov/cities/SanJose50.htm).

Quantification Methodology

Solid waste emissions were modeled using the California Air Resources Board (ARB) Landfill Emissions Tool Version 1.3.[13] This tool uses the mathematically-exact first order decay model from the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. The tool was used to calculate solid waste emissions estimates based on modeled community-wide waste generation from 1950 through 2014.[14]

The project team modeled the historic waste disposal estimates based on decennial population growth in the city and the 2014 baseline year disposal rate (i.e., tons disposed per resident). Table 1 on the following page shows a summary of the population inputs and corresponding solid waste disposal estimates that were applied to the ARB landfill tool. Values for intermediary years (e.g., 1951, 1952) were interpolated between the decennial estimates shown in Table 1 for inclusion in the ARB tool.

[13] California Air Resources Board. Landfill Emissions Tool, Version 1.3. Available: <http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm> Accessed January 2016.

[14] The technical guidance provided with ARB's Landfill Emissions Tool suggests including historic waste disposal amounts, beginning with the landfill's first operating year, or 60 years before the baseline year, whichever is greater. The project team used the tool to model a hypothetical landfill that has been receiving San José's community-wide solid waste, and therefore a precise first operating year was unavailable. The project team estimated community-wide solid waste generation values back to 1950 to align with decennial population data; this estimate represents 64 years of historic waste-in-place methane generation (i.e., 1950-2014).

Table 1 Solid Waste Modeling Inputs		
Year	**Population [1]**	**Solid Waste (tons) [2]**
1950	95,280	62,039
1960	204,196	132,958
1970	445,779	290,259
1980	629,442	409,847
1990	782,225	509,328
2000	894,943	582,722
2010	945,942	615,928
2014	1,016,479 [3]	661,857

Source: AECOM 2016

[1] Bay Area Census decennial population data, except for 2014 (see note [3]). Available online: <http://www.bayareacensus.ca.gov/cities/SanJose50.htm>

[2] 2014 baseline solid waste data provided by City of San José; all other years were modeled from 2014 value based on average annual population growth rates from decennial Census data

[3] State of California, Department of Finance, E-5 Population and Housing Estimates for Cities, Counties, and the State; January 1, 2011-2015, with 2010 Benchmark. Sacramento, California, May 1, 2015

Potable Water

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 Great Oaks Water Company (GOWC), and the San José Water Company (SJWC).

Data Sources

City staff provided the project team with a water supply assessment memo that was prepared in support of the General Plan 4-year review. The memo (*Summary Review Regarding Water Supply for Envision San José 2040* prepared by Schaaf & Wheeler) includes a table describing total water consumption by water supplier from 2012-2015. The 2014 water supply values were used in this inventory analysis. It should be noted that SJWC does not separate water demand by customer area, so isolating San José customers from their total water supply value was not possible. The project team contacted SJWC staff separately to discuss specific data needs for the inventory update and were told that San José-specific consumption values could not be obtained given the company's database constraints, consistent with Schaaf & Wheeler's finding in the water supply assessment memo. Water supply sources (e.g., groundwater, surface water) were obtained from each water provider's 2010 Urban Water Management Plan. Potable water process energy intensity values were obtained from the 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. The electricity emissions factor applied to the potable water sector comes from the US EPA's eGRID 2012 analysis for the CAMX subregion (WECC California).

Quantification Methodology

This sector uses equation WW.14.1 from the Community Protocol to estimate energy-related emissions from water consumption. Total water consumption in 2014 was multiplied by water supply source ratios to calculate the total water consumption by source by water provider shown below in Table 2.

Table 2
Water Supply Source by Provider

Water Provider	Groundwater (MG)	Surface (MG)	Recycled (MG)	Total (MG)
Great Oaks Water Company	3,475	-	-	3,475
San José Water Company	15,944	25,595	420	41,959
Municipal Water Service	188	5,145	941	6,274
Total	19,607	30,740	1,361	51,707

Note: MG = million gallons

Source: Total water for each provider from *Summary Review Regarding Water Supply for Envision San Jose 2040*, Table 7, Schaaf & Wheeler, March 2016. Available online: <http://www.sanjoseca.gov/DocumentCenter/View/55130#page=7> Water supply sources by provider calculated by AECOM based on providers' 2010 Urban Water Management Plans.

Per the Community Protocol guidance, water supply energy intensity values were acquired from the CPUC-sponsored water study referenced above. However, of the City's three water providers, only 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 energy information for five segments of the water process, whereas the Community Protocol equation references four segments in its equation. Table 3 below shows how the CPUC study segments were assumed to correlate to the Community Protocol equation terms.

Table 3
Water Process Segments

CPUC Study Segment	Community Protocol Equation Term
Groundwater	Extraction
Booster Pumps	Distribution/Conveyance
Raw Water Treatment	Distribution/Conveyance
Water Treatment	Treatment
Pressure System Pumps	Distribution/Conveyance

The CPUC study did not provide annual averages for energy intensity by water process phase, but instead 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 as shown in Table 4 on the following page.

Table 4 Energy Intensity in Water Supply – San Jose 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

Note: kWh = kilowatt hour; MG = million gallons

Source: Avg. Summer and Avg. Winter values from *Embedded Energy in Water Studies – Study 2: Water Agency Function Component Study and Embedded Energy-Water Load Profiles, Appendix B,* pg 280-297, GEI Consultants/Navigant Consulting, August 2010. Available online: <ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Water%20Studies%202/Appendix%20B%20-%20Agency%20Profiles%20-%20FINAL.pdf> Adapted by AECOM 2016.

Water process segment emissions were calculated separately and summed for the sector total. Per the Community Protocol, extraction emissions only apply to groundwater use and treatment emissions only apply to surface water use. Therefore, extraction segment emissions were calculated by multiplying total groundwater use by the extraction energy factor by the eGRID electricity factor; treatment segment emissions were calculated by multiplying total surface water by the treatment energy factor by the eGRID electricity factor; and, distribution/conveyance emissions were calculated by multiplying total water consumption by the distribution/conveyance energy factor by the eGRID electricity factor.

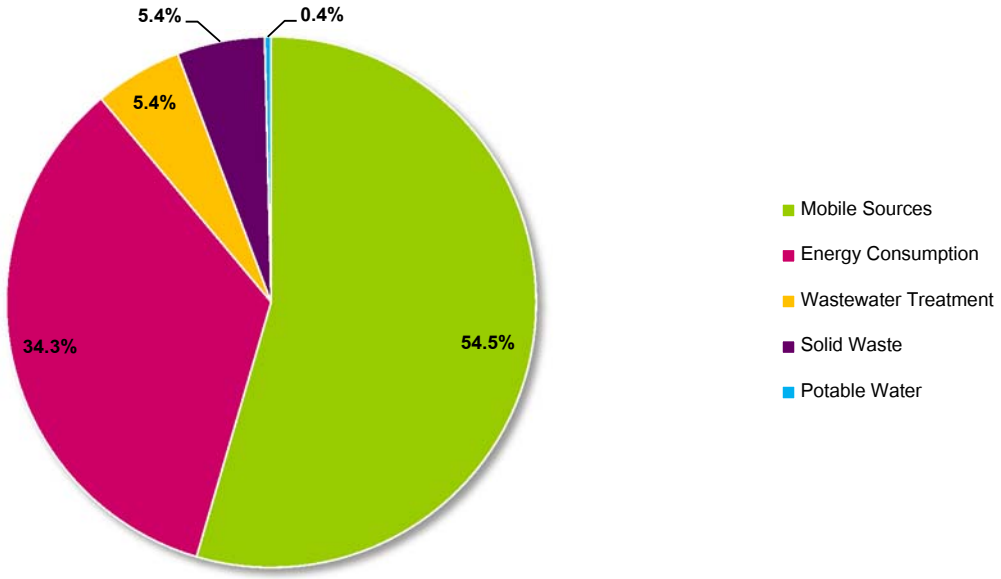
Recycled water contributed approximately 2.5% of total water consumption in 2014. However, the Community Protocol does not provide a methodology for assessing energy use related to recycled water use; it only considers groundwater and surface water. For purposes of this analysis, recycled water was combined with surface water since it does not require energy use associated with groundwater pumping. Further, the Community Protocol equation to calculate emissions from the water treatment segment is intended to address energy use associated with treating surface water to potable water standards; not to consider the energy required to treat wastewater to recycled water standards. In San José, the South Bay Water Recycling (SBWR) main pump station receives tertiary-treated water from the adjacent SJSC-RWF, which is located within the city boundary. Therefore, the project team assumes that the energy required to produce the recycled water distributed by SBWR is included in the total energy consumption of the SJSC-RWF, which is included in the inventory's energy sector.

It should be noted that SJWC was unable to provide information specific to their San José customers for use in this analysis. Therefore, the project team analyzed the energy-related emissions resulting from the total SJWC water supply (i.e., San José and surrounding jurisdictions), resulting in an overestimate of the community's emissions in this sector. However, given the relatively small contribution of potable water emissions to the total inventory, this overestimate does not substantially influence the inventory results. City-specific water consumption information from SJWC may be available for future inventory updates and would help to further refine the community inventory.

GHG Emissions Inventory

The City of San José's 2014 GHG inventory totals 7.47 MMT CO_2e/yr. Mobile sources and energy consumption are the largest emissions sectors, contributing 89% of total emissions; mobile sources are the largest sector, contributing more than half of all emissions (55%), while energy consumption contributes approximately one-third of total emissions (34%). Waste-related emissions are the next largest contributor with wastewater treatment plant operations and the disposal of solid waste contributing nearly 11% of total emissions combined. The consumption of potable water provides the remaining community-wide emissions, totaling less than 1%. Figure 2 below illustrates the community's emissions by sector.

Figure 2 – 2014 Community-wide Emissions by Sector



For informational purposes, per capita and per service population (SP) emission rates for San José were calculated using population and jobs estimates for the community. Table 5 below shows demographic information collected for this analysis.

Table 5
Demographic Data

Year	2008 [1]	2010 [2]	2014	2040 [2]
Population	985,307		1,016,479 [3]	
Jobs	369,450	377,140	396,789 [4]	524,510
Service Population	1,354,757 [5]		1,413,268 [5]	

Notes

[1] General Plan EIR Appendix K - Greenhouse Gas Emissions, Table 3-5 Development of County-to-City Scaling Factors for Off-Road Equipment Emissions

[2] Draft Plan Bay Area, July 2013: Final Forecast of Jobs, Population, and Housing; Available online: <http://planbayarea.org/pdf/final_supplemental_reports/FINAL_PBA_Forecast_of_Jobs_Population_and_Housing.pdf>

[3] CA Department of Finance, Report E-5, Population and Housing Estimates for Cities, Counties, and the State, January 1, 2011-2015, with 2010 Benchmark, Released May 1, 2015

[4] 2014 value interpolated between 2010 and 2040 values

[5] Sum of population and jobs values

Table 6 shows the 2014 community emissions in MT CO_2e/yr for each sector and sub-sector. The 2014 population and service population values shown in Table 5 were used to calculate the community emissions efficiency rates provided at the bottom of Table 6. In 2014, San José generated approximately 7.4 MT CO_2e/yr/capita and 5.3 MT CO_2e/yr/SP.

Table 6
San José 2014 Community-wide GHG Emissions Inventory

Emission Sector/Subsector	Emissions (MT CO_2e/yr)	Percent of Total (%)
Mobile Sources	**4,076,505**	**54.5%**
On-Road Vehicles	3,724,641	49.8%
Off-Road Vehicles (ships, trains, aircraft equipment)	27,946	0.4%
Off-Road Equipment	323,918	4.3%
Energy Consumption	**2,567,038**	**34.3%**
Electricity	1,469,809	19.7%
Residential	*426,700*	*5.7%*
Non-residential	*665,661*	*8.9%*
Direct Access	*377,448*	*5.1%*
Natural Gas	1,097,228	14.7%
Residential	*670,150*	*9.0%*
Non-residential	*427,079*	*5.7%*
Wastewater Treatment	**400,290**	**5.4%**
Solid Waste	**400,086**	**5.4%**
Potable Water	**29,530**	**0.4%**
TOTAL	**7,473,449**	**100.0%**
Emissions Per Capita – 2014 (MT CO_2e/capita/yr)	7.35	
Emissions Per Service Population – 2014 (MT CO_2e/SP/yr)	5.29	

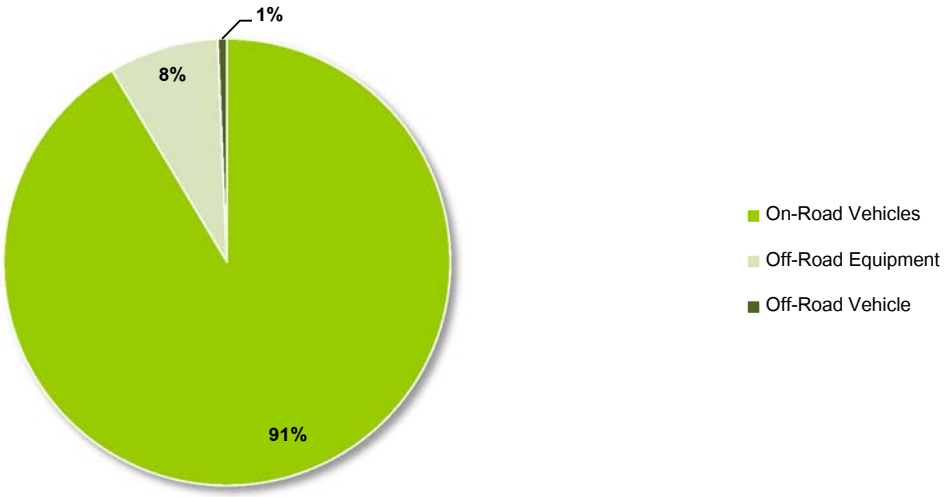
Notes: Totals may not appear to add exactly due to rounding; SP = service population, calculated as population plus jobs, see Table 5
Source: AECOM 2016

Sub-Sector Analysis

Mobile Sources

Mobile source emissions consist of three sub-sectors. On-road vehicles represent the largest emissions source within the sector, accounting for half of the community's total emissions. Off-road equipment provides an additional 4% of total emissions through use of lawn and garden equipment, light commercial and industrial equipment, and construction equipment within the community. Off-road vehicles, consisting of train ridership within the City's boundaries (i.e., Caltrain, ACE, and Capitol Corridor) contribute less than 1% of total emissions. Figure 3 on the following page illustrates the contribution of each sub-sector to the total mobile sources sector.

Figure 3 – Mobile Source Emissions by Sub-Sector



Energy Consumption

Energy sector emissions are split between electricity (57%) and natural gas (43%), as shown in Figure 4 below. Residential and non-residential users are each responsible for 43% of total energy emissions. Direct access users provide the remaining 15% of emissions. Natural gas represents 61% of residential energy emissions, and electricity provides the remaining 39% of emissions. The opposite is true of non-residential users. Direct access customers receive electricity through PG&E infrastructure, which is generated or procured by a third-party provider. See Figures 5 and 6 on the following page for an illustration of energy emissions by end user and fuel type.

Figure 4 – Energy Consumption by Source

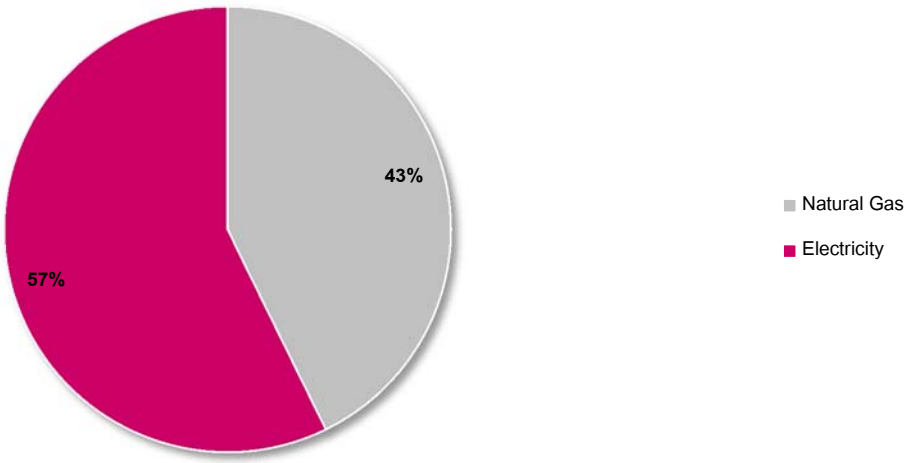
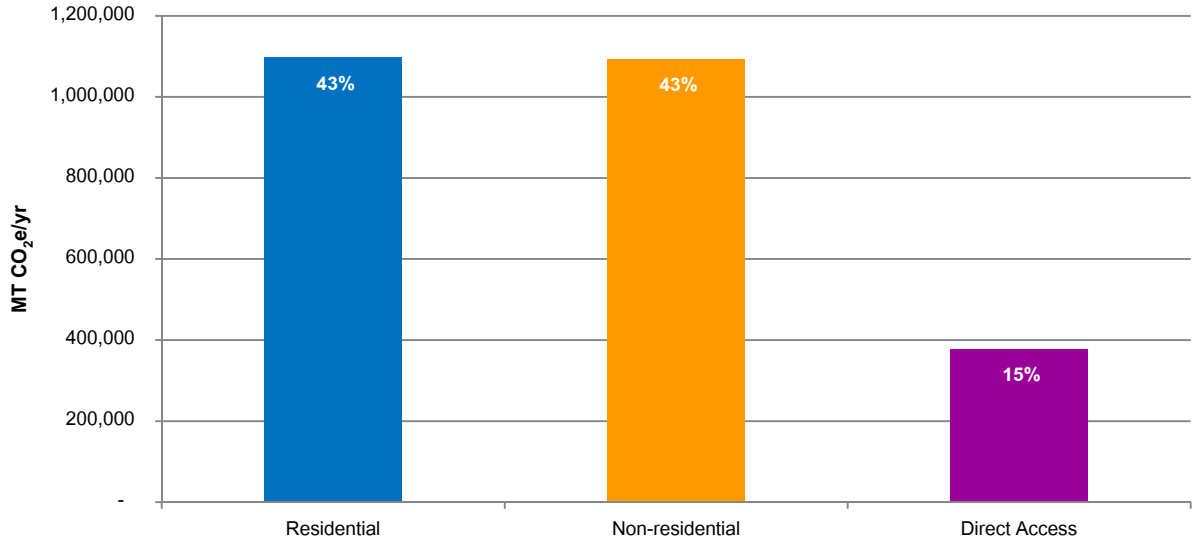
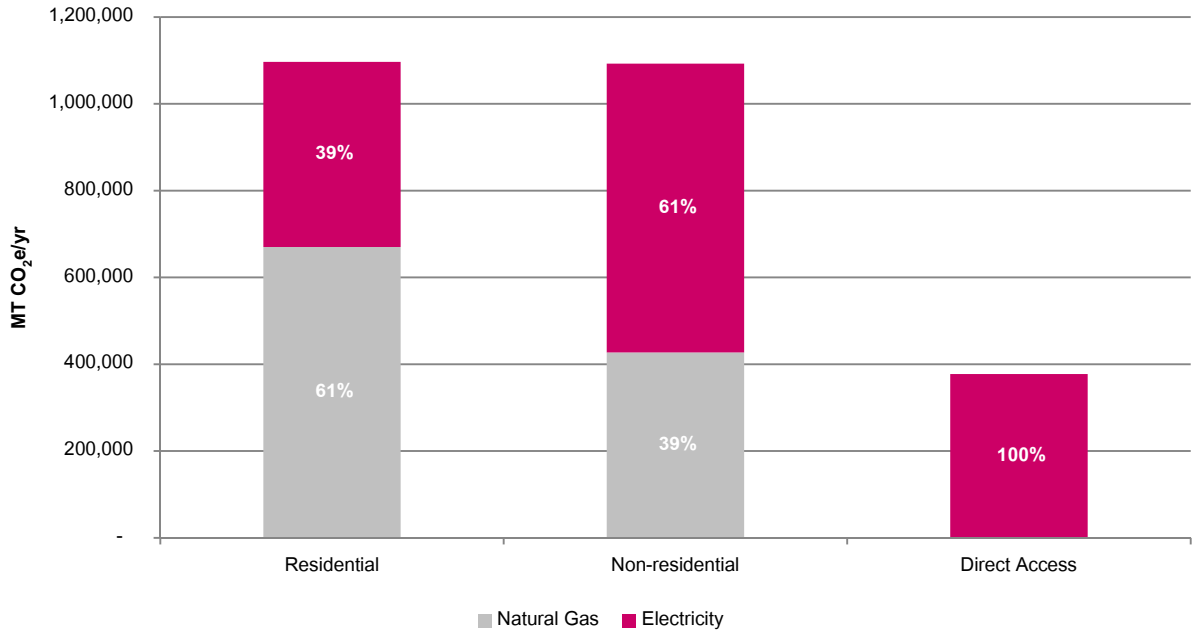


Figure 5 – Energy Consumption by End User



Note: MT CO_2e/yr = metric tons carbon dioxide equivalent per year; percentages represent end user contribution to total energy consumption sector emissions; percentages may not sum to 100% due to rounding

Figure 6 – Energy Consumption by Fuel Type by End User



Note: MT CO_2e/yr = metric tons carbon dioxide equivalent per year; percentages represent energy source contributions to end user total energy consumption

Comparison to 2008 Inventory

The City's previous community-wide inventory prepared for the Envision San José 2040 General Plan update represents emissions levels in calendar year 2008. As part of this inventory update project, the project team reviewed the previous inventory to compare results and identify methodological or data discrepancies that could affect direct comparisons between the two inventories. This section first compares the two inventories to illustrate the community's emissions trends over the past 6 years, and then describes variations in the inventories on a sector-by-sector basis.

Inventory Comparison

As shown in the *Integrated Final Program EIR* for the Envision San José 2040 General Plan (General Plan EIR), the 2008 inventory was organized into the following five sectors:

- Transportation
- Residential
- Commercial
- Industrial
- Waste

Table 7 shows the 2008 estimated emissions by sector as included in the General Plan EIR. For purposes of comparison with the 2014 inventory update, Table 8 on the following page represents results from the 2008 and 2014 inventories using a common naming convention. The residential, commercial, and industrial sectors from the 2008 inventory were combined in the "energy consumption" sector; within this sector, the commercial and industrial subsectors were combined and renamed non-residential.[15] Further, the transportation sector is shown as "mobile sources" and the 2008 transportation sector is split into two sub-sectors (on-road vehicles and off-road vehicles) based on analysis provided in the General Plan EIR Appendix K – Greenhouse Gas Emissions; the 2008 inventory did not specifically identify off-road equipment as a separate subsector. Finally, the "waste" sector includes the solid waste and wastewater treatment subsectors from the 2014 inventory; the 2008 inventory only identified a waste sector, and sufficient information was unavailable to determine what subsectors it might include, if any. Demographic indicators from Table 5 were used to compare emissions efficiency levels across the two inventories.

Table 7
Estimated 2008 Community GHG Emissions for San José

Sector Category	Annual Emissions (MMT CO_2e/yr)	Percent
Transportation	3.52	46.3%
Residential	1.47	19.3%
Commercial	1.33	17.5%
Industrial	1.03	13.5%
Waste	0.26	3.4%
TOTAL	**7.61**	**100.0%**

Notes: Totals may not appear to add exactly due to rounding; MMT CO_2e/yr = million metric tons of carbon dioxide equivalent per year
Source: Envision San José 2040 General Plan, Integrated Final Program EIR. Section 3.0 Environmental Setting, Impacts, and Mitigation, pg. 800. City of San José. September 2011.

[15] Direct access energy users as identified in the 2014 inventory are included in the non-residential sub-sector of Table 8 for comparison purposes only; direct access users can include both residential and non-residential customers.

Table 8 2008 and 2014 GHG Emissions Inventory Comparison		
Emission Sector/Subsector	**2008 Emissions (MMT CO_2e/yr)**	**2014 Emissions (MMT CO_2e/yr)**
Mobile Sources	**3.52**	**4.08**
On-Road Vehicles	3.48	3.72
Off-Road Vehicles (ships, trains, aircraft equipment)	0.04	0.03
Off-Road Equipment	- [1]	0.32
Energy Consumption	**3.83**	**2.57**
Residential	1.47	1.10
Non-residential	2.36	1.47
Waste	**0.26**	**0.80**
Wastewater Treatment	- [1]	0.40
Solid Waste	- [1]	0.40
Potable Water	**- [2]**	**0.03**
TOTAL	**7.61**	**7.47**
Emissions Per Capita (MT CO_2e/capita/yr)	7.72	7.35
Emissions Per Service Population (MT CO_2e/SP/yr)	5.62	5.29

Source: AECOM 2016

Notes: Totals may not appear to add exactly due to rounding; SP = service population, calculated as population plus jobs

[1] Not identified separately in 2008 inventory

[2] Sector not included in 2008 inventory

Based on the City's 2008 inventory shown in Tables 7 and 8, emissions have decreased 1.8% community-wide since 2008. During the same period, the city's population has increased 3.2% and service population increased 4.3%, resulting in a decrease in emissions generated per capita and per service population. This demonstrates that the city has been able to accommodate residential and employment growth more efficiently, with fewer emissions generated per unit of growth. This is the result of decreasing energy emissions through energy efficiency improvements and increased use of renewable energy sources in the electricity grid, as well as a modest decrease in the daily vehicle miles traveled per service population (i.e., residents and jobs) in the city.

Sector Comparisons

The following sections describe differences between the 2008 and 2014 inventories regarding the methodological approaches used or data quality.

Mobile Sources

On-Road Vehicles

Based on the traffic model analysis developed in support of the City's General Plan update project, daily VMT from on-road vehicles operated within the city's boundaries increased 2.9% from 2008 to 2014. The City's service population grew 4.3% during that same period. Both inventories used the RTAC methodology when estimating VMT values associated with the city's land uses. It is worth noting that the VMT estimates from the two inventories were developed from different proprietary travel demand models and used different version of the EMFAC model for vehicle emissions factors, so an exact comparison from one year to the next cannot be made. However, this type of discrepancy is common in most

inventory updates and the quantification methodologies used were the same, resulting in a high level of compatibility among the inventories.

Off-Road Vehicles

The project team used the same methodologies (when applicable) as described in the 2008 inventory to estimate community emissions from use of trains, airport equipment, and boats in 2014.

Trains

The 2008 and 2014 inventories applied the same methodology for estimating emissions resulting from train ridership within the city boundaries. The increase in train-related emissions between 2008 and 2014 is due to increased service operation along some lines (i.e., additional trains per day, additional track miles in city) and increased daily average ridership along some lines.

Airport Ground Support Equipment

The decrease in emissions from airport equipment from 2008 to 2014 is explained by methodological differences and City efforts to reduce airport-related emissions. The 2008 inventory represents 100% of Santa Clara County's off-road emissions from airport ground support equipment (GSE) as included in the OFFROAD2007 emissions model. The 2008 inventory methodology states that SJC was the only commercial airport within the county using GSE during the 2008 baseline inventory year; other civilian airports operating within the county at that time would not use GSE. Therefore, all GSE-related emissions that were estimated within the OFFROAD207 model were assumed to be associated with SJC.

The 2014 inventory update relied upon empirical fuel consumption data provided by airport staff as opposed to emissions estimates from the OFFROAD model. Since the 2008 inventory, the City has taken steps to replace its diesel- and gasoline-powered GSE with electric vehicle models. Electricity consumption related to refueling the new GSE is included within the energy consumption sector, and not represented separately in the 2014 inventory update. Airport GSE emissions included in the 2014 inventory are based on total gallons of gasoline and diesel consumed by the remaining non-electric airport equipment.

Boats

The 2008 and 2014 inventories both used ARB's OFFROAD model to determine boat emissions within Santa Clara County. However, the 2008 inventory used the total Santa Clara County boating emissions to represent the city's boating emissions. This method would likely overestimate the city's total boating emissions. For the 2014 inventory update, the project team used a proportional ratio of boat attendances by boat type at facilities within the city compared to total attendances within Santa Clara County. Using this approach, the project team calculated ratios for power boats, non-power boats, and pleasure craft. These ratios were then used to allocate total Santa Clara County emissions for each boat type. As previously described, total annual boat attendances by boat type and park were provided by the Santa Clara County Parks and Recreation Department. Using this method, total Santa Clara County boating emissions are allocated to the city based on boat attendance days within the city.

Off-Road Equipment

As shown in the City's General Plan EIR, off-road equipment is not identified as a separate sub-sector within the emissions inventory. However, Appendix K to the EIR does describe a methodology for how off-road equipment emissions were quantified. The 2014 off-road equipment estimates were prepared using the same methodology to support direct comparison of the inventories, even though the 2008 inventory does not separately identify this sub-sector. As described earlier in this memo, city population, household, and local jobs data were compared to county-wide data to calculate San

José's proportional share of emissions from lawn and garden, light commercial, industrial, and construction equipment, based on the OFFROAD2007 model for Santa Clara County.

Energy Consumption

Both inventories collected electricity and natural gas activity data from PG&E for all land uses within the city's boundary. Table 9 below compares energy consumption for 2008 and 2013 according to the end user type, including residential, non-residential, and direct access customers within the City's boundary. These categories are based on PG&E's rate schedule classifications.

As shown, residential electricity consumption slightly decreased while natural gas consumption slightly increased. The residential electricity decrease can be explained, in part, by participation in home energy efficiency programs, which have focused primarily on electricity conservation opportunities. The slight increase in natural gas use is a result of residential growth in the city since the 2008 inventory. Non-residential electricity and natural gas use decreased 16% and 14%, respectively. The decreases in this category can be explained, in part, by participation in utility-sponsored energy efficiency improvement programs that identify opportunities for both electricity and natural gas conservation. A deeper analysis of economic changes within the community during this time frame might also indicate a transition away from land uses that typically consume relatively more natural gas (e.g., manufacturing) towards less energy-intensive uses (e.g., retail). Purchases of direct access electricity increased more than 46% since 2008. Direct access electricity is an option that allows customers to purchase their electricity directly from 3rd-party electric service providers. The electricity is transported and delivered through PG&E's transmission infrastructure, but is not generated by PG&E. Direct access customers are typically large electricity consumers that negotiate lower rates with a 3rd party provider. It is worth noting that data centers, which consume large quantities of electricity, could appear in both the non-residential and direct access categories. However, PG&E staff noted that the majority of data centers within San José are represented in the non-residential category. As previously mentioned, this is due to self-selection in which customers can choose the electricity rate schedule that best meets their individual needs.

Table 9
2008 and 2013 Energy Consumption Activity Data

	ELECTRICITY			NATURAL GAS		
User Type	**2008 Consumption (kWh/yr)**	**2013 Consumption (kWh/yr)**	**% Change**	**2008 Consumption (therm/yr)**	**2013 Consumption (therm/yr)**	**% Change**
Residential	1,917,716,406	1,875,919,122	-2.2%	123,489,652	125,908,563	2.0%
Non-Residential	3,484,374,792	2,926,474,828	-16.0%	93,670,593	80,240,109	-14.3%
Direct Access	872,382,672	1,274,752,335	46.1%	-	-	-
Total	**6,274,473,870**	**6,077,146,285**	**-3.1%**	**217,160,245**	**206,148,672**	**-5.1%**

Source: Adapted by AECOM 2016; 2013 values provided to AECOM by PG&E in February 2016; 2008 values adapted from Envision San José 2040 General Plan Integrated Final Program EIR, Appendix K – Greenhouse Gas Emissions, pgs. A-3 and A-4.
Notes: kWh/yr = kilowatt hours per year

Solid Waste

Solid waste emissions are not clearly identified in the 2008 inventory; the waste sector emissions identified therein may represent solid waste, wastewater treatment operations, or a combination of both. However, the General Plan EIR Appendix K describes the methodology used to estimate the 2008 solid waste emissions, which differs from the methodology the project team used to calculate the 2014 emissions. The 2008 inventory calculated the city's proportional share of solid waste emissions based on BAAQMD's 2007 Santa Clara County emissions inventory. As previously

described, the 2014 inventory estimated solid waste emissions using ARB's Landfill Emissions Tool Version 1.3, which is based on the first-order decay methodology. As with on-road vehicle emissions, direct comparisons of solid waste emissions from one inventory year to the next are often difficult to make due to the complexity involved in calculating landfill-generated emissions and the differing methodologies incorporated in the various landfill emissions calculators available for use.

Wastewater Treatment

The 2008 and 2014 inventories both quantified emissions associated with three distinct wastewater processes: lagoon treatment of influent (i.e., CH_4 emissions), discharge of effluent (i.e., N_2O emissions), and fugitive digester gas (i.e., fugitive CH_4 emissions). The 2008 inventory used general influent BOD, effluent nitrogen, and digester gas production factors that are based on population. However, for the 2014 inventory, City staff provided SJSC-RWF-specific influent BOD and effluent nitrogen levels that were used to calculate wastewater emissions. For digester gas, because facility-specific information was not available, the same digester gas production factors used in the 2008 inventory were also used for the 2014 inventory. Consistent with the Community Protocol, the 2014 inventory also calculated fugitive N_2O emissions resulting from incomplete combustion of digester gas. These N_2O emissions represent 4.0% of the total fugitive digester gas emissions in 2014; the 2008 inventory did not include N_2O emissions from digester gas. It should be noted that the SJSC-RWF-specific BOD and nitrogen content information represents activity levels for the entire SJSC-RWF service area (i.e., the total customer base served by the facility, rather than only those customers with a City of San José address). Future inventory updates should attempt to separate the amount of influent and effluent allocated to land uses within the city boundary in order to provide a more accurate assessment of community-wide wastewater treatment emissions. In addition, efforts should be taken to obtain SJSC-RWF-specific data related to processing digester gas in order to create a more city-specific inventory.

Potable Water

The 2008 inventory did not estimate emissions from the potable water sector. As previously described, energy consumption related to potable water use is one of the five required emissions sources for a community inventory according to the Community Protocol. The emissions estimate presented in this memo is based on several assumptions to determine total energy use associated with water consumption within the city boundary. Future inventory updates may have the benefit of better empirical data for this sector, which would help to improve the inventory's accuracy.

Appendix A
Inventory Data Tables

City of San José
Energy Consumption Sector
Activity Data - 2013

ELECTRICITY

User Type	Consumption (kWh/yr)	Emissions (MT CO_2e)
Residential		***426,700.06***
NONGOVENT	1,875,684,742	426,646.75
(3) COUNTY	123,114	28.00
(4) CITY	96,031	21.84
(5) DISTRICT	15,235	3.47
Commercial		***486,130.95***
NONGOVENT	1,940,020,019	441,280.57
(3) COUNTY	33,943,949	7,720.95
(4) CITY	76,782,434	17,465.08
(5) DISTRICT	86,451,188	19,664.35
Industrial		***179,530.47***
NONGOVENT	665,362,670	151,344.63
(3) COUNTY	28,625,966	6,511.32
(4) CITY	67,750,598	15,410.68
(5) DISTRICT	27,538,004	6,263.85
Direct Access		***289,957.54***
NONGOVENT	1,261,671,738	286,982.21
(3) COUNTY	-	-
(4) CITY	-	-
(5) DISTRICT	13,080,597	2,975.34
Total		**1,382,319.03**

NATURAL GAS

User Type	Consumption (therm/yr)	Emissions (MT CO_2e)
Residential		***670,149.57***
NONGOVENT	125,864,632	669,915.75
(3) COUNTY	40,559	215.88
(4) CITY	2,475	13.17
(5) DISTRICT	897	4.77
Commercial		***393,191.16***
NONGOVENT	67,744,568	360,571.13
(3) COUNTY	1,420,601	7,561.16
(4) CITY	1,898,026	10,102.26
(5) DISTRICT	2,810,065	14,956.60
Industrial		***33,887.62***
NONGOVENT	15/15 Rule Fail	-
(3) COUNTY	501,814	2,670.91
(4) CITY	5,427,977	28,890.46
(5) DISTRICT	437,058	2,326.25
Total		**1,097,228.35**

Source: PG&E Green Communities program, February 2016

City of San José
Energy Consumption Sector
Emissions Factors

Emissions Sector	Subsector	Emission Factor Type	Value	Units	Source
Energy					
	Electricity				
		PG&E 2005	0.4890	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2006	0.4560	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2007	0.6357	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2008	0.6410	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2009	0.5750	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2010	0.445	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2011	0.393	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2012	0.4440	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		PG&E 2013	0.4990	lbs CO2 per kWh	PG&E. 2014. Emission Factors and Other Information
		2012	650.31	lbs CO2 per MWh	eGRID2012: CAMX, WECC California
		2012	31.12	lbs CH4 per GWh	eGRID2012: CAMX, WECC California <http://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf>
		2012	5.67	lbs N2O per GWh	
		PG&E 2013	0.5015	lbs CO2e per kWh	PG&E 2014 and eGRID2012
		CA 2012	0.6528	lbs CO2e per kWh	eGRID2012: CAMX, WECC California
	Natural Gas				
		2005	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2006	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2007	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2008	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2009	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2010	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2011	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2012	11.70	lbs CO2 per therm	PG&E. 2014. Emission Factors and Other Information
		2009	0.005	kg CH4 per MMBtu	CCAR General Reporting Protocol v3.1
		2009	0.0001	kg N2O per MMBtu	CCAR General Reporting Protocol v3.1
		2012	11.73	lbs CO2e per therm	PG&E 2014 and CCAR GRP
Off-Road Vehicles	Caltrain		0.37	lbs CO_2e/passenger-mile	https://www.carbonfund.org/how-we-calculate
	ACE		0.37	lbs CO_2e/passenger-mile	https://www.carbonfund.org/how-we-calculate
	Capitol Corridor		0.37	lbs CO_2e/passenger-mile	https://www.carbonfund.org/how-we-calculate

City of San José
Unit Conversions and Standards

Emissions Sector	Category	Value	Conversion	Source
All	GWP	1	CO_2	IPCC 4th Assessment Report
	GWP	25	CH_4	IPCC 4th Assessment Report
	GWP	298	N_2O	IPCC 4th Assessment Report
	Weight	2000	lbs/ton	
	Weight	2204.623	lbs/MT	
	Weight	453.59	grams/lb	
	Weight	1000000	grams/MT	
	Annualize	365	days/year	
Energy	Electricity	1000	kWh/MWh	
		1000	MWh/GWh	
	Natural Gas	100,000	Btu/therm	
		0.10	MMBtu/therm	
		2.20462	lbs/kg	
Water/Wastewater				
	volume	0.0283	m^3/ft^3	
	Annualize	365.25	days/year	

City of San José
On-Road Vehicles
2014 VMT by Speed Bin

Total Citywide VMT

Speed Bin	2014 Citywide DVMT (miles/year)	Speed Bin Distribution (%)	2014 Citywide DVMT (miles/year)	Annualization Factor (days/year)	Annual Citywide VMT (miles/year)	Emission Factor (grams/mile)	Emissions (MT CO_2e/yr)
5	138,472	0.7%	137,829	347	47,826,491	1,544.54	77,758.12
10	326,612	1.6%	325,095	347	112,807,994	1,688.52	200,504.24
15	587,576	2.9%	584,847	347	202,941,999	1,002.15	214,084.40
20	1,099,065	5.4%	1,093,961	347	379,604,311	832.87	332,801.22
25	4,511,356	22.4%	4,490,403	347	1,558,169,804	542.07	889,093.67
30	2,542,074	12.6%	2,530,267	347	878,002,615	413.73	382,373.18
35	1,927,031	9.6%	1,918,081	347	665,574,179	437.91	306,803.67
40	1,178,084	5.8%	1,172,613	347	406,896,551	401.32	171,891.55
45	1,418,101	7.0%	1,411,515	347	489,795,681	362.41	186,851.82
50	1,534,595	7.6%	1,527,468	347	530,031,322	439.12	244,997.56
55	4,908,301	24.3%	4,885,504	347	1,695,269,898	402.06	717,481.92
Total	**20,171,268**	**100%**	**20,077,582**		**6,966,920,846**		**3,724,641**

Notes:
Emission factors are obtained from EMFAC2014 for Santa Clara County, Year 2014
Emission factors are weighted by total VMT per vehicle class

City of San José
4-Year Review GHG Analysis (VMT Data)
2014 VMT Interpolation

Notes:
VMT by Speed Bin calculated with City of San Jose General Plan Model.
VMT's are calculated assuming that trips that have an origin and destination (I-I) in San Jose are counted for 100% and trips that have only one trip end in San Jose (X-I and I-X) are counted for 50%.
X-X trips are excluded.
Used 2008 City of San Jose Roadway Network.

Source:
2008 and 2015 VMT by speed bin from Hexagon Transportation Consultants, January 2016
2014 VMT interpolation prepared by AECOM, February 2016

Speed Interval	2008 Baseline				
	Morning	Midday	Afternoon	Night	Daily
0 - 7.5	16,763	13,800	76,177	2,693	109,434
7.5 - 12.5	17,081	12,060	147,799	3,276	180,217
12.5 - 17.5	76,333	70,344	341,736	31,814	520,226
17.5 - 22.5	183,424	196,038	772,746	83,771	1,235,979
22.5 - 27.5	767,525	1,265,946	1,441,188	677,373	4,152,033
27.5 - 32.5	569,982	759,482	835,718	410,050	2,575,232
32.5 - 37.5	393,437	659,499	454,142	274,176	1,781,253
37.5 - 42.5	285,771	530,817	310,989	90,700	1,218,277
42.5 - 47.6	302,489	952,962	269,920	110,871	1,636,243
47.6 - 52.5	324,517	1,430,208	194,655	86,158	2,035,538
52.5 - 57.5	445,151	906,846	252,539	2,466,494	4,071,031
Totals	3,382,473	6,798,002	5,097,610	4,237,377	19,515,462

Totals 2014	3,426,458	6,964,555	5,374,214	4,312,355	20,077,582

Note: 2014 is interpolated between 2008 and 2015 total VMT. 2015 speed bin distributions are used for the inventory update

Speed Interval	2015				
	Morning	Midday	Afternoon	Night	Daily
0 - 7.5	20,214	15,455	188,480	1,998	226,146
7.5 - 12.5	34,414	18,375	381,957	3,524	438,270
12.5 - 17.5	119,811	85,694	527,839	36,283	769,627
17.5 - 22.5	240,536	206,026	856,932	88,734	1,392,228
22.5 - 27.5	879,894	1,345,894	1,397,937	704,157	4,327,883
27.5 - 32.5	535,666	824,711	744,282	426,127	2,530,786
32.5 - 37.5	417,425	801,146	421,465	278,840	1,918,877
37.5 - 42.5	270,392	582,883	299,310	106,676	1,259,262
42.5 - 47.6	229,234	1,091,090	243,387	100,451	1,664,163
47.6 - 52.5	268,903	1,346,393	152,451	93,882	1,861,628
52.5 - 57.5	417,299	674,646	206,274	2,484,180	3,782,398
Totals	3,433,789	6,992,314	5,420,315	4,324,851	20,171,268

City of San José
Off-Road Vehicles: Boating

Park Name	Within City	# Power Boats	PB Attendence	# Pleasure Watercraft	PWC Attendence	# Non-Power Boats	NPB Attendence	Special Permit Boats	Special Permit Boat Attendence	Total Attendence	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 Jose Total		5,236	18,327	1,204	1,806	937	1,405	-	-		
City of San Jose Allocation			34%		72%		26%				

Activity Data				OFFROAD Emissions				
Boat Type	Santa Clara County	City of San Jose	Percent	Santa Clara County Total (MT CO_2/yr)	Santa Clara County Total (MT CH_4/yr)	Santa Clara County Total (MT N_2O/yr)	Santa Clara County Total (MT CO_2e/yr)	City of San Jose (MT CO_2e/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%	6.90	0.01	0.00	7.50	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**

City of San José
Off-Road Vehicles: Trains

Transit Name	Transit Line	Daily Activity (passby trips) [1]	Average Ridership (riders/train) [2]	Train Miles in City (miles) [1]	Emission Factor (lb CO_2e/ passenger-mile) [3]	CO_2e Emissions (MT/yr)
Caltrain						
	Diridon North	92	616	2.4	0.37	8,440
	Tamien North	40	616	4.13	0.37	6,314
	Tamien South	6	616	15.87	0.37	3,640
ACE						
	Diridon	8	546	3.27	0.37	886
Capitol Corridor						
	Diridon	14	135	3.27	0.37	383
Total						**19,662**

Sources:

[1] Email from David J. Powers & Associates to AECOM, received February 03, 2016; data included in email from City of San José

[2] Caltrain (Uniform Limited Passengers Per Train by Service Type): http://www.caltrain.com/Assets/_MarketDevelopment/pdf/2014+Annual+Passenger+Count+Key+Findings.pdf

[2] ACE (ACE Average Weekday Riders/8 trains/day): http://www.vta.org/sfc/servlet.shepherd/document/download/069A0000001ePEjIAM

[2] Amtrak (Annual Ridership/365 days/30 trains/day): http://www.capitolcorridor.org/downloads/performance_reports/CCJPA_Performance2015.pdf

[3] Carbonfund.org (commuter rail emission factor): https://www.carbonfund.org/how-we-calculate

City of San José
Off-Road Vehicles: Airport Ground Support Equipment

Airport Ground Support Equipment			Emission Factors (kg/gallon)			
Fuel Use in 2014	**gallons/mo**	**gallons/yr**	**CO_2**	**N_2O**	**CH_4**	**MT CO_2e/yr**
Unleaded Gasoline	1,052	12,624	8.81	0.00022	0.00050	112.20
Diesel	475	5,700	10.15	0.00026	0.00058	58.38
Total						**170.58**

Source:
Fuel consumption data from City of San José, February 2016
Emission factors from General Reporting Protocol Version 3.1 (Table C.3 and C.6)

Global Warming Potential (GWP)

CO_2	1
CH_4	25
N_2O	298

Source:
GWP from IPCC Fourth Assessment Report

City of San José
Off-Road Equipment

		Demographics				OFFROAD Emissions				
Off-Road Equipment/Vehicle Class	**OFFROAD Category**	**Demographic**	**Santa Clara County**	**City of San Jose**	**Percent**	**Santa Clara County Total (MT CO_2/yr)**	**Santa Clara County Total (MT CH_4/yr)**	**Santa Clara County Total (MT N_2O/yr)**	**Santa Clara County Total (MT CO_2e/yr)**	**City of San Jose (MT CO_2e/yr)**
Lawn and Garden	Lawn and Garden Equipment	Households+Jobs	2,825,367	1,399,481	50%	27,775.24	42.48	18.26	34,277.62	16,978.64
Construction	Construction and Mining Equipment	Jobs	966,696	396,789	41%	371,673.38	39.55	2.35	373,361.84	153,249.83
Industrial	Industrial Equipment	Jobs	966,696	396,789	41%	306,323.95	102.57	17.28	314,036.21	128,899.07
Light Commercial	Light Commercial Equipment	Jobs	966,696	396,789	41%	57,152.75	17.06	9.46	60,397.49	24,790.71
TOTAL										**323,918.25**
Annualization Factor	365									

Demographics Input Table

	City of San Jose				Santa Clara County		
Year	**2008**	**2010**	**2014**	**2040**	**2010**	**2014**	**2040**
Population	985,307	-	1,016,479	-	-	1,889,638	-
Jobs	369,450	377,140	396,789	524,510	926,260	966,696	1,229,530
Service Population	1,354,757	-	1,413,268	-	-	2,856,334	-
Households	309,350	-	1,002,692	-	-	1,858,671	-
			4.3%				

Sources:

Population:	CA Department of Finance, Report E-5, Population and Housing Estimates for Cities, Counties, and the State, January 1, 2011-2015, with 2010 Benchmark, Released May 1, 2015
Households:	CA Department of Finance, Report E-5, Population and Housing Estimates for Cities, Counties, and the State, January 1, 2011-2015, with 2010 Benchmark, Released May 1, 2016
Jobs:	2010 and 2040 values from Draft Plan Bay Area, July 2013: Final Forecast of Jobs, Population, and Housing; 2014 value interpolated between 2010 and 2040 values http://planbayarea.org/pdf/final_supplemental_reports/FINAL_PBA_Forecast_of_Jobs_Population_and_Housing.pdf
Service Population:	Service population = population + jobs
2008 City of San Jose Values:	General Plan EIR Appendix K - Greenhouse Gas Emissions, Table 3-5 Development of County-to-City Scaling Factors for Off-Road Equipment Emissions

City of San José
Wastewater Sector (Process Emissions)

	Influent Emissions							Effluent Emissions					
Facility/Jurisdiction	Influent (MGD)	Influent (gal/yr)	Influent BOD (mg/L)	Influent BOD (kg/yr)	Adjusted BOD Emission Factor (kg CH_4/kg BOD)	CH_4 Emissions (MT/yr)	Influent Emissions (MT CO_2e)	Effluent (MGD)	Effluent (gal/yr)	Effluent Nitrogen Content (mg/L)	Effluent Nitrogen Content (kg/yr)	N_2O Emissions (MT/yr)	Effluent Emissions (MT CO_2e)
San Jose-Santa Clara Regional WW Facility	101.70	37,117,000,000	334	32,846,058	0.48	15,766	394,153	84.00	31,653,000,000	16.1	1,928,886	15.16	4,516

Note: City staff provided influent and effluent values as both average MGD and MG/yr. This analysis uses the annual values instead of applying an annualization factor to the average daily values.

Population Served by SJSC-WF (Year 2014)

City of San Jose	1,016,479
Total Population Served	1,400,000
Percent	

Source: https://www.sanjoseca.gov/DocumentCenter/View/29166

EMISSION FACTORS AND EQUATIONS

Methane Emissions

Emission Factor (kg CH_4/kg BOD)	Max CH_4 Producing Capacity (kg CH_4/kg BOD)	Methane Correction Factor (MCF)	Fraction of BOD Removed in Primary Treatment	Conversion (L/gal)
0.48	0.6	0.8	0.3	3.785

Source: ICLEI Community Protocol equation WW.6

Nitrogen Emissions

$EF_{Effluent}$ (kg N2O-N/kg N)	MW Ratio (N_2O/N_2)
0.005	1.57

Source: ICLEI Community Protocol equation WW.12

Methane Correction Factors (MCF)

Untreated Systems	Comments	MCF	Range
Sea, river and lake discharge	Rivers with high organic loads, can turn anaerobic	0.1	0 - 0.2
Stagnant sewer	Open and warm	0.5	0.4 - 0.8
Flowing sewer (open or closed)	Fast moving, clean (insign amounts of CH4)	0	0
Treated System	**Comments**	**MCF**	**Range**
Centralized aerobic treatment plant	Well managed. Some CH4 from settling basins	0	0 - 0.1
Centralized aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 - 0.4
Anaerobic digester for sludge	No CH4 recovery	0.8	0.8 - 1.0
Anaerobic reactor	No CH4 recovery	0.8	0.8 - 1.0
Anaerobic shallow lagoon	Less than 2 meter depth	0.2	0 - 0.3
Anaerobic deep lagoon	More than 2 meter depth	0.8	0.8 - 1.0
Septic system	Half BOD settles in anaerobic tank	0.5	0.5
Latrine	Dry climate, ground water table lower than latrine (3-5 persons)	0.1	0.05 - 0.15
Latrine	Dry climate, ground water table lower than latrine (many users)	0.5	0.4 - 0.6
Latrine	Wet climate/flush water use, groundwater table higher than latrine	0.7	0.7 - 1.0
Latrine	Regular sediment removal for fertilizer	0.1	0.1

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Chapter 6, Table 6.3 - Default MCF Values for Domestic Wastewater;
MCF of 0.8 was used in City's 2008 community inventory

City of San José
Wastewater Sector (Digester Gas Emissions)

Fugitive CH4 Emissions - Modeled

						Captured/Combusted		Digester Gas Emitted	
Population Served	**Digester Gas Production Rate (ft^3/person/day)**	**Methane Fraction of Biogas (%)**	**Methane Density (g/m^3)**	**Destruction Efficiency (%)**	**Annualization (days/year)**	**Biogenic Emissions (MT CH_4/year)**	**Biogenic Emissions (MT CO_2e/year)**	**Fugitive Emissions (MT CH_4/year)**	**Fugitive Emissions (MT CO_2e/year)**
1,400,000	1	65%	662.00	99%	365.25	6,164.69	154,117.25	62.27	**1,557**

Notes:
Population from San Jose-Santa Clara Regional Wastewater Facility website: https://www.sanjoseca.gov/Index.aspx?NID=1663
ICLEI Community Protocol equation WW.1.(alt) references equation source as Local Government Operations Protocol (LGOP) Equation 10.2, but represent equation differently within ICLEI Protocol; For purposes of this analysis, the referenced equation from the LGOP was used because it is the same methodology referenced in Envision San José 2040 General Plan Integrated Final Program EIR, Appendix K – Greenhouse Gas Emissions, pgs. 21-22.

Fugitive N20 Emissions - Modeled

Population Served	**Digester Gas Production Rate (ft^3/person/day)**	**Methane Fraction of Biogas (%)**	**Default BTU Content (BUT/ft^3)**	**Conversion BTU to 1 MMBTU**	**N_2O Emission Factor (kg N_2O/MMBTU)**	**Conversion Factor (day/year)**	**Conversion kg to MT**	**GWP N_2O**	**Fugitive Emissions (MT CO_2e/year)**
1,400,000	1	65%	1,028.00	0.00000	0.00063	365.25	0.00	298.00	**64.1**

Notes:
Population from San Jose-Santa Clara Regional Wastewater Facility website: https://www.sanjoseca.gov/Index.aspx?NID=1663
Methodology from ICLEI Community Protocol equation WW.2.(alt)

									MT CO2e/year
TOTAL FUGITIVE EMISSIONS									**1,621**

City of San José
Potable Water Energy Use

WATER SUPPLY SOURCES

Water Supply Sources from City's Water Providers

Collected from each company's 2010 Urban Water Management Plan

	Groundwater	Surface	Recycled
Great Oaks Water Company	100%	0%	0%
San Jose Water Company	38%	61%	1%
MWS	3%	82%	15%

	Groundwater	Surface
Great Oaks Water Company	100%	0%
San Jose Water Company	38%	62%
MWS	3%	97%

Note:

ICLEI Community Protocol Appendix F equation WW.14.1 does not specify 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. Further, it is assumed that the energy use associated with treating the recycled water to standards for reuse are represented within the Energy sector, which includes energy use at the San Jose-Santa Clara Regional Water Facility (SJSC RWF). [The South Bay Water Recycling main pump station is adjacent to SJSC RWF, within the City of San Jose boundary.] Thereore, the estimation of water treatment included in this analysis only pertains to the treatment of surface water prior to distribution.

WATER USAGE - 2014

Actual Water Usage - 2014

Collected from Schaaf & Wheeler memo prepared for City of San Jose: *Summary Review Water Supply for Envision San Jose 2040 memo*

Table 7: UWMP Demand Predictions vs. Actual Drought (AFY)

	2014 - AFY	2014 - MG
Great Oaks Water Company	10,663	3,475
San Jose Water Company	128,767	41,959
MWS	19,254	6,274

Conversions

Gallons per Acre Foot (AF)	
325,851	
Gallons per Million Gallons (MG)	
1,000,000	

WATER USE BY SUPPLY SOURCE - 2014

	Groundwater (MG)	Surface (MG)	
Great Oaks Water Company	3,475	-	3,475
San Jose Water Company	15,944	26,014	41,959
MWS	188	6,086	6,274
Total	19,607	32,100	51,707

City of San José
Potable Water Energy Use

ENERGY INTENSITIES BY PROCESS

San Jose Water Company

Source: *Embedded Energy in Water Studies, Study 2: Water Agency and Function Component Study and Embedded Energy-Water Load Profiles, Appendix B*
ftp://ftp.cpuc.ca.gov/gopher-data/energy%20efficiency/Water%20Studies%202/Appendix%20B%20-%20Agency%20Profiles%20-%20FINAL.pdf

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

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 Jose 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.

ELECTRICITY EMISSIONS FACTOR

eGRID 2012

	CO2 (lb/MWh)	CH4 (lb/GWh)	N20 (lb/GWh)
CAMX - WECC California	650.31	31.12	5.67

	CO2	CH4	N2O	Total
lb/kWh	0.65031	0.00003112	0.00000567	
metric ton	0.0002949756	0.0000000141	0.0000000026	
GWP	1	25	298	
MT CO2e/kWh	0.0002949756	0.0000003529	0.0000007664	0.000296095

Note:
This analysis uses a California regional electricity emissions factor from eGRID 2012 instead of the city-specific factor used in the Energy sector. The water system serving the city is part of a regional network that extends beyond the City's boundaries, and likely extends beyond the boundaries of the City's electricity provider (i.e., PG&E).

Conversions

lbs per metric ton	MW per kW	GW to kW
2204.623	0.001	0.000001