SECTION 3: EMISSION INVENTORY

This section describes the process of developing a greenhouse gas emission inventory and provides an inventory of the sources of greenhouse gas emissions for San Ramon.

3.1 - Emission Inventory Overview

Greenhouse gas inventories consider a wide range of human activities. Estimating the amount of greenhouse gases generated by these activities requires using a multiplicity of data sources and a diverse set of methodologies. Emission inventories are, by nature, the reflection of the best available data and the most applicable methods at the time of their compilation. As data grow and understanding develops, the inventory can be updated and improved.

Emissions inventories are organized by source categories or sectors. The State of California organizes its emission inventory by the following sectors: transportation, electricity, commercial and residential, industry, recycling and waste, high global warming potential gases, and agriculture. This inventory provides emission estimates for all of the sectors except for agriculture and industry. San Ramon has very limited agriculture and industrial sources and the emissions from energy use from these sources are included in the commercial sector. The inventory is based on the emissions of a number of greenhouse gases. Although carbon dioxide (CO_2) is the largest contributor to climate change, AB 32 also defines the following as greenhouse gases: methane (CH_4), nitrous oxide (N_2O), hexafluoride (SF_6), hydrofluorocarbons (HFC), and perfluorocarbons (PFC). The emissions of each gas are standardized by the global warming potential in comparison to CO_2 and is referred to as CO_2 equivalent or CO_2e.

California Emission Inventory

A comparison of major sources of greenhouse gas emissions at the state and county levels illustrates the scale of emissions. The most current year available was used for each inventory summary. A summary of California's greenhouse gas inventory for 2006 is provided in Table 2.

Table 2: California Greenhouse Gas Emissions Inventory in 2006 by Sector

Scoping Plan Sector	2006 Emission (Millions of Metric Tons of CO_2 Equivalent/Year)	Percentage of Inventory
Transportation	185.77	38.4
Electric Power	105.92	21.9
Commercial and Residential Fuel Use	44.37	9.2

Table 2 (cont.): California Greenhouse Gas Emissions Inventory in 2006 by Sector

Scoping Plan Sector	2006 Emission (Millions of Metric Tons of CO_2 Equivalent/Year)	Percentage of Inventory
Industrial Fuel Use	96.05	19.9
Recycling and Waste	6.31	1.3
High Global Warming Potential Gases	15.15	3.1
Agriculture	30.13	6.2
Forestry	0.19	0.0
Total Emissions	483.87	100.0

Notes:
Sequestration of emissions from forestry activities is not included. Emission categories are as defined in the CARB Scoping Plan.
Source: California Greenhouse Gas Inventory for 2000-2006 by Category as Defined in the CARB Climate Change Scoping Plan (CARB 2008).

3.2 - San Ramon Inventory

This assessment presents the estimated greenhouse gas emissions generated in the City of San Ramon for calendar year 2008, as well as the projected San Ramon emissions for calendar years 2020 and 2030. The inventory for the year 2020 is based on an interpolation of General Plan 2030 buildout data assuming steady growth each year. See Appendix A for supporting documentation for the emission inventories.

Summary of Emissions

Greenhouse gas emissions produced within San Ramon in 2008 were estimated to be 573,293 $MTCO_2e$. Projected emissions for 2020 are 624,271 $MTCO_2e$. Projected emissions for 2030 are 758,749 $MTCO_2e$. The 2008 emissions are considered the baseline inventory year. The 2020 and 2030 emissions are considered future year business as usual inventories that account for growth but not planned regulations and mitigation measures that may be applied in the future. When normalized by population, total annual emissions within the planning area equate to 8.6 $MTCO_2e$ per resident in 2008, 7.8 $MTCO_2e$ per resident in 2020, and 8.2 $MTCO_2e$ per resident in 2030.

Methods

This assessment includes emissions attributable to all land within the City of San Ramon Planning Area. Therefore, the San Ramon Planning Area is considered the organizational boundary for the assessment. The assessment includes emission inventories for five main sectors of emission sources: electricity, natural gas, solid waste, refrigerants, and

transportation sources. Therefore, these sectors are considered the operational boundary for the assessment.

Emissions in 2008 were calculated using data from calendar year 2008, when available. When data from 2008 was unavailable, data from other years were used as a proxy. Year 2030 projections assume that overall buildout outlined in the San Ramon General Plan 2030 Update would occur. Year 2030 projections also assume a business-as-usual trajectory for generation and emission of greenhouse gases in the City. Year 2020 business as usual projections are interpolated from 2008 and 2030 emissions.

Detailed information regarding the methodology used to develop the community inventory is contained within Appendix A. There is currently no published guidance for preparing a community inventory. Emissions data was estimated using processes and emission factors provided in the spreadsheets contained in Appendix A as well as ICLEI's Clean Air and Climate Protection (CACP) model.

On-Road Vehicles

On-road vehicles include gasoline and diesel passenger automobiles, light-duty trucks (and sports utility vehicles), and heavy-duty vehicles. The Metropolitan Transportation Commission (MTC) provided the vehicle miles traveled (VMT) for 2008, 2020, and 2030 from the latest regional transportation model (Model One) adjusted by the Bay Area Simplified Simulation of Travel, Energy and Greenhouse Gases (BASSTEGG) share of household VMT for San Ramon and for higher population projections from the San Ramon General Plan 2030 Update. The VMT estimates include MTC estimates of commercial related travel including trucking based on San Ramon's share of regional travel. The vehicle-miles-traveled data was entered into the CACP model to estimate the greenhouse gas emissions.

Electricity and Natural Gas

Electricity-related emissions refers to the emissions from power plants that generate electricity used in the City. Electricity is used for lighting, electronics, and appliances. Natural gas emissions refer to the emissions generated when natural gas is burned. Natural gas is used for heating clothes dryers and water heaters, and for natural gas kitchen stoves.

PG&E provided electricity and natural gas emissions data for 2008. PG&E provides estimates for residential and non-residential energy use. The non-residential category includes both commercial and industrial use. PG&E was not able to provide Direct Access Electricity usage (power from a provider other than PG&E but delivered with PG&E power lines) because of regulations prohibiting disclosure to ensure customer privacy. Note that the ICLEI CACP model does not include utility-specific emissions factors, so the emissions data provided by PG&E was used, since it most accurately reflects the emissions from the power generation facilities that serve the City. Emissions for future years were forecast by

assuming that household growth was proportional to the increase in residential emissions and square footage of non-residential growth was proportional to the increase in commercial emissions projected for the 2030 General Plan buildout.

Solid Waste Generated

Solid waste generated by residents, employees, and visitors in the City are sent to a landfill outside of the City, where the trash produces greenhouse gas emissions through decomposition processes. The majority of the City's waste (the franchised portion) goes to the Vasco Road Landfill in Alameda County. The Vasco Road Landfill has a methane collection system but does not produce electricity with the captured methane. Alameda County estimates the Vasco Road Landfill's methane capture rate at 75 percent. Prior to 2010, San Ramon sent about 8,000 tons per year to landfills to be used as Alternative Daily Cover (ADC). While this counts as diversion by the State, it is buried in the landfill and produces methane. Currently, the City sends all green waste (mixed with food scraps) to be composted. Most of the City's ADC was formerly used at the Altamont Landfill in Alameda County. Altamont has a methane recovery system, and it captures 75 percent of the methane and uses it to create electricity, which is sold to the PG&E grid.

The California Department of Resources Recycling and Recovery maintains records of waste generated by the City. Waste generation for future years was estimated from per capita waste in 2008. The CACP model used to calculate emissions from waste generation assumes no emission capture or power generation from the waste, providing the emissions for the business as usual case.

Energy Use: Water

Emissions in this category include emissions from the electricity required to pump water. The emissions are generated using generalized factors for water-related energy use in California.

Refrigerants

In some cases, high global warming potential gases that do not deplete ozone in the upper atmosphere have been substituted for ozone depleting substances (ODS) with lower global warming potential in refrigeration and manufacturing processes. ODS are being phased out pursuant to the Montreal Protocol because they are gases that cause chemical destruction of the ozone in the stratosphere (a layer of air in the upper atmosphere). Ozone in the stratosphere is good because it absorbs ultraviolet radiation, which can cause skin cancer, cataracts, and other health problems in humans. Stratospheric ozone is not to be confused with ozone in the troposphere (the layer of air that we breathe), where it becomes an air pollutant that results in health effects.

ODS substitutes can be released into the atmosphere when they leak out of refrigeration and air conditioning equipment contained in stationary and mobile applications. ODS

substitutes are also used in solvent cleaning, foam production, sterilization, fire suppressants, and aerosols. Emissions of ODS substitutes consisted of 2.9 percent of California's greenhouse gas inventory in 2008 and are anticipated to increase to 7.5 percent by 2020. The large increase is due to the growing use of ODS substitutes to replace ODS gases.

Residential units and commercial/industrial square footage in the City was used to estimate the number of refrigeration and air conditioning systems within the City. The emissions from those systems were then estimated using emission factors from the CARB and the United States Environmental Protection Agency. The ODS emissions in California in 2008 were estimated to be 13.89 $MMTCO_2e$ (CARB 2010), which is 0.37 $MTCO_2e$ per person. This emission rate applied to the City's population in 2008 of 66,413 yields 24,572 $MTCO_2e$, which is approximately what was estimated using the methods described in Appendix A.

Results

Emissions were estimated with the ICLEI CACP model supplemented by emission factors and protocols from CARB and other agencies. Using protocol guidelines, the process used to perform this greenhouse gas inventory is as follows:

1. Set organizational boundaries
2. Set operational boundaries
3. Identify sources of emissions
4. Collect data on emissions for a representative period of time
5. Calculate greenhouse gas emissions from data using data-specific emission factors
6. Create an inventory of CO_2e emissions that is complete and transparent

The organizational boundary for the community emission inventory is the City of San Ramon planning area. Figure 2 displays the regional location and San Ramon boundary. The emissions by sector for the years 2008, 2020, and 2030 are presented in Table 3.

The emissions are presented graphically in Figure 6. Note that the City's government emissions are included within the community emissions inventory.

Table 3: City of San Ramon Community Business as Usual Emissions

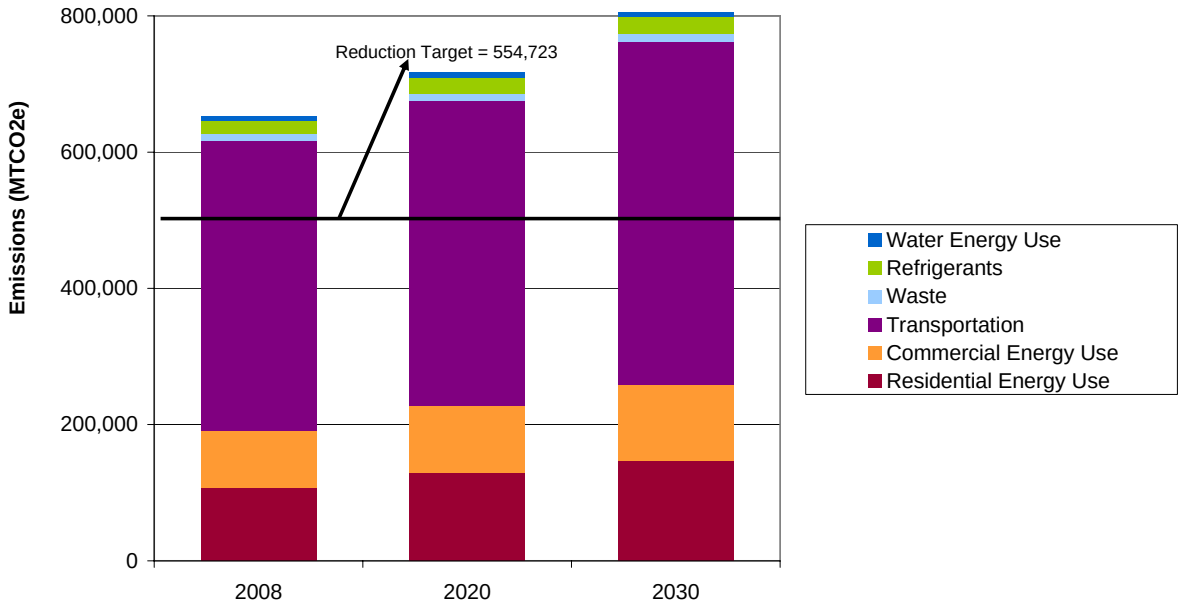
Community Sector	Greenhouse Gas Emissions ($MTCO_2e$)		
	2008	2020	2030
Energy Use: Residential	106,420	128,812	147,471
Energy Use: Commercial/Industrial	85,006	99,272	111,161
Transportation	426,161	447,153	502,901

Table 3 (cont.): City of San Ramon Community Business as Usual Emissions

Community Sector	Greenhouse Gas Emissions ($MTCO_2e$)		
	2008	2020	2030
Waste	8,862	10,726	12,280
Refrigerants	19,104	22,333	25,034
Energy Use: Water	7,063	8,547	9,787
Total	**652,615**	**716,843**	**808,634**
Population	**66,413**	**80,386**	**92,031**
Total Emissions per Capita	**9.8**	**8.9**	**8.8**
Employment	**40,152**	**49,898**	**58,769**
Service Population	**106,565**	**130,284**	**150,800**
Emissions per Service Population	**6.1**	**5.5**	**5.4**

Notes:
$MTCO_2e$ represents metric tons of carbon dioxide equivalent, which accounts for the global warming potential of greenhouse gases such as methane and nitrous oxide.
Sources: Data compiled by Michael Brandman Associates using the ICLEI Clean Air and Climate Protection 2009 Software, Version 2.2.1. Refrigerant and Water Energy Use emissions are estimated as described in spreadsheets contained in Appendix A.

Figure 6: San Ramon Community Greenhouse Gas Business as Usual Emissions



As shown in Table 4, the City of San Ramon's 2020 emissions are reduced below the target of 15 percent below 2008 levels.

Table 4: City of San Ramon 2020 Emissions Detail

Community Sector	2020 Emissions ($MTCO_2e$)	Percentage of Inventory
Electricity Use: Residential	53,947	7.5
Electricity Use: Commercial/Industrial	60,756	8.5
Natural Gas Use: Residential	74,865	10.4
Natural Gas Use: Commercial/Industrial	38,516	5.4
Transportation: Automobiles and Light Duty Trucks	377,070	52.6
Transportation: Heavy Duty Diesel Trucks	70,083	9.8
Waste	10,726	1.5
Refrigerants	22,333	3.1
Energy Use: Water	8,547	1.2
Total Business as Usual Emissions	**716,843**	**100.0**
Reductions from Statewide Measures	-187,096	26.3
Reductions from New Development between 2008 and 2020	-9,634	2.2
2020 Community Emissions with Reductions	**520,113**	—
Target: 2008 Emissions Minus 15%	**554,723**	—
2020 Service Population Emissions ($MTCO_2e$/SP/Year)	**4.0**	—
Target: Service Population ($MTCO_2e$/SP/Year)	**6.6**	—
Are 2020 Emissions below targets?	**Yes**	—

Notes:
$MTCO_2e$ represents metric tons of carbon dioxide equivalent, which accounts for the global warming potential of greenhouse gases such as methane and nitrous oxide. Reductions from Statewide Measures is calculated as shown in Table 9. Reductions from new development = 15 percent of new development emissions (the difference in business as usual emissions between 2008 and 2020). 2020 service population is 130,284.
Source: Data compiled by Michael Brandman Associates using the ICLEI Clean Air and Climate Protection 2009 Software, Version 2.2.1.

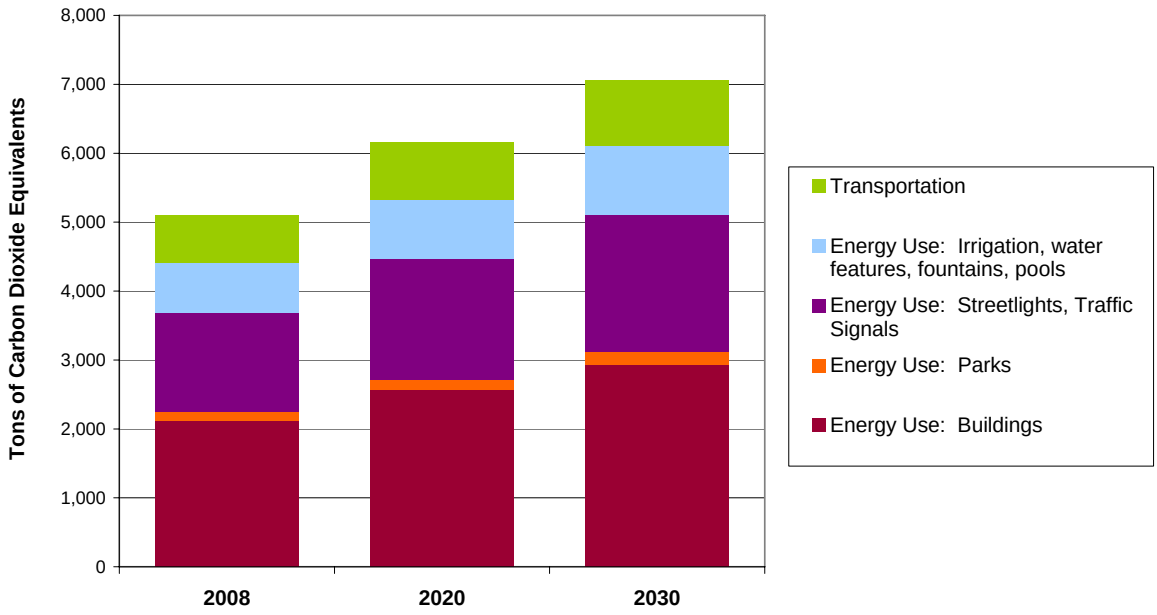
Table 5 provides the greenhouse gas emission inventory for City of San Ramon government operations. Emissions from government operations are dominated by electricity and natural gas consumption in City buildings, streetlights, and other City operations. Figure 7 graphically illustrates the emissions from each major San Ramon government source category.

Table 5: City of San Ramon Government Business as Usual Emissions

Government Sector	Greenhouse Gas Emissions (tons CO_2e)		
	2008	2020	2030
Energy Use: Buildings	2,115	2,560	2,931
Energy Use: Parks	131	159	182
Energy Use: Streetlights, Traffic Signals	1,444	1,748	2,001
Energy Use: Irrigation, water features, fountains, pools	716	867	992
Transportation	685	829	949
Total tons CO_2e	**5,091**	**6,163**	**7,055**
Total metric tons CO_2e	**4,619**	**5,591**	**6,400**

Notes:
CO_2e represents the carbon dioxide equivalent, which accounts for the global warming potential of greenhouse gases such as methane and nitrous oxide. The emissions in metric tons are converted from tons by multiplying by 0.9072.
Source: Data compiled by Michael Brandman Associates using the ICLEI Clean Air and Climate Protection 2009 Software, Version 2.2.1 for the year 2008. Data for 2020 and 2030 are interpolated based on a 21 percent population growth in 2020 and 39 percent population growth in 2030 compared with 2008 levels.

Figure 7: San Ramon Government Greenhouse Gas Business as Usual Emissions



3.3 - Reduction Target

The City examined reduction target approaches being considered by other local agencies and the Bay Area Air Quality Management District (BAAQMD). The BAAQMD offers several approaches that vary based the starting point for determining reductions. The basic concept is that a jurisdiction would provide reductions for the source categories over which it has jurisdiction that are at least as great as the reductions required to meet the State's goal of reducing emissions to 1990 levels by 2020. The authority to control emissions from many of these sources is shared by multiple jurisdictions. In those cases, it is appropriate to allocate a portion of the reduction target to each jurisdiction. For example, the State's fuel and vehicle efficiency regulations will reduce mobile source emissions, but the County can also provide mobile source reductions through land use patterns and transportation system designs that reduce vehicle trips and miles traveled. The BAAQMD has proposed several options, including a "service population" approach that is based on the community emissions divided by the sum of the population and employment in the City of 6.6 $MTCO_2e$ per service population per year and a 15-percent reduction from 2008 emissions. The City is using a target of a 15-percent reduction from 2008 emissions, but it also demonstrates compliance with the service population approach.

The CARB Climate Change Scoping Plan states, "The 2020 goal was established to be an aggressive, but achievable, mid-term target, and the 2050 greenhouse gas emissions reduction goal represents the level some scientists believe is necessary to reach levels that will stabilize climate" (page 4). The year 2020 goal of AB 32 corresponds with the mid-term target established by S-3-05, which aims to reduce California's fair-share contribution of greenhouse gases in 2050 to levels that will stabilize the climate. The goal of the Governor's Executive Order of reducing emissions by 80 percent below 1990 levels by the year 2050 is not addressed in this analysis. However, the effects of the CAP strategies by the General Plan 2030 buildout year were addressed to show the benefits of implementing San Ramon's progressive land use plan over a twenty-year period. To obtain the 2050 goal, substantial emission reductions would need to occur in California, such as a conversion to alternative energy generation, conversion to electric and/or zero emission motor vehicles, and substantial changes to land use patterns and transportation. The objective of this CAP is to provide San Ramon's contribution to achieving the initial target and to provide the framework for future reductions as technology advances.

The analysis also demonstrates consistency with the CARB Climate Change Scoping Plan reduction targets in 2020. The two largest sources over which the City has jurisdiction, mobile sources and new building construction, will see substantial emission reductions from state regulations on fuel efficiency in motor vehicles and energy efficiency in buildings. If state reductions were not counted, future year emissions would be greatly overstated. The CARB Climate Change Scoping Plan only calls for an incremental reduction in excess of the actions in the Scoping Plan measures to achieve the 2020 target. Regional transportation

measures, transit improvements, transportation demand management enhancements, and voluntary energy retrofits will provide reductions to all existing and new development.

If a project chooses to rely on compliance with this CAP to result in a less than significant impact, the project must demonstrate a 15-percent reduction. The CAP strategy provides an average reduction of 15 percent from all development that will occur in implementing the General Plan. Reductions from new development only apply to a portion of the overall community inventory. Therefore, the impact of these reductions on the community inventory depends on the amount new development that occurs between the base year and the future years. By 2020, the General Plan forecasts a 21-percent increase in population compared to 2008 in the planning area. However, lower growth rates in regional vehicle miles traveled and related transportation emissions due to the recession result in a projected 9.8-percent emission inventory increase between 2008 and 2020. Therefore, 9.8 percent of the 2020 emissions inventory will benefit from the measures implemented by new development during that timeframe. This will reduce San Ramon's 2020 Community Inventory by 1.5 percent (0.098 x 0.15 = 0.015 or 1.5 percent). By 2030, the business as usual emission inventory will have increased by 23.9 percent compared with 2008, and new development will provide a 2.3-percent reduction in the community inventory (0.098 x 0.239 = 0.023 or 2.3 percent).

Based on the analysis conducted in preparing the CAP, an overall reduction of 27.6 percent will be achieved, including the benefits from new development and statewide measures compared with business as usual in 2020. This demonstrates consistency with the CARB Climate Change Scoping Plan target for development related sources of 26.2 percent in 2020. The project reductions may be achieved through land use related measures such as increased density (e.g., multi-story buildings, multi-family housing, and small lot single family), pedestrian and transit-oriented development, support for alternative transportation modes, and measures that reduce energy consumption through improved energy efficiency in buildings, water conservation, and waste reduction. Voluntary programs will also provide reductions from existing homes and businesses that install energy saving retrofits and solar photovoltaic systems. No reduction was claimed for voluntary measures.