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CITY OF LA CAÑADA FLINTRIDGE GREENHOUSE GAS INVENTORY

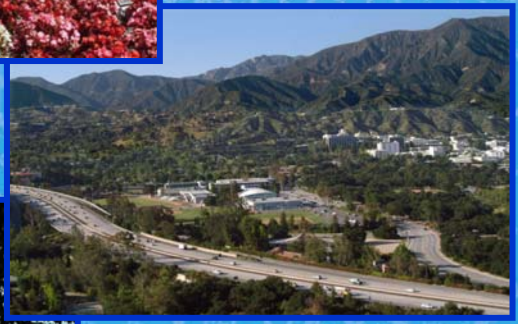
ICF Jones & Stokes

an ICF International Company

City of La Cañada Flintridge Greenhouse Gas Inventory

March 2010

Submitted to:
The City of La Cañada Flintridge



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ACRONYMS AND ABBREVIATIONS

AB 32	California Assembly Bill 32 (the Global Warming Solutions Act of 2006)
ARB	California Air Resources Board
BAU	business-as-usual
BTU	British Thermal Unit
CCAR	California Climate Action Registry
CEC	California Energy Commission
CH_4	methane
CIWMB	California Integrated Waste Management Board
CNG	compressed natural gas
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
City	City of La Cañada Flintridge
FMWD	Foothill Municipal Water District
Ft^3	cubic foot
FY	fiscal year
GHG	greenhouse gases
GWh	gigawatt hour
GWP	global warming potential
HCFCs	halogenated chlorinated fluorocarbons
HFCs	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
kWh	kilowatt hour
LA	Los Angeles
LGOP	Local Government Operations Protocol
Mcf	thousand cubic feet
MMBTU	million BTU
MT	metric ton
$MTCO_2e$	metric tons of carbon dioxide equivalent
MWD	Metropolitan Water District
MWh	megawatt hour
N_2O	nitrous oxide
NASA	National Aeronautics and Space Administration
ODS	ozone depleting substances
PFCs	perfluorinated carbons
SDLAC	Sanitation Districts of Los Angeles County
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SF_6	sulfur hexafluoride
SWP	State Water Project
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VMT	vehicle miles travelled
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

EXECUTIVE SUMMARY

The City of La Cañada Flintridge (City) has committed to undertake the following measures that will reduce greenhouse gas (GHG) emissions associated with its internal government operations and the City as a whole:

- prepare a GHG inventory for the City's government operations ("government inventory") to gain an understanding of the municipal GHG emissions profile;
- prepare a GHG inventory associated with City-wide activities ("community inventory") to gain an understanding of the GHG emissions profile of the entire City;
- prepare a 1990 and 2020 estimate of emissions for government operations and City-wide activities to support the development of a GHG reduction policy;
- adopt a reduction goal for 2020 (for both government and community), consistent with Assembly Bill (AB) 32 recommendations for local government municipal and external emissions[1]; and
- identify measures and strategies to reach the 2020 reduction goal and incorporate these into the City's general plan.

The City will address climate change through the identification of overall reduction goals for GHG emissions and creation of a policy framework to support control and ultimate reduction of GHG emissions. The government and community GHG inventories form a baseline from which the City can establish GHG reduction targets. By establishing robust GHG inventories, the City can determine where additional emission reduction opportunities exist.

INTRODUCTION

The City of La Cañada Flintridge, with the assistance of ICF Jones and Stokes, developed a 2007 inventory and estimated 1990 and 2020 greenhouse gas emissions (GHG) and sinks[2] for City government operations ("government inventory") and the entire City ("community inventory"). The 2007 inventory is based on actual 2007 activity data and emission factors. The 1990 emissions estimate is based on the 2007 inventory as well as historical population, activity, and growth information. The 2020 emissions projection represents "business as usual" (BAU) emissions associated with the City in 2020. The inventories define a baseline emissions level from which City of La Cañada Flintridge can begin to quantify emissions reduction efforts in order to comply with AB 32 goals. These inventories also identify the largest contributing sectors to GHG emissions, and as such can be used to make informed decisions about potential, effective GHG controls.

A BAU projection was developed for the year 2020. If the City decides to develop a GHG reduction plan, this projection can be used to determine the magnitude of the reductions that need to be achieved by 2020 (relative to current emissions) to reach a particular emissions target. The BAU projections are based on current energy consumption and anticipated growth rates provided by the City, the Southern California Association of Governments (SCAG), the California Air Resources Board (ARB), the California Department of Finance, and other appropriate data sources, as listed in this report. The BAU projection

[1] In 2006, California passed Assembly Bill (AB) 32, the Global Warming Solutions Act of 2006. This law established a state goal of reducing GHG emissions statewide to 1990 levels by 2020. This effort is roughly equivalent to the reduction in emissions to a level 15 percent below current levels.

[2] A greenhouse gas sink is a natural or manmade reservoir that absorbs and stores more CO_2 or other GHG from the atmosphere than it releases.

does not assume the implementation of any federal, state, or local reduction measures, but projects the future emissions based on current energy and carbon intensity in the existing economy. The specific assumptions associated with the energy growth rates are provided in Tables 2 and 3.

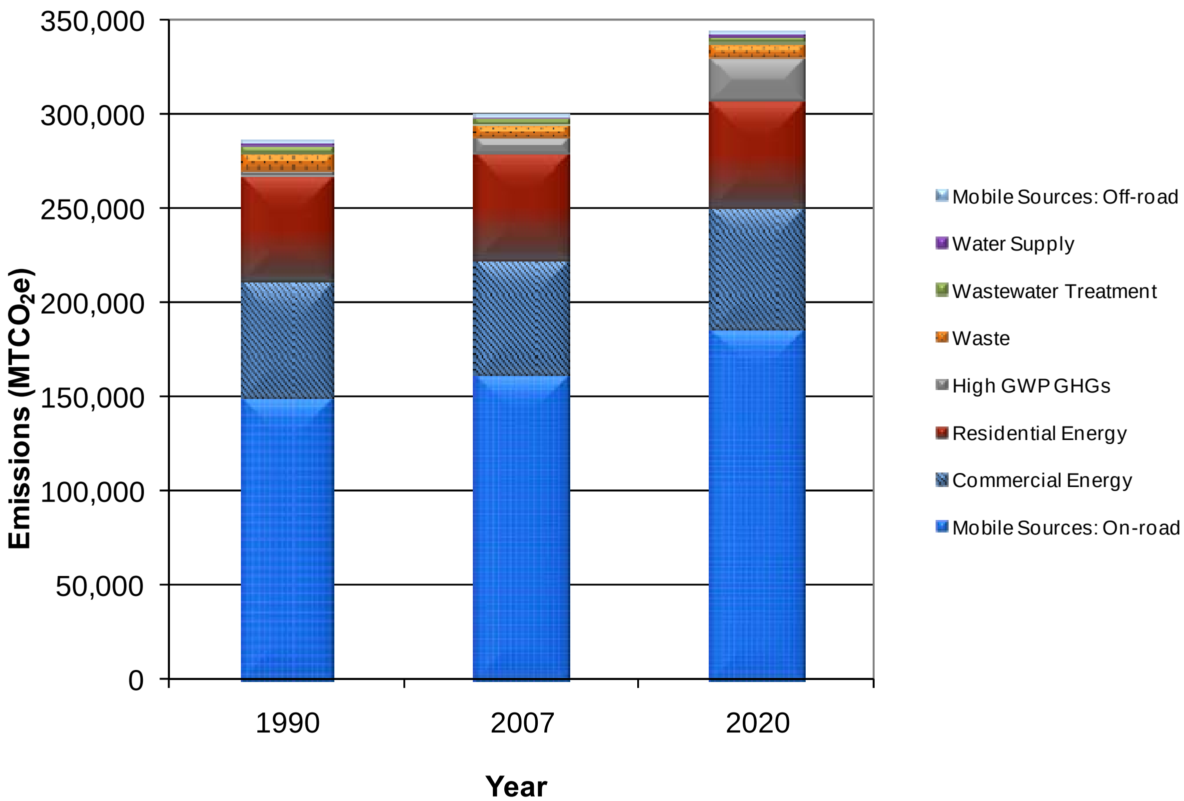
The City of La Cañada Flintridge is an incorporated city in Los Angeles (LA) County and is located at the western end of the San Gabriel Valley, bordered by the Angeles National Forest. The City covers 8.5 square miles and is 13 miles northeast of downtown Los Angeles. The City has a highly ranked public school system and is home to NASA's Jet Propulsion Laboratory. In 2007, the City's population was 21,155 and the median family income was $144,563 (Southern California Association of Governments 2009; California Department of Finance 2009).

This report describes the data sources and methodology used to calculate GHG emissions for each source sector. This report also describes the GHG inventory and GHG forecast. The GHG inventory for La Cañada Flintridge has two components: 1) the community inventory and 2) the government inventory (municipal operations). Both are described below. The community inventory presented in this report was developed using a geographic boundary (i.e., jurisdictional/city limits) for the emissions reporting. In contrast, the boundaries of the government inventory are defined as areas of the government's operational control. Emissions for a particular source were included in this inventory if the government entity either wholly owns an operation, facility or source, or has full authority to introduce and implement operating policies at the operation. This typically includes: government-owned facilities, vehicles, and streetlights/traffic signals.

The community inventory includes all emissions and sinks occurring within the City boundaries and that could reasonably be quantified, regardless of the City's ownership or authority over the source. The community inventory includes emissions due to government operations as well as community sources. For example, emissions associated with energy use at City Hall are included in the building energy use sector of the community inventory. The government inventory includes only those emissions specifically attributed to government operations. Describing the government and community inventories as separate will result in double-counting of some sectors (i.e., building energy use, transportation, etc.) if the two inventories are added together. Consequently, the government inventory is a subset of the community inventory.

Figures 1 and 2 present summaries of the government and community 2007 GHG emissions inventories and the estimated 1990 and 2020 emissions for the City of La Cañada Flintridge. Community emissions increased slightly from 1990 to 2007 and are also projected to increase slightly from 2007 to 2020. The increase in emissions between 1990 and 2007 is due primarily to an increase in vehicle miles traveled (VMT) attributable to the City. The increase from 2007 to 2020 occurs primarily because of an increase in VMT and an increase in the use of hydrofluorocarbons and perfluorocarbons as substitutes for ozone depleting substances, resulting in higher emissions of high global warming potential GHGs. Government emissions increase from 1990 to 2020. This trend occurs because of the growth in City electricity consumption and vehicle fuel use, as the Government's workforce and services increase over time. Emissions from individual sectors are discussed in more detail below.

Figure 1. La Cañada Flintridge Estimated 1990 Community Emissions, 2007 Community Inventory and BAU (2020) Projections ($MTCO_2e$)



Note**:** figure does not include emission sinks. See Table 4 for emission sinks in the City.

Figure 2. La Cañada Flintridge Estimated 1990 Government Emissions, 2007 Government Inventory and BAU (2020) Projections ($MTCO_2e$)

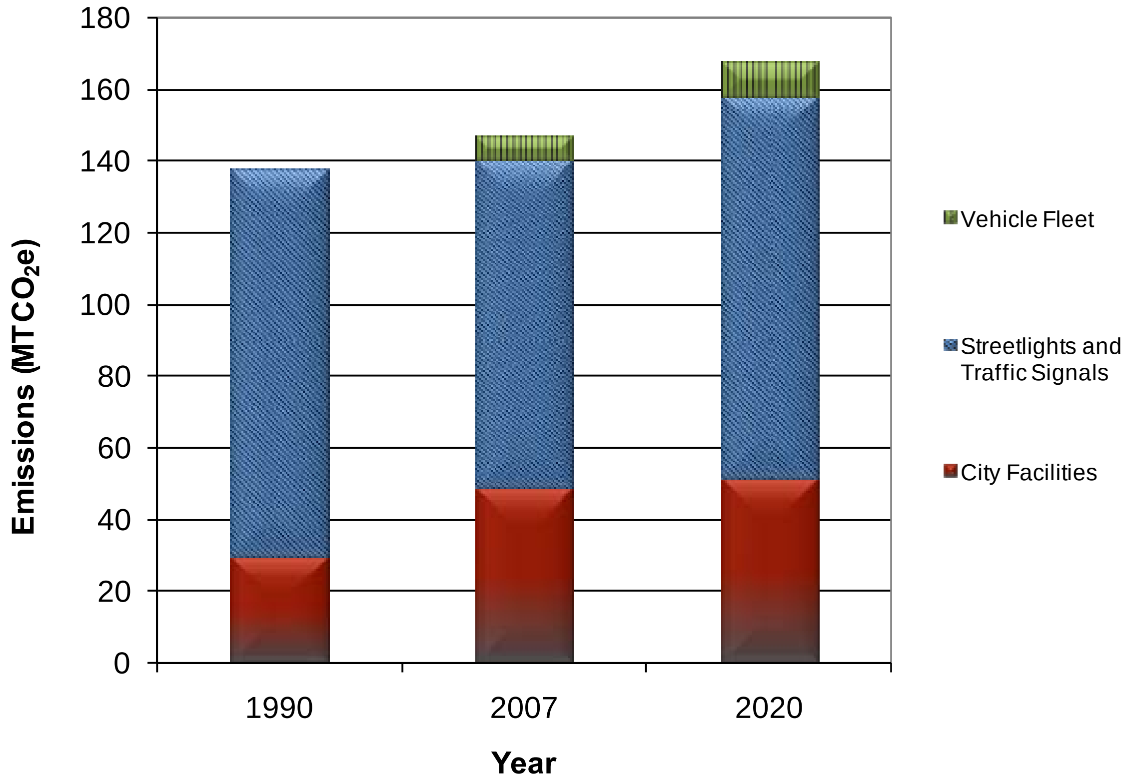
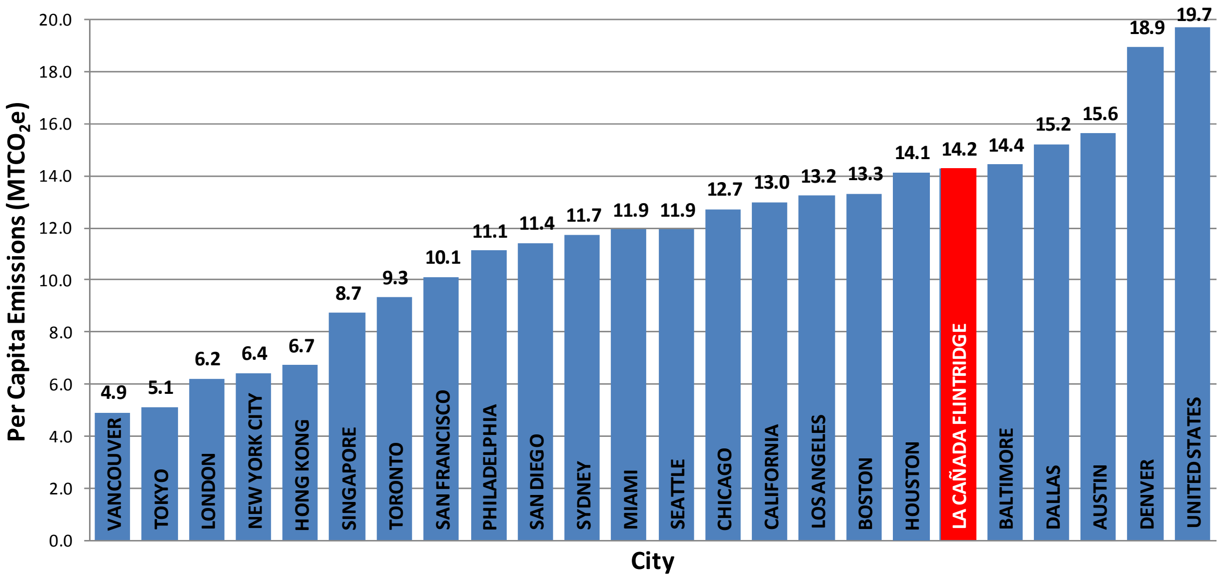


Figure 3 presents 2007 per capita emissions for the La Cañada Flintridge compared to California, the United States, and other large cities around the world. 2007 per capita emissions are 14.2 metric tons of CO_2e (not including sinks). This is higher than the average per capita emissions of 13.0 metric tons of CO_2e for California, and much lower than the average per capita emissions of 19.7 metric tons of CO_2e for the United States as a whole (City of New York 2009; California Air Resources Board 2009a). La Cañada's per capita emissions are well above the per capita emissions goal of approximately 9.7 metric tons of CO_2e, as expressed in AB32 as necessary to achieve 1990 levels by 2020 for the state of California.

Per capita emissions vary depending on the methodologies used to estimate emissions for each individual source and the types of emissions sources included in each inventory. For example, transportation emissions are often assigned to the location in which they take place (as was done in this inventory), but sometimes only the transportation emissions that originate or terminate in the location are included in that location's inventory. The per capita emissions presented in Figure 3 are based on many different inventories and multiple methodologies, producing some uncertainty in the comparison.

Figure 3. Per Capita Emissions for the U.S., California, International Cities, and La Cañada Flintridge (2007)



Source: Inventory of New York City Greenhouse Gas Emissions, September 2009.

Inventory Limitations: 1990 Estimate and 2020 Projection

The current year (2007) inventory for the City of La Cañada Flintridge is based on actual data for both government operations and community activities. The 1990 and 2020 emissions estimates, however, are based largely on estimates, forecasts, and growth factors, and not actual activity data for those years. 2007 emissions and sinks are based on data which is often not available for 1990. For example, detailed land use information and energy use data for the City's economic sectors are not available for 1990. Similarly, 2020 BAU emissions are projected based on the most appropriate growth data available for each sector. For example, 2020 energy use emissions are estimated based on projected population, employment, and housing growth.

Although this report does not present a comprehensive 1990 inventory due to data limitations, this limitation does not affect the City's 2020 emission reduction goals, or its ability or responsibility to comply with AB 32. Future work on the City's 1990 and 2020 emissions estimates may entail more robust data collection and more comprehensive activity data, as well as updates and refinements to the City's current inventory.

Description of Greenhouse Gases

The temperature on Earth is regulated by a system commonly known as the "greenhouse effect." GHGs absorb heat radiated from the Earth's surface. As the atmosphere warms, it in turn radiates heat back to the surface to create the greenhouse effect. According to the United States Environmental Protection Agency (USEPA), a GHG is any gas that absorbs infrared radiation in the atmosphere. AB 32 and the

CEQA guideline amendments define the following six (6) GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), sulfur hexaflouride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

GHGs are both naturally occurring and anthropogenic (e.g. man-made). Once emitted, GHGs remain in the atmosphere for decades or centuries and can therefore mix globally. Innumerable direct and indirect sources, both natural and anthropogenic, cause increased atmospheric concentrations of GHGs. Natural sources of GHGs include decomposition of organic matter and wildfires. Many human activities add to the levels of naturally occurring gases. Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels. Carbon dioxide and nitrous oxide are the two GHGs released in the greatest quantities from mobile sources burning gasoline and diesel fuel. Methane, a highly potent GHG, results from off-gassing associated with agricultural practices and landfills, among other sources. Hydrofluorocarbons and perfluorocarbons are families of synthetic chemicals that are used as substitutes to ozone depleting substances (ODS) being phased out under the Montreal Protocol. Sulfur hexafluoride is used in the electric transmission and distribution systems, as well as various industrial manufacturing processes.

As the global, national, and statewide population and economy continue to grow, anthropogenic emissions of GHGs continue to increase due largely to the burning of fossil fuels. The associated increase in atmospheric concentrations of GHGs will cause a variety of adverse environmental impacts related to large scale changes in the climate system. Climate change impacts of greatest concern for the state of California include: sea-level rise, increased frequency and intensity of wildfire, decreased Sierra snowpack and associated consequences to state water supply, changes in winter precipitation patterns and associated consequences to state water supply, increased frequency and intensity of extreme heat events, and degradation in regional air quality due to warmer temperatures (California Energy Commission 2009; California Natural Resources Agency 2009).

METHODOLOGY

This section presents the overall methodology used to prepare the community and government inventory for the year 2007, and estimated emissions for 1990 and 2020. This section discusses the inventory definitions, inventory protocols used, emission factors, growth projections, and inventory scope.

Inventory Definitions

There are two separate GHG inventories for the City of La Cañada Flintridge included in this report: the community inventory and the government inventory. These inventories are defined below.

Community Inventory: The community inventory includes GHG emissions and sinks occurring within the City's boundaries. The boundaries of the community inventory are "geographical" such that all emissions associated with activities occurring within City boundaries are included. The emissions and sinks included may occur outside of the geographical boundary of the City, as long as they are related to activities in the City. The year 2007 was chosen for the current community inventory as it was the most recent year with the necessary data to perform a comprehensive inventory. The 1990 emission estimate is based on historical population, activity, and growth information. The 2020 emissions projection represents business as usual emissions associated with the City in 2020.

Government Inventory: The government inventory includes GHG emissions associated with the City's services and government operations. The City's current government inventory is for the year 2007, which represents the most recent year with the necessary data to perform a comprehensive inventory. The 1990 emission estimate is based on City operations in 1990. The 2020 emissions projection represents BAU emissions associated with the City's government operations in 2020.

Some emissions sources are included in both inventories, as there are overlaps in the boundaries of the two inventories. For example, in the community inventory, on-road transportation emissions include emissions from all vehicles travelling in the City, as calculated with the California Air Resources Board (ARB) EMFAC model. The corresponding government inventory category includes City vehicle fleet emissions, which operate in the City and outside of the City. The overlap between the community and government inventories for this category pertains to City vehicle emissions that occur within City boundaries since these emissions are accounted for in the EMFAC modeling.

The unit of measure used throughout this GHG inventory is the metric ton of carbon dioxide (CO_2) equivalent ($MTCO_2e$). This is the international unit that combines the differing impacts of all greenhouse gases into a single unit, by multiplying each emitted gas by its global warming potential (GWP). GWP is the measure of how much a given mass of greenhouse gas contributes to global warming. GWP compares the relative warming effect of the GHG in question to carbon dioxide.[3]

GHG emissions can be defined as either *direct* (emissions that occur at the end use location such as natural gas combustion for building heating) or *indirect* (emissions that result from consumption at the end use location but occur at another location such as emissions from electricity). This report addresses both types of emissions. In addition, all references to *emissions* are equivalent to *GHG emissions.*

Inventory Protocols

A number of widely accepted protocols for estimating GHG emissions were used to prepare the community and government inventory. The major protocols used are:

- California Air Resources Board (ARB) Local Governments Operations Protocol (LGOP) (2008). This protocol is the standard for estimating emissions resulting from government buildings and facilities, government fleet vehicles, wastewater treatment and potable water treatment facilities, landfill and composting facilities, and other operations.
- California Climate Action Registry (CCAR) and General Reporting Protocol (2009a). This protocol provides guidance for preparing GHG inventories in California.
- ARB California Greenhouse Gas Inventory Data 1990–2006 (2009a, 2009b, 2009c). ARB's documentation provides background methodology, activity data, protocols, and calculations used for California's statewide inventory.
- California Energy Commission (CEC) Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004 (2006a). This inventory provides useful methodology and emission factors for statewide GHG emissions inventorying.
- U.S. Environmental Protection Agency (USEPA) Inventory of U.S. Greenhouse Gas Emissions

[3] The GWP of CO_2 is, by definition, one (1). The GWP values used in this report are based on the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR) and United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines and are as follows: CO_2 = 1, Methane (CH_4) = 21, Nitrous Oxide (N_2O) = 310, Sulfur Hexaflouride (SF_6) = 23,600 (IPCC 1996; UNFCCC 2006). Although the IPCC Fourth Assessment Report (AR4) presents different GWP estimates, the current inventory standard relies on SAR GWPs to comply with reporting standards and consistency with regional and national inventories (USEPA 2009a).

and Sinks: 1990–2007 (2009a). This inventory provides useful methodology and emission factors for nationwide GHG emissions inventorying.

- Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (2006). This document is the international standard for inventories and provides much of the baseline methodology used in the national and statewide emission inventories.

The LGOP employs the convention of categorizing local government emission sources as Scope 1 (direct), Scope 2 (indirect), and Scope 3 (other indirect). The LGOP defines these emissions as follows (ARB 2008):

- **Scope 1:** All direct GHG emissions (with the exception of direct CO_2 emissions from biogenic sources).
- **Scope 2:** Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.
- **Scope 3:** All other indirect emissions not covered in Scope 2 that are not under the control or influence of the local government, such as the emissions resulting from the extraction and production of purchased materials and fuels, and transport-related activities in vehicles not owned or controlled by the reporting entity.

Scope 1, 2, and 3 emissions were quantified and included in both the government and community inventories. For example, direct emissions associated with on-site natural gas and fuel oil use are included in Scope 1 because these emissions occur in the City and are subject to the City's influence or control. Indirect GHG emissions associated with electricity use are included in Scope 2, since these emissions can occur outside of the City, but are subject to the City's influence or control. Some of the Scope 3 community inventory categories were quantified but not included in the community inventory per the LGOP guidance. These emissions include other indirect emissions that the City does not influence or control but are associated with activities occurring within the City. For the community inventory, Scope 3 emissions include waste-related lifecycle emissions.

Emission Factors

Emission factors and references are summarized in Table 1. These emission factors were used to calculate GHG emissions from activity data, such as kWh of electricity consumed for lighting or gallons of gasoline fuel combusted for on-road transportation.

Table 1. GHG Emission Factors

Fuel	Emission Factor	Source
Compressed Natural Gas (CNG) (Vehicle)	0.054 Kg CO_2/Standard Ft^3	USEPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006 (2008)
Motor Gasoline (Vehicle)	8.81 Kg CO_2/US gal	Provided in the California Local Government Operations Protocol (ARB et al. 2008)
Propane (Vehicle)	5.74 Kg CO_2/US gal	
Diesel (Vehicle)	10.15 Kg CO_2/US gal	
Natural Gas	0.0546 Kg CO_2/Standard Ft^3	
	0.1 g NO_2/MMBTU	
	5 g CH_4/MMBTU	
Electricity (2007 and 2020)	286.2 kg CO_2/MWh	CCAR (2009b) Public Reports, USEPA (2009b) eGrid2007 (2005 data), and ARB statewide inventory (2009a)
	3.66 kg NO_2/GWh	
	13.72 kg CH_4/GWh	
	0.16 kg SF_6/GWh	
Electricity (1990)	364.9 kg CO_2/MWh	CCAR (2009a) General Reporting Protocol, USEPA (2009b) eGrid2007 (2005 data) , and ARB statewide inventory (2009a)
	1.68 kg NO_2/GWh	
	3.04 kg CH_4/GWh	
	0.51 kg SF_6/GWh	

Growth Projections

Table 2 presents the various growth projections used to estimate the 1990 and 2020 BAU emissions for the community. Population data for California and LA County were provided by the California Department of Finance (2009) and were used to estimate emissions based on state-wide or county-wide data for certain sectors where local data was unavailable. Demographic data for La Cañada Flintridge was provided by the Southern California Association of Governments (SGAG) (2008) and the California Department of Finance (2009). This data was used to estimate emissions for 1990, 2007, and 2020 for applicable sectors as described in the following sections of this report.

Table 2. 1990, 2007, and 2020 Growth for California and La Cañada Flintridge

Year	California	LA County	La Cañada Flintridge		
	Population	Population	Population	Households	Employment
1990	29,828,496[1]	8,860,281[1]	19,162[2]	6,918[3]	N/A
2007	37,712,588[4]	10,273,083[4]	21,155[2]	7,069[5]	9,320[6]
2020	44,135,923[7]	11,214,237[7]	21,712[8]	7,104[8]	9,884[8]

[1] California Department of Finance 2009, Table E-6.

[2] California Department of Finance 2009, Table E-4.

[3] California Department of Finance 2009, Table E-5.

[4] California Department of Finance 2009, Table E-2.

[5] California Department of Finance 2009, Table E-8.

[6] Estimated based on growth from 2000 to 2020 provided by the Southern California Association of Governments (SCAG) (2008).

[7] California Department of Finance 2009, Table P-1.

[8] SCAG (2008).

Table 3 presents a summary of the methodology used to estimate 1990 and project 2020 GHG emissions for both government and community emissions. Emissions from many sectors were back-cast to 1990 and forecast to 2020 based on demographic data including population, households and employment (see Table 2), because these emission sources normally scale with this data. Where demographic data was inappropriate to scale 2007 emissions, alternative methodologies were employed as discussed below.

The methodology for estimating 1990 and 2020 emissions for the City is subject to limitations. In cases where emission factor data was limited, the emission factors used for each year were assumed to remain constant. Some sectors of emissions may not linearly scale with demographic data precisely, such as building energy use. Emissions for other sectors were estimated based on historical and projected trends in associated emissions-generating activities. It is possible that past and future emissions may not actually follow these trends.

The methodology and assumptions discussed in the following sections are not intended to produce a completely accurate inventory of 1990 and 2020 emissions for the City. They are intended to produce a reasonable estimate of emissions for 1990 and 2020. It was determined that for each sector, these assumptions are appropriate and accurate. In most cases these assumptions are supported by established inventory protocols and widely used inventory methodologies.

Table 3. Methodology for the 1990 Emission Estimate and BAU (2020) Projections

Inventory/Sector	1990 Estimate	2020 Projection
Community Inventory		
Building Energy Use		
Residential	Utility records	Household projection
Commercial	Utility records	Employment projection
Mobile Source		
On-Road	EMFAC model and VMT estimates extrapolated from data provided by the traffic engineer	EMFAC model and VMT estimates extrapolated from data provided by the traffic engineer
Off-Road	OFFROAD model and historical population	OFFROAD model and population projections
Waste	Historical waste disposal	Waste disposal projections
Wastewater Treatment		
Fugitive	ARB data and historical population	ARB data and population projections
Electricity	Historical population	Population projections
High Global Warming Potential GHGs		
HFCs and PFCs as ODS Substitutes	ARB data and historical population	ARB data and population projections
Electricity Transmission	Building energy use (see above)	Building energy use (see above)
Carbon Sinks and Sequestration		
Landfill Carbon	Historical waste disposal	Waste disposal projections
Forest Land / Open Space	Constant	Constant
Urban Forest	Constant	Constant
Government Inventory		
City Facilities	City employees[1]	Projected City employees
Streetlights and Traffic Signals	Roadway miles[1]	Projected roadway miles
Vehicle Fleet	No vehicles	Projected vehicle fleet

[1] Historical energy use data for 1990 would be more appropriate, but this data was unavailable.

Community Inventory

As defined above, the community inventory includes all GHG emissions associated with activities occurring within City boundaries. The guidelines of the LGOP (CARB et al. 2008) were followed in developing this inventory where applicable. IPCC (2006) and USEPA (2007, 2008, 2009a) protocols and the CCAR General Reporting Protocol (2009b) were also followed. This inventory utilizes a "geographical" approach. This approach was selected because it most accurately accounts for GHG emissions from the City's activities.

The following emissions sectors are included in the community inventory. The data source for each emission sector is also included.

- *Residential Energy:* natural gas and electricity consumption for the residential sector. Data provided by utilities.

- *Commercial Energy:* natural gas and electricity consumption for the commercial sector. Data provided by utilities.[4]
- *Mobile Source*. On-road transportation and off-road transportation and equipment emissions. Data provided primarily by the traffic engineer and supplemented with data from the ARB's EMFAC and OFFROAD models.
- *Waste:* methane emissions from landfilled waste. Data provided by the California Integrated Waste Management Board (CIWMB) and the USEPA.
- *Wastewater:* electricity consumption and fugitive emissions from domestic wastewater treatment. Data provided by ARB and the Foothill Municipal Water District (FMWD).
- *Water Supply:* electricity consumption associated with water importation, water pumping and distribution, and water treatment. Data provided by the CEC and the FMWD.
- *High Global Warming Potential GHGs*: fugitive emissions of HFCs, PFCs, and SF_6. Data provided by ARB.
- *Carbon Sinks and Sequestration*: sequestration of CO_2 in landfills, forest land, and urban forest. Data provided by the City, the USEPA, and various studies of sequestration.

The following emissions sectors are included as Scope 3 sources and are not included in the community inventory. These emissions are presented for informational purposes only. The data source for each emission sector is also included.

- *Waste:* lifecycle emissions including energy inputs for material manufacture and transport and lifecycle emissions from recycling. Data provided by the CIWMB and the USEPA.

The City's 2007 GHG community inventory is defined as the annual GHG emissions associated with the City. The City's estimated 1990 and projected (2020) GHG community emissions represent BAU emissions associated with the City in 1990 and 2020, respectively.

Government Inventory

As defined above, the government inventory includes GHG emissions associated with the City's services and government operations. The guidelines of the LGOP (ARB et al. 2008) were followed in developing this inventory. IPCC (2006) and USEPA (2007, 2008, 2009a) protocols and the CCAR General Reporting Protocol (2009a) were also followed. This inventory utilizes an "operational control approach," as defined in the LGOP, to set the inventory's organizational boundaries (ARB et al. 2008):

> *Operational Control Approach: A local government has operational control over an operation if the local government has the full authority to introduce and implement its operating policies at the operation. One or more of the following conditions establishes operational control:*
>
> - *Wholly owning an operation, facility, or source*
> - *Having the full authority to introduce and implement operational and health, safety and environmental policies*

[4] La Cañada Flintridge does not have industrial land uses. In addition, there are no large stationary sources in the City (Whynot pers. comm.).

This approach is corroborated by the "operational control approach," as defined in the World Resources Institute and World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol (WRI/WBCSD 2004). In this context, the government inventory will include 100 percent of the GHG emissions from City activities over which it has operational control. This approach was selected because it most accurately accounts for GHG emissions from the City's operations. The following emissions sectors are included in the government inventory. The data source for each emission sector is also included.

- *City Facilities:* natural gas and electricity consumption for City owned and operated facilities. Data provided by the City.
- *Streetlights and Traffic Signals:* electricity consumption for City owned and operated streetlights and traffic signals. Data provided by the City.
- *Vehicle Fleet:* fuel consumption for City fleet vehicles. Data provided by the City.

The City's 2007 government GHG inventory is defined as the quantification of annual GHG emissions associated with the City's services for the year 2007. The City's 1990 and projected (2020) GHG government emissions represent emissions associated with the City's government operations in 1990 and BAU operations in 2020, respectively.

COMMUNITY INVENTORY

This section presents the 1990 emissions estimate, 2007 inventory, and 2020 projected emissions inventories for the City of La Cañada Flintridge, including data collection and calculation methodology. The results of the community inventory for 2007 in $MTCO_2e$ are presented in Figure 4 and Table 4. Accounting for historical and projected population and economic growth, estimated 1990 and BAU community emissions in 2020 are also presented in Table 4. Emission sinks were also included in the inventory because they influence the net CO_2 flux related to City activities. Sinks were included and separated from emissions following common inventory protocol and to illustrate a more detailed picture of the City inventory.

In descending order of magnitude, community emissions sources are dominated by on-road mobile sources, commercial energy, and residential energy. Table 5 presents Scope 3 sources for the City of La Cañada Flintridge, including upstream and downstream lifecycle emissions from waste (see Waste section below for a description of these sources). Scope 3 emissions are indirect emissions that are not under direct control of the City, but occur as a result of City activities, such as manufacture and transport of purchased materials and fuels (refer to the *Inventory Protocols* section).

Figure 4. La Cañada Flintridge 2007 Community Inventory

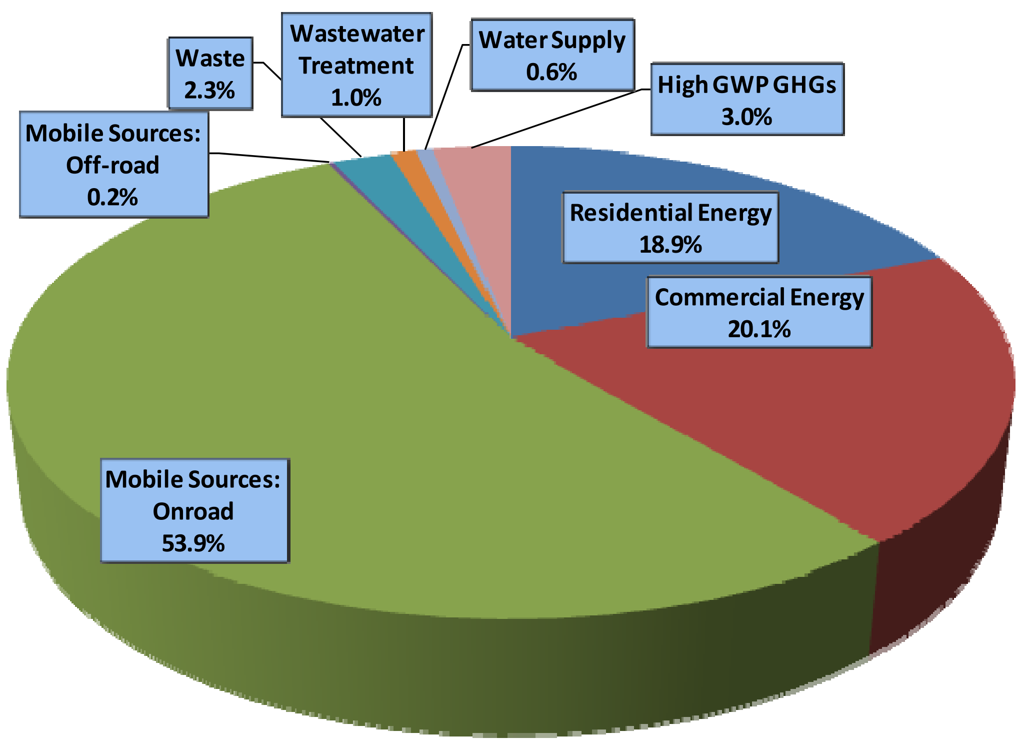


Table 4. La Cañada Flintridge Community Emissions and Sinks Summary

La Cañada Flintridge 1990 Estimate, 2007 Community Inventory, and BAU (2020) Projections ($MTCO_2e$)						
Sector	**1990**		**2007**		**2020**	
	Emissions	Percent	Emissions	Percent	Emissions	Percent
Emission Sources						
Residential Energy	56,971	19.9	56,823	18.9	57,104	16.6
Commercial Energy[1]	61,326	21.4	60,464	20.1	64,121	18.6
Mobile Sources: On-road	149,848	52.3	162,385	53.9	186,378	54.1
Mobile Sources: Off-road	314	0.1	638	0.2	731	0.2
Waste	8,897	3.1	6,889	2.3	7,275	2.1
Wastewater Treatment	4,190	1.5	3,042	1.0	3,057	0.9
Water Supply[2]	1,976	0.7	1,940	0.6	2,414	0.7
High-GWP GHGs	2,720	1.0	8,932	3.0	23,204	6.7
Subtotal	**286,242**	**100.0**	**301,113**	**100.0**	**344,283**	**100.0**
Emission Sinks						
Landfill Carbon	(2,583)	33.4	(2,000)	28.0	(2,112)	29.1
Forest Land / Open Space[3]	(775)	10.0	(775)	10.8	(775)	10.7
Urban Forest[3]	(4,377)	56.6	(4,377)	61.2	(4,377)	60.3
Subtotal	**(7,734)**	**100.0**	**(7,151)**	**100.0**	**(7,263)**	**100.0**
Net Emissions (Sources and Sinks)	**278,508**	**100.0**	**293,961**	**100.0**	**337,019**	**100.0**

[1] La Cañada Flintridge does not have industrial land uses. This sector also includes emissions associated with water pumping and treatment occurring within the City.
[2] This sector represents emissions associated with water pumping and treatment occurring outside City boundaries.
[3] These estimates are based on average sequestration rates for California, and are therefore only approximations of actual sequestration occurring in La Cañada.

Table 5. Scope 3 La Cañada Flintridge Community Emissions and Sinks

Scope 3 La Cañada Flintridge 1990 Estimate, 2007 Community Inventory, and BAU (2020) Projections ($MTCO_2e$)						
Sector	**1990**		**2007**		**2020**	
	Emissions	Percent	Emissions	Percent	Emissions	Percent
Emission Sources						
Waste Lifecycle: Upstream[1]	28,130	100.0	60,503	100.0	63,892	100.0
Subtotal	**28,130**	**100.0**	**60,503**	**100.0**	**63,892**	**100.0**
Emission Sinks						
Waste Lifecycle: Downstream[2]	0	N/A	(27,018)	100.0	(28,532)	100.0
Subtotal	**0**	**N/A**	**(27,018)**	**100.0**	**(28,532)**	**100.0**
Net Scope 3 Emissions (Sources and Sinks)	**28,130**	**100.0**	**33,484**	**100.0**	**35,360**	**100.0**

[1] Upstream emissions are associated with energy inputs for material manufacture and transport (see Waste section for further discussion).
[2] Downstream emissions are associated with recycling activities (see Waste section for further discussion).

Building Energy Use

Building energy use for residential and commercial buildings is a significant component of La Cañada Flintridge's GHG inventory, accounting for 39 percent of the City's total emissions in 2007. This sector includes any emissions from building energy use occurring within City boundaries, including energy consumption at NASA's Jet Propulsion Laboratory (JPL) within the city. Energy consumption includes electricity and natural gas. Electricity data were obtained from Southern California Edison (SCE) and natural gas data were obtained from Southern California Gas, the two utilities serving the City. According to SCAQMD, there are no large stationary sources[5] in the City (Whynot pers. comm.). Consequently, the building energy use sector captures all emissions associated with JPL within the City.

Electricity and natural gas consumption quantities were multiplied by the appropriate emission factors presented in Table 1 to determine GHG emissions. Electricity consumption results in indirect emissions occurring at the power plants which produce the electricity. The emission factors for electricity consumption represent all emissions related to electricity deliveries from SCE (including owned and purchased power) for 2007 (CCAR 2009b).[6] Natural gas consumption results in direct emissions through the combustion process occurring where the natural gas is combusted. Emission factors for natural gas remain constant because the energy content and combustion processes of natural gas do not change over time.

1990 emissions were estimated based on electricity data for the City provided by SCE for the year 1990. 2020 emissions were estimated based on the historical estimates and growth projections for population, households, and employment presented in Table 2. 2007 energy consumption was projected to estimate 2020 energy consumption as follows:

- Residential Energy—projected using growth in the number of households, and
- Commercial Energy—projected using growth in the number of jobs.

Building Energy Use Emissions

Table 6 presents building energy use emissions for the residential and commercial sectors in La Cañada Flintridge. Electricity emissions decrease slightly from 1990 to 2007. Even though electricity consumption increases over time, the electricity 1990 emission factor for CO_2 is higher than the emission factor for 2007 (see Table 2). This results in lower emissions in 2007. Electricity emissions show a minor increase from 2007 to 2020, and natural gas emissions increase from 1990 to 2020. This occurs because population, the number of households, and the number of jobs all increased during these years (and the emission factors remain constant). It is expected that community energy use approximately scales with these metrics, and thus increases over time.

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[5] Stationary sources would include emissions from fuel combustion (such as diesel, gasoline, and propane).

[6] The emission factor varies from year to year due to a variety of factors that influence SCE's ratio of owned to purchased power and the source of generation (natural gas, hydroelectric, coal, etc.). The emission factor is higher in years when SCE purchases more power to meet California electricity demand. For example, the emission factor was 679 lbs CO_2/MWh, 666 lbs CO_2/MWh, 641 lbs CO_2/MWh and 631 lbs CO_2/MWh for the years 2004, 2005, 2006, and 2007 respectively. Thus, the emission factor for any given year can vary (CCAR 2009b).

Table 6. Building Energy Use Emissions for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	1990	2007	2020
Residential			
Electricity Use (MWh)	72,376	89,154	89,596
Natural Gas Use (Mcf)	556,415	568,560	571,375
CH_4 Emissions (kg)	3,088	4,154	4,174
N_2O Emissions (kg)	179	385	387
CO_2 Emissions (kg)	56,851,142	56,615,902	56,896,218
CO_2e Emissions ($MTCO_2e$)	**56,971**	**56,823**	**57,104**
Commercial[1]			
Electricity Use (MWh)	142,584	175,638	186,275
Natural Gas Use (Mcf)	167,904	181,476	192,365
CH_4 Emissions (kg)	1,299	3,344	3,546
N_2O Emissions (kg)	257	662	702
CO_2 Emissions (kg)	61,218,835	60,189,011	63,828,662
CO_2e Emissions ($MTCO_2e$)	**61,326**	**60,464**	**64,121**
All Sectors			
Electricity ($MTCO_2e$)	78,572	76,151	79,337
Natural Gas ($MTCO_2e$)	39,725	41,136	41,887
Total CO_2e Emissions ($MTCO_2e$)	**118,297**	**117,287**	**121,225**

[1] La Cañada Flintridge does not have industrial land uses.

Mobile Sources

Mobile source emissions account for 53.9 percent of La Cañada Flintridge's total emissions in 2007. Mobile source emissions within La Cañada Flintridge include on-road and off-road vehicle and equipment activity. On-road sources include cars, trucks, buses, etc. Off-road sources include recreational boats and vehicles, industrial equipment, construction equipment, lawn and garden equipment, commercial equipment, and more.

On-Road Transportation

On-road emissions were calculated using ARB's EMFAC2007 V2.3 mobile source emissions model and traffic model runs performed in support of the City's General Plan update (Iteris 2010). VMT for the City was provided in 5 mph speed bins for the following scenarios: 1) conditions in 2000, 2) existing conditions (2008), 3) future No Project conditions (2030), and 4) future with General Plan build-out (2030). Trends in the VMT modeling outputs between 2000 and 2030 were used to estimate VMT for 1990 and 2020. The same methodology was used in the Traffic Impacts Analysis to estimate VMT on individual road segments (personal communication, Steven Green, Iteris). For EMFAC model runs, Los Angeles County was used as a proxy for conditions in La Cañada-Flintridge because the EMFAC model cannot produce outputs at a finer resolution than county-scale. The EMFAC model was run for the years 1990, 2007, and 2020 to calculate the distribution of VMT among vehicle types and to estimate fuel economy by vehicle type for Los Angeles County. This information was used in conjunction with the

VMT supplied by the traffic engineer to calculate total fuel consumption for the City, which was multiplied by fuel emission factors to calculate CO_2 (see Table 1). VMT by vehicle type was multiplied by CH_4 and N_2O emission factors for each vehicle type to determine emissions of CH_4 and N_2O (USEPA 2007).

The estimate of GHG emissions from on-road mobile sources is based entirely on modeled VMT levels on roadway segments in the City. The Traffic impacts Analysis report prepared by Iteris (2010), states that the analysis includes major roadway segments in the City as well as those in adjacent jurisdictions. Roadway segments within the City were selected because they provide access to major nodes throughout the study area. Roadways adjacent to the City, but in other jurisdictions were selected because they provide connectivity to surrounding jurisdictions (Iteris, 2010). The study area does not include VMT on Interstate 210 or State Route 2. However, certain segments of the Angeles Crest Highway are included.

Off-Road Vehicles and Equipment

The ARB OFFROAD 2007 air quality model was used to calculate off-road GHG emissions. The OFFROAD 2007 model was run for the years 1990, 2007, and 2020 to calculate overall fuel consumption for Los Angeles County, and fuel emission factors were used to calculate CO_2 (see Table 1). CH_4 and N_2O emissions were taken directly from the model. These emissions were then apportioned by population to obtain emissions for La Cañada Flintridge. Agricultural equipment, pleasure craft, and rail operations were not included since there is no activity associated with these equipment types in the City.

Summary of Mobile Source Emissions

Table 7 presents mobile source emissions for La Cañada Flintridge. On-road emissions have increased over time VMT occurring within the City increases from 1990 to 2020. Increased VMT is correlated with increased fuel consumption, and therefore emissions. Off-road emissions are based on population, and have thus increased slightly over time as the City's population has risen.

Table 7. Mobile Source Emissions for 1990, 2007, and 2020 for LA County and La Cañada Flintridge

Sector	1990	2007	2020
On-Road Transportation			
Modeled VMT (1,000)	270,330	325,795	381,224
CH_4 Emissions ($MTCO_2e$)	553.4	707.0	821.0
N_2O Emissions ($MTCO_2e$)	3,260.9	4,263.4	4,951.9
CO_2 Emissions ($MTCO_2e$)	146,034	157,415	180,605
Total Emissions ($MTCO_2e$)	**149,848**	**162,385**	**186,378**
Off-Road Vehicles and Equipment			
CH_4 Emissions ($MTCO_2e$)	3.2	2.2	1.5
N_2O Emissions ($MTCO_2e$)	1.9	3.1	3.7
CO_2 Emissions ($MTCO_2e$)	309.0	632.5	725.8
Total Emissions ($MTCO_2e$)	**314.1**	**637.8**	**731.0**
Total	**150,162**	**163,023**	**187,109**

Sources: Iteris 2007; OFFROAD 2007; EMFAC 2007; USEPA 2007; California Department of Finance 2009.

Waste

Waste-related emissions account for approximately 2 percent of La Cañada Flintridge's total emissions in 2007. Emissions from waste were considered from a lifecycle perspective. This inventory includes only direct landfill emissions (methane). Lifecycle emissions associated with waste are included as Scope 3 sources but are not included in the inventory because reporting lifecycle emissions is considered to be optional (CARB et al. 2008). These lifecycle emissions include upstream emissions (i.e., emissions produced as a result of raw material manufacture) and downstream emissions (i.e., emissions offset through the recycling process).

Landfill Emissions

The materials disposed of by La Cañada Flintridge are recycled, composted, or placed in a landfill.[7] Landfill-related emissions from waste are primarily CH_4, which is released over time when waste decomposes in a landfill. Although there are no landfills located in La Cañada Flintridge, waste generated within the City will either be diverted (through recycling, composting, etc.) or transported to a landfill outside of the City. These emissions will not occur within City boundaries, but the City is responsible for creating this waste.

Waste generation data was compiled from the California Integrated Waste Management Board's (CIWMB) web site (CIWMB 2009a, 2009b). The CIWMB provides waste stream profile information for the City, including waste by waste type, total disposal, and disposal location. This data was collected for all years available: 1996-2008. 1990 disposal was estimated by linearly projecting disposal for the years 1996-2004, since a notable drop in disposal is evident after 2005 due to diversion programs. 2020 disposal was estimated by multiplying the projected 2020 City population by the average per capita disposal rate for the years 2006-2008. This projection assumes a constant diversion rate of 64 percent

[7] No data was available for amount of solid waste composted.

(based on most recent data available for the year 2006). Total disposal was separated into various waste types using waste profile information for the year 1999 (the only year available from the CIWMB). The waste profile is assumed to remain constant. Emissions were estimated using emission factor components derived from the USEPA report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks* (USEPA 2006).

Lifecycle Emissions – Scope 3

Waste disposal activities in the City of La Cañada Flintridge result in more sources of emissions than the methane emissions produced as solid waste decomposes in a landfill. Consequently, a "lifecycle" accounting of solid waste emissions provides a more complete understanding of the City's GHG emissions "footprint" for this sector. Typically, lifecycle emissions include both upstream and downstream emissions resulting from solid waste management practices. For example, the materials disposed of by La Cañada Flintridge required energy to manufacture and transport to the City: these emissions are called *upstream* emissions. Emissions offset through the recycling process, such as emissions associated with manufacturing materials without recycled components, are called *downstream* emissions.

Data used for this analysis include waste disposal, diversion percentages, and waste stream profile information that was collected from the CIWMB as described above. Both upstream and downstream emissions were calculated using emission factor components for recycling and landfilling from the USEPA (2006).

From a lifecycle perspective, recycling waste often results in a net emissions sink, because recycling is assumed to displace 100 percent virgin material inputs during the manufacturing process. This sink is a component of the downstream emissions profile of solid waste. The City diverted zero percent of waste from landfills in 1990 and 64 percent in 2007 (CIWMB 2009b). This diversion rate was assumed to remain constant in 2020. Data on recycled waste quantities by waste type was unavailable. Consequently, it was assumed that the waste profile for recycled materials was equal to the waste profile for landfilled materials.

Summary of Waste Emissions

Table 8 presents landfill emissions for La Cañada Flintridge. Landfill emissions decrease slightly from 1990 to 2007 because even though total waste generation increases over time, the City's diversion rate (recycling, composting, etc.) has increased, resulting in less waste going to landfills. Landfill emissions increase slightly from 2007 to 2020 because waste generation increases and the City's diversion rate is assumed to remain constant. Further increases in the City's diversion rate may produce lower waste-related emissions in the future.

Table 8. Landfill Emissions for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	1990	2007	2020
Waste Generation (tons)			
Landfilling	32,420	25,103	26,509
Recycling	0	44,628	47,128
Landfill Emissions ($MTCO_2e$)			
Commercial	4,366	3,380	3,570
Residential	4,531	3,509	3,705
Total	**8,897**	**6,889**	**7,275**
Sources: CIWMB 2009a, 2009b.			

Table 9 presents Scope 3 lifecycle emissions from waste. Lifecycle emissions increase from 1990 to 2020 because the increase in waste generation is associated with increased emissions from manufacturing both landfilled and recycled materials.

Table 9. Scope 3 Lifecycle Waste Emissions and Sinks for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	1990	2007	2020
Lifecycle Emissions: Upstream ($MTCO_2e$)			
Commercial Landfilling	12,963	10,037	10,599
Commercial Recycling	0	17,844	18,843
Residential Landfilling	15,167	11,744	12,402
Residential Recycling	0	20,878	22,048
Total	**28,130**	**60,503**	**63,892**
Lifecycle Emissions: Downstream ($MTCO_2e$)			
Commercial Recycling	0	(12,411)	(13,106)
Residential Recycling	0	(14,608)	(15,426)
Total	**0**	**(27,018)**	**(28,532)**
Total Lifecycle Emissions ($MTCO_2e$)	**28,130**	**33,484**	**35,360**
Sources: CIWMB 2009a, 2009b.			

Wastewater Treatment

Wastewater treatment emissions account for approximately 1 percent of La Cañada Flintridge's total emissions in 2007. This inventory includes both fugitive emissions occurring through wastewater treatment processes and indirect emissions from electricity consumption as discussed below. Wastewater services for the City are provided by the Sanitation Districts of Los Angeles County (SDLAC).

Fugitive Emissions

Treatment of wastewater from both domestic (municipal sewage) and industrial sources can produce fugitive CH_4 and N_2O emissions (USEPA 2007). Due to lack of data on industrial wastewater treatment, only GHG emissions from domestic wastewater were analyzed. Wastewater from domestic sources is treated to remove soluble organic matter, suspended solids, pathogenic organisms, and chemical contaminants. CH_4 is generated when microorganisms biodegrade soluble organic material in wastewater under anaerobic conditions. N_2O is generated during both nitrification and denitrification of the nitrogen present in wastewater, usually in the form of urea, ammonia, and proteins (USEPA 2007).

ARB's 1990, current, and 2020 inventories provide State-wide emissions for CH_4 and N_2O for various wastewater treatment processes. These emissions were scaled by the reported California population in 1990, 2007, and 2020 to derive State-wide per capita emissions of CH_4 and N_2O from wastewater treatment for each respective year (California Department of Finance 2009; ARB 2009a). In 1990, 100 percent of the City's population was on septic systems. In 2007, 57 percent of the City was on septic systems; consequently, the statewide per capita emission factors for septic systems were applied to 100 percent and 57 percent of the City's population for 1990 and 2007, respectively. The 2007 percent of the population on septic was assumed to remain constant for 2020. The remaining population was multiplied by the aggregated emission factor for other sources of wastewater treatment emissions, which include aerobic and anaerobic processes, as well as plant and effluent emissions.

Table 10 presents per capita and total fugitive emissions associated with wastewater treatment for La Cañada Flintridge. Emissions increase slightly from 1990 to 2007, but show a minor decrease from 2007 to 2020. This is because the City population is increasing, resulting in higher energy use associated with treating more wastewater, but the state-wide per-capita CH_4 emission factor for non-septic wastewater treatment systems is decreasing (ARB 2009a).

Table 10. Fugitive Wastewater Treatment Emissions for 1990, 2007, and 2020 for La Cañada Flintridge (MT CO_2e)

Sector	1990	2007	2020
Septic Systems[1]			
Per Capita CH_4	0.207	0.207	0.207
Per Capita N_2O	–	–	–
CH_4 Emissions	3,968	2,500	2,565
N_2O Emissions	–	–	–
Total Emissions	**3,968**	**2,500**	**2,565**
Other Wastewater Systems[2]			
Per Capita CH_4	0.020	0.011	0.004
Per Capita N_2O	0.027	0.027	0.027
CH_4 Emissions	0	100	37
N_2O Emissions	0	249	255
Total Emissions	**0**	**348**	**292**
Total Emissions (MTCO$_2$e)	**3,968**	**2,848**	**2,857**

Note: See Table 1 for population data.

[1] 1990 and 2020 per capita held constant (ARB 2009a).

[2] CH_4 per capita emissions assumed to decrease linearly; 1990 and 2020 N_2O per capita emissions based on average of 2000 – 2006 per capita emissions.

Sources: California Department of Finance 2009; ARB 2009a.

Electricity-Related Emissions

Wastewater treatment plants also consume energy to treat influent wastewater. Indirect emissions from electricity consumption related to wastewater treatment occurring outside City boundaries are estimated based on data provided by the SDLAC and CEC discussed below (SDLAC 1995, 2009; CEC 2006b). Emissions from natural gas or other fuel combustion were not included because fuel consumption was not available.[8] Although the actual emissions are not directly occurring inside La Cañada Flintridge (similar to electricity consumption in the Building Energy Use sector), they occur indirectly as a result of activity inside La Cañada Flintridge (wastewater production). All emissions related to electricity consumption and natural gas combustion for wastewater treatment activities occurring inside City boundaries are included in the Commercial sector of the Building Energy Use section above.

As noted above, 50 percent of the City is on septic systems, and 425 homes (approximately 1,300 residents) are serviced by the La Cañada Wastewater Treatment Plant (SDLAC 2009). The average commercial and residential wastewater production in the region is approximately 101 gallons per person per day (SDLAC 1995). This factor was applied to the remainder of the City's population to determine wastewater generation treated outside City boundaries. According to the CEC, the average wastewater treatment plant in Southern California requires 1,911 kWh to treat one million gallons (MG) of wastewater (CEC 2006b).

[8] It is expected that these emissions are small, since natural gas combustion in wastewater treatment facilities is likely only used for building heating.

Table 11 presents calculations and emissions associated with electricity consumption for wastewater treatment for La Cañada Flintridge. Emissions decrease from 1990 to 2007 because although energy use increases, the CO_2 emission factor for electricity is higher in 1990 (see Table 1). Emissions increase slightly from 2007 to 2020 because total wastewater generation within the City increases with population growth and the electricity emission factors are assumed to remain constant.

Table 11. Electricity-Related Wastewater Treatment Emissions for 1990, 2007, and 2020 for La Cañada Flintridge

Data and Emissions	1990	2007	2020
Population[1]	8,287	9,283	9,562
Wastewater Production (MG)[2]	317	353	364
Electricity Use (kWh)[3]	605,221	675,423	695,043
CH_4 Emissions (kg)	1.84	9.38	9.65
N_2O Emissions (kg)	1.02	1.38	1.42
CO_2 Emissions (kg)	220,865	193,283	198,897
Total Emissions ($MTCO_2e$)	**221**	**194**	**200**

[1] Population not on septic systems or served by the La Cañada Wastewater Treatment Plant. See Table 1.

[2] Based on a per capita wastewater generation rate of 101 MG/day.

[3] Based on 1,911 kWh per MG of wastewater (CEC 2006b)

Sources: SDLAC 1995, 2009; CEC 2006b.

Water Supply

Water supply emissions account for approximately 1 percent of La Cañada Flintridge's total emissions in 2007. This inventory includes indirect emissions from electricity consumption for imported water, water pumping and distribution, and water treatment, as discussed below. Electricity used for water pumping and treatment occurring within the City was included in the Commercial sector of the Building Energy Use section above. However, energy consumption for the following activities is not included in the Building Energy Use section:

- transporting water to the City from outside of City boundaries (imported water);
- distributing this water to end users in the City (water pumping and distribution); and
- treatment of water at facilities outside of the City (water treatment).

Water supply data was provided by the Foothill Municipal Water District (FMWD) *2005 Urban Water Management Plan* and the *Management Report for Fiscal Year 2007-08* (FMWD 2005, 2008). For all sectors described below, water supply was provided for fiscal year (FY) 2007-08 (used to approximate 2007 water supply) and 2020. 1990 water supply was estimated by linearly projecting water demand backward based on estimated and projected water demand for the years 2000, 2005, 2010, 2015, 2020, and 2025 (FMWD 2005).

Imported Water

Water supply involves indirect emissions from the generation of electricity required to supply the City with imported water. Imported water is supplied by four water districts: the Crescenta Valley Water District, the La Canada Irrigation District, the Mesa Crest Water Company, and the Valley Water Company. The FMWD supplies these four agencies with water purchased from the Metropolitan Water District (MWD) (FMWD 2005). The energy used to transport water from outside of the City was obtained from the CEC 2006 report, *Refining Estimates of Water-Related Energy Use in California*, which provides proxies for embodied energy use for water in southern and northern California (CEC 2006b). The energy intensity associated with imported MWD water is approximately 1,103 kWh/MG (CEC 2006b).

Information in the CEC report regarding electricity usage and loss factors, and imported water quantities listed in FMWD Reports, was used to calculate indirect emissions from water importation to the City (FMWD 2005, 2008; CEC 2006b). Electricity emission factors for the CAMX/WECC California region were used to calculate GHG emissions (724.12 lbs CO_2/MWh, 30.24 lbs CH_4/GWh, and 8.08 lbs N_2O/GWh), since electricity used to transport water to the City is supplied by many utilities within this region (USEPA 2009b).

Water Pumping and Distribution

The FMWD supplies the four water districts serving the City through its main pump station located in Pasadena. Water flows from the MWD's conveyance system to the main pumping plant, where it is then pumped to each water district. Electricity used to pump this water is supplied by SCE. Although this electricity is consumed outside of City boundaries, it is required to pump water consumed within the City. Consequently, emissions associated with this electricity were included in the community inventory. The energy intensity for water pumping is approximately 360 kWh/acre-foot of water (FMWD 2008). The energy intensity is assumed to remain constant between 1990 and 2020.

Water Treatment

Before water is pumped into the City, it is purified by passing through various treatment processes. Since there are no water treatment plants inside the City, electricity consumed to treat City water occurs outside city boundaries, and is thus not included in the utility data provided above. Since the City relies on this service, emissions associated with electricity consumed for water treatment processes were included in the community inventory. The energy intensity for water treatment is approximately 111 kWh/acre-foot of water (CEC 2006b).

Summary of Water Supply Emissions

Table 12 presents information and emissions associated with water supply for the City. Emissions decrease from 1990 to 2007 because although energy use increases, the CO_2 emission factor for electricity is higher in 1990 (see Table 1). Emissions increase from 2007 to 2020 because the City's water demand increases over time and the electricity emission factors are assumed to remain constant (FMWD 2005). This increase in demand means that more water must be treated, imported to the City, and distributed within the City. All of these processes require energy and produce indirect emissions through electricity consumption.

Table 12. Water Supply Emissions for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	**1990**	**2007**	**2020**
Water Supply (acre-feet)	7,439	8,774	10,917
Imported Water			
Electricity Use (kWh)	2,456,500	2,897,474	3,605,002
CH_4 Emissions (kg)	7.5	39.7	49.4
N_2O Emissions (kg)	4.1	10.6	13.2
CO_2 Emissions (kg)	896,458	937,057	1,165,875
Total Emissions (MTCO$_2$e)	**898**	**941**	**1,171**
Water Pumping and Distribution			
Electricity Use (kWh)	2,680,427	3,161,600	3,933,624
CH_4 Emissions (kg)	8.1	43.9	54.6
N_2O Emissions (kg)	4.5	6.4	8.0
CO_2 Emissions (kg)	978,177	904,740	1,125,666
Total Emissions (MTCO$_2$e)	**980**	**908**	**1,129**
Water Treatment			
Electricity Use (kWh)	269,065	317,365	394,862
CH_4 Emissions (kg)	0.8	4.4	5.5
N_2O Emissions (kg)	0.5	0.6	0.8
CO_2 Emissions (kg)	98,191	90,819	112,996
Total Emissions (MTCO$_2$e)	**98**	**91**	**113**
Total			
Electricity Use (kWh)	5,405,992	6,376,440	7,933,487
CH_4 Emissions (kg)	16.4	88.0	109.5
N_2O Emissions (kg)	9.1	17.7	22.0
CO_2 Emissions (kg)	1,972,826	1,932,616	2,404,537
Total Emissions (MTCO$_2$e)	**1,976**	**1,940**	**2,414**

Sources: FMWD 2005, 2008; CEC 2006b; USEPA 2009b.

High Global Warming Potential GHGs

High-GWP emissions account for approximately 3 percent of La Cañada Flintridge's total emissions in 2007. High-GWP gases include SF_6 from electric utility applications, substitutes for ozone depleting substances (primarily HFCs and PFCs), and other high-GWP gases used in semiconductor manufacturing and other industrial processes. Emissions of high-GWP GHGs were quantified for two sources:

- substitutes for ozone depleting substances (ODS), and
- SF_6 emissions from electricity transmission lines.

Emissions from semiconductor manufacturing and specific industrial processes were not estimated because these emissions do not occur in the City and are not closely tied to specific activities in the City.

HFCs and PFCs as ODS Substitutes

Emissions of HFCs and PFCs occur from their use in refrigeration and air conditioning systems. These high-GWP compounds are being phased in as ODS substitutes. The majority of anthropogenic high-GWP GHGs includes SF_6, HFCs, and PFCs. Emissions of high-GWP GHGs were quantified for two major source categories: appliances and electricity transmission lines. In appliances, ODS substitutes required by the Montreal Protocol include HFCs and PFCs. These high-GWP gases are emitted during normal use in appliances such as refrigeration and air conditioning systems, as well as leakage after disposal.

The California State-wide per capita emissions of HFCs and PFCs from these applications were used to determine emissions for the City on a population basis (ARB 2009a, 2009b). 2007 emissions were estimated using the growth in per capita emissions of HFCs and PFCs from 2000 to 2020 (the ARB does not have a 2007 estimate). The ARB's estimated and projected emissions for 1990 and 2020 were used to determine a per capita emission rate for each respective year, which was used to estimate emissions from the City in 1990 and 2020. The California Department of Finance population projections for the City were used to estimate future emissions (California Department of Finance 2009).

Electricity Transmission

Electrical transmission and distribution systems emit SF_6. SF_6 is used to insulate power switching equipment and transformers (CEC 2006a). ARB estimates the California statewide emissions of SF_6 from electricity transmission and distribution to be constant from 2004 to 2020 (ARB 2009b). The ARB's estimated emissions for 1990 and 2006 and projected emissions for 2020 were used to determine a per kWh emission rate, which was used to estimate emissions from the City in 1990, 2007, and 2020 (ARB 2009a, 2009b).

Summary of High Global Warming Potential Emissions

Table 13 presents emissions of high-GWP GHGs from ODS substitutes and electricity transmission in La Cañada Flintridge. Emissions of high-GWP GHGs from ODS substitutes increase significantly from 1990 to 2020. This is because the ODS phase-out program did not begin until 1994, and the use of ODS substitutes has increased notably since then (USEPA 2009c). SF_6 emissions have decreased from 1990 to 2007 over time because California utilities are implementing procedures to control their SF_6 emissions (CEC 2006a). Emissions increase from 2007 to 2020 because the emission factor per kWh of electricity was held constant according to ARB's projection, but electricity consumption is expected to increase (ARB 2009a).

Table 13. High-GWP Emissions for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	1990	2007	2020
HFCs and PFCs as ODS Substitutes			
Per Capita Emissions (kg CO_2e)	1.2	373.7	1,019.3
La Cañada Emissions (kg CO_2e)	23.1	7,905.8	22,130.2
Electricity Transmission SF_6			
Emissions Factor (kg CO_2e /MWh)	12.2	3.8	3.8
La Cañada Electricity Consumption (MWh)[1]	220,972	271,844	284,499
La Cañada Emissions ($MTCO_2e$)	2,697.3	1,026.2	1,073.9
Total Emissions ($MTCO_2e$)	**2,720**	**8,932**	**23,204**

Sources: ARB 2009a, 2009b; California Department of Finance 2009.

[1] Sum of electricity consumption for buildings, wastewater treatment, and water supply.

Carbon Sinks and Sequestration

The community inventory includes both GHG emissions and sinks occurring within the City's boundaries. Sinks were included in the inventory because they influence the net CO_2 flux related to City activities. Sinks were included and separated from emissions following common inventory protocol and to illustrate a more detailed picture of the City inventory.

Two categories of carbon sinks are associated with activities in the City: carbon sequestration from certain landfilled materials and carbon sequestration from vegetated areas within the City. When food discards, yard trimmings, and paper are landfilled, for example, these materials do not fully decompose. Under natural conditions, virtually all carbon stored in these materials would be released as CO_2. Because landfills inhibit some decomposition of organic carbon, excess carbon stored in landfills is considered an anthropogenic sink of CO_2 (USEPA 2006).

In addition, various land covers within La Cañada Flintridge provide sequestration of carbon in vegetation and soils. The amount of carbon within standing vegetation and soils is called the *carbon stock*. The amount of carbon sequestered from the atmosphere annually is called the *carbon flow, the GHG flux,* or the *annual sequestration*. Carbon sinks from forest land, land use change, and urban forestry are included in both the California and National GHG Inventories (ARB 2009a; USEPA 2009d). These emissions are based on regional estimates of sequestration and carbon stock values and broad assumptions about land use types, forest types, and urban tree cover, and should not be considered a precise accounting of current or projected annual or cumulative losses of sequestration value.

Landfill Carbon Storage

As noted above, materials such as food discards, yard and tree trimmings, and paper store carbon in landfills. This carbon would normally be released as CO_2 through the natural process of decomposition. But evidence shows that these waste types degrade very slowly in landfills and, consequently, the carbon they contain is effectively sequestered (USEPA 2009a). In accordance with inventory and landfill emission protocol, this stored carbon is considered an anthropogenic sink of CO_2 (USEPA 2006; 2009a).Waste data and emissions estimates required to account for this sequestration were conducted using the methodology discussed in the Waste section of this report.

Forest Land / Open Space

Conversion of natural and agricultural land to urban uses results in the loss of the annual carbon sequestration value of that land unless the new land cover provides a carbon sequestration value of its own that is equal to greater than that of the original land cover. For example, natural oak woodlands sequester carbon through photosynthesis. When oak trees are removed for development purposes, this sequestration no longer occurs. Conversely, conversion of urban land to natural land, or preservation of natural land which would otherwise become urban land, results in annual carbon sequestration gains. Loss or gain of sequestration of carbon (and thus CO_2) is functionally equivalent to emissions or sinks of CO_2 in the inventory context (USEPA 2009d).[9]

According to the City, in 1990 and 2007, there were 856 designated acres of open space in the City. Of these 856 acres, 110 acres have been cleared for high-intensity transmission lines, for a total of 746 designated acres of forested open space. It was assumed that for BAU, open space acreage in 2020 is equal to open space acreage in 2007.

Annual sequestration for open space lands in La Cañada Flintridge was calculated and included as an emission sink in the community inventory. Studies show that oak hardwood forests, which represent the average Los Angeles County forest type, can sequester between 0.35 and 1.05 MT carbon/hectare, or 0.5 to 1.6 $MTCO_2$/acre (USCCP 2007; Forbes and Dakin 2003). A mid-range value of 1.0 $MTCO_2$/acre was selected to calculate annual sequestration for open space forest lands in La Cañada Flintridge.

Urban Forest

Trees in urban areas sequester carbon from the atmosphere as they grow, and provide a sink of CO_2. Such trees can be found in parks, open space, private property, or along streets. Regions with high urban tree canopy cover can sequester more carbon. Although there are no specific studies on urban tree cover for the City itself, metropolitan areas in the Southwest and dry West have an average tree canopy cover of 25 percent (American Forests 2009). Suburban residential zones in these areas have an average tree canopy cover of 35 percent. For comparison, the neighboring urban area of Eagle Rock (City of Los Angeles) has an average tree canopy cover of 34.5 percent (McPherson et al. 2007; Million Trees LA 2007). For this analysis, it was assumed that La Cañada Flintridge has a 25 percent tree canopy cover for each year. This represents a conservative estimate of the urban tree cover in the City because La Cañada Flintridge is primarily suburban residential area and neighbors suburban areas with greater than 30 percent tree canopy cover.

According to the City, in 1990 and 2007, there were a total of 4,790 acres of land designated as City land. The acreage of urban land was calculated by subtracting designated acres of open space (856) from the total designated area, yielding 3,934 designated acres of urban land in the City. It was assumed that for BAU, urban land acreage in 2020 is equal to urban land acreage in 2007.

[9] Loss of carbon stocks does not necessarily translate into an equivalent emission of CO_2 in the same manner as loss of annual carbon sequestration value. For example, when trees are cut and used in building products, the carbon in the wood fiber remains sequestered and is not released to the atmosphere. However, when carbon stock is burned or otherwise degrades, the carbon is released into the atmosphere, representing a one-time release of the CO_2 formerly bound up as stock.

Since there are no specific studies of urban tree carbon sequestration rates for the area, the California average sequestration rate was used to approximate annual sequestration rates in La Cañada Flintridge for 1990, 2007, and 2020, based on designated urban land area only, as reported in the City's draft General Plan, which is in the process of being updated. The California average sequestration rate for urban trees is 300 MT carbon/km^2 tree cover, or 1.2 MT carbon/acre tree cover (Nowak and Crane 2002). This analysis assumes that all acres of land designated as urban land-use types in the City by the General Plan (for each year of analysis) have equivalent rates of sequestration, which is likely not the case. In order to determine more accurate rates of sequestration for the City's urban area, a detailed urban forestry study would need to be performed.

Summary of Carbon Sinks

Table 14 presents sinks of CO_2 due to annual sequestration occurring in landfills, forests, and urban trees. Carbon sinks decrease slightly from 1990 to 2007 because less waste was landfilled in 2007, resulting in decreased landfill carbon storage. Carbon sinks increase slightly from 2007 to 2020 because more waste is landfilled in 2020, resulting in increased landfill carbon storage.

Table 14. Carbon Sinks for 1990, 2007, and 2020 for La Cañada Flintridge

Sector	1990	2007	2020
Landfill Carbon Sinks ($MTCO_2e$)			
Commercial Waste	(916)	(709)	(749)
Residential Waste	(1,667)	(1,291)	(1,363)
Total Sinks ($MTCO_2e$)	**(2,583)**	**(2,000)**	**(2,112)**
Forest Land (Open Space)			
Designated Acres	746	746	746
Annual Sequestration (MT carbon)[1]	211	211	211
Annual Sequestration ($MTCO_2e$)	775	775	775
Total Sinks ($MTCO_2e$)	**(775)**	**(775)**	**(775)**
Urban Forest			
Designated Urban Area (acres)	3,934	3,934	3,934
Urban Tree Cover (acres)[2]	984	984	984
Annual Sequestration (MT carbon)[3]	(1,194)	(1,194)	(1,194)
Annual Sequestration ($MTCO_2e$)	(4,377)	(4,377)	(4,377)
Total Carbon Sinks ($MTCO_2e$)	**(7,734)**	**(7,151)**	**(7,263)**

Note: carbon was converted to CO_2 using the ratio of the molecular mass of CO_2 to the molecular mass of carbon (3.67).

1 Based on mid-range value for oak hardwood forests (USCCP 2007; Forbes and Dakin).

2 Assumes 25 percent tree canopy cover.

3 Based on California average urban tree sequestration: 1.2 MT carbon/acre (Nowak and Crane 2002).

GOVERNMENT INVENTORY

This section presents the 1990 emissions estimate, 2007 inventory, and 2020 projected GHG emissions inventories for the City of La Cañada Flintridge Government operations, including data collection and calculation methodology. The results of the government inventory for 2007 in metric tons of carbon dioxide equivalent ($MTCO_2e$) are presented in Table 15 and Figure 5. Accounting for historical and projected population and economic growth, estimated 1990 and BAU emissions associated with City operations in 2020 are also presented in Table 15.

Figure 5. La Cañada Flintridge 2007 Government Inventory

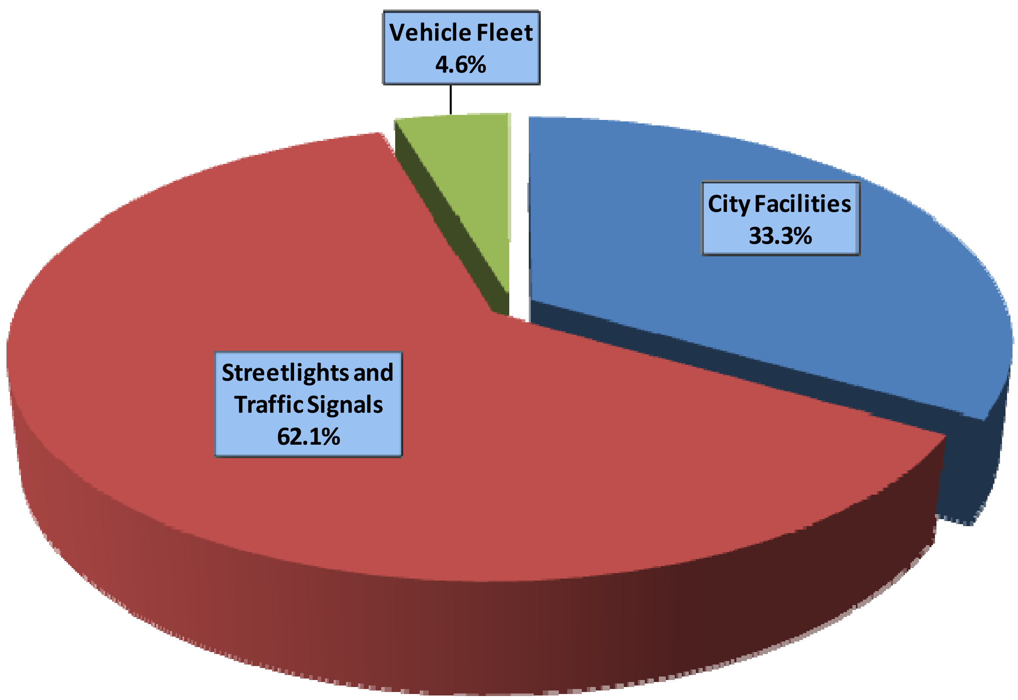

Table 15. La Cañada Flintridge Government Emissions Summary

La Cañada Flintridge 1990 Estimate, 2007 Government Inventory and BAU (2020) Projections ($MTCO_2e$)						
Sector	**1990**		**2007**		**2020**	
	Emissions	**Percent**	**Emissions**	**Percent**	**Emissions**	**Percent**
City Facilities	29.9	21.7	48.9	33.3	51.4	30.6
Streetlights and Traffic Signals	107.9	78.3	91.2	62.1	106.7	63.5
Vehicle Fleet	0.0	0.0	6.7	4.6	10.0	6.0
Total	**137.8**	**100.0**	**146.8**	**100.0**	**168.1**	**100.0**

City Facilities

Energy use for buildings and facilities owned and operated by the City Government of La Cañada Flintridge accounts for approximately 33 percent of the City's total emissions in 2007. Energy consumption includes electricity and natural gas. The City owns two buildings: City Hall and the Lanterman House. Electricity and natural gas data were obtained from the City. Electricity and natural gas consumption quantities were multiplied by the appropriate emission factors presented in Table 1 to determine GHG emissions.

1990 and 2020 emissions were estimated based on the number of City employees in 1990 and the projected number of city employees in 2020, relative to the number of city employees in 2007. The City had 19 employees in 1990 and currently has 39 employees. The City expects to expand their workforce to 41 employees by 2020. Using historical energy use data for City facilities to estimate 1990 emissions would be more appropriate, but this data was unavailable.

City Facility Emissions

Table 16 presents building energy use emissions for the La Cañada Flintridge City government. City Facility emissions increase from 1990 to 2020 because the number of City employees has increased since 1990 and is expected to increase slightly by 2020. It is expected that building energy use for buildings and facilities approximately scales with the number of City employees, and thus increases over time.

Table 16. City Facility Emissions for 1990, 2007, and 2020 for the La Cañada Flintridge City Government

Data/Emissions	1990	2007	2020
Electricity Use (kWh)	70,105	143,900	151,279
Natural Gas Use (therms)	647	1,328	1,396
CH_4 Emissions (kg)	0.28	2.13	2.24
N_2O Emissions (kg)	0.12	0.31	0.32
SF_6 Emissions (kg)	0.04	0.02	0.02
CO_2 Emissions (kg)	29,017	48,226	50,699
Total Emissions ($MTCO_2e$)	**29.9**	**48.9**	**51.4**

Source: CCAR 2009b; USEPA 2008.

Streetlights and Traffic Signals

Energy use for streetlights and traffic signals owned and operated by the City Government of La Cañada Flintridge accounts for approximately 62 percent of the City's total emissions in 2007. Energy consumption includes electricity which was obtained from the City. Electricity consumption quantities were multiplied by the appropriate emission factors presented in Table 1 to determine GHG emissions.

1990 and 2020 emissions were estimated based on miles of road within the City. Roadway miles were available for the years 1996-2007, so 1990 and 2020 roadway miles were estimated based on the linear growth trend of roadway miles from 1996-2007.

Streetlight and Traffic Signal Energy Use Emissions

Table 17 presents streetlight and traffic signal energy use emissions for the La Cañada Flintridge City government. Streetlights and traffic signals emissions decrease from 1990 to 2007 because of the higher CO_2 emission factor for electricity in 1990 (see Table 1). Emissions increase slightly from 2007 to 2020 because the number of roadway miles within the city is expected to increase and the electricity emission factors are assumed to remain constant. It is expected that streetlight and traffic signal energy use approximately scales with the miles of roadway within the City, and thus increases over time.

Table 17. Streetlight and Traffic Signal Energy Use Emissions for 1990, 2007, and 2020 for the La Cañada Flintridge City Government

Data/Emissions	1990	2007	2020
Electricity Use (kWh)	285,551	313,605	366,769
CH_4 Emissions (kg)	0.87	4.35	5.09
N_2O Emissions (kg)	0.48	0.64	0.75
SF_6 Emissions (kg)	0.15	0.05	0.06
CO_2 Emissions (kg)	104,207	89,743	104,957
Total Emissions ($MTCO_2e$)	**107.9**	**91.2**	**106.7**

Source: CCAR 2009b; USEPA 2008.

Vehicle Fleet

Vehicle fleet emissions for vehicles owned and operated by the City Government of La Cañada Flintridge accounts for approximately 5 percent of the City's total emissions in 2007. These emissions are associated with fuel combustion. Fuel consumption data were obtained from the City and consumption quantities were multiplied by the appropriate emission factors presented in Table 1 to determine GHG emissions. The City owns two vehicles, one of which is a hybrid.

The City did not own or operate any vehicles in 1990. The City expects to add one vehicle to their fleet by 2020, resulting in an estimated 50 percent growth in vehicle fleet emissions.

Vehicle Fleet Emissions

Table 18 presents vehicle fleet emissions for the La Cañada Flintridge City government. Vehicle fleet emissions increase from 1990 to 2020 because the City had no vehicles in 1990 and the City plans to add one vehicle to their fleet by 2020. It is expected that adding one vehicle to the City's two vehicle fleet will result in a 50 percent increase in 2007 emissions by 2020.

Table 18. Vehicle Fleet Emissions for 1990, 2007, and 2020 for the La Cañada Flintridge City Government

Sector	1990	2007	2020
Gasoline Consumption (gallons)	0.0	736	1,104
CH_4 Emissions (kg)	0.0	1.17	1.76
N_2O Emissions (kg)	0.0	1.17	1.76
CO_2 Emissions (kg)	0.0	6,294	9,441
Total Emissions ($MTCO_2e$)	**0.0**	**6.7**	**10.0**

Source: ARB et al. 2008.

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