CITY OF ONTARIO

Community Climate Action Plan

Appendix A

City of Ontario 2008 Community Greenhouse Gas Emissions Inventory and 2020 Forecast

City of Ontario 2008 Community Greenhouse Gas Emissions Inventory and 2020 Forecast

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City of Ontario

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Acronyms and Abbreviations

AB	Assembly Bill
BAU	business as usual
BOD	biochemical oxygen demand
CAPCOA	California Air Pollution Control Officer's Association
CARB	California Air Resources Board
CEC	California Energy Commission
CH_4	methane
CIWMB	California Integrated Waste Management Board
CO_2	carbon dioxide
County	San Bernardino County
DEIR	Draft Environmental Impact Report
EPA	U.S. Environmental Protection Agency
FMMP	Farmland Mapping and Monitoring Program
FOD	First Order Decay
GIS	Geographic Information Systems
GWP	global warming potential
GHG	greenhouse gas
GHG:ID	Greenhouse Gas Inventory Database
HCFCs	halogenated fluorocarbons
HFCs	hydrofluorocarbons
IEUA	Inland Empire Utilities Agency
IPCC	Intergovernmental Panel on Climate Change
k-value	first order decay rate constant for landfill methane equation (1/year)
kWh	kilowatt-hour

LMOP	Landfill Methane Outreach Program
LGOP	Local Governments Operations Protocol
$MTCO_2e$	metric tons of carbon dioxide equivalent
MG	million gallons
NMC	New Model Colony
N_2O	nitrous oxide
ODS	ozone depleting substances
PFCs	perfluorinated carbons
RTAC	Regional Target Advisory Committee
SANBAG	San Bernardino Associated Governments
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SCAG	Southern California Association of Governments
SCE	Southern California Edison
SCG	Southern California Gas Company
SWP	State Water Project
TAZ	Traffic Analysis Zone
UNFCCC	United Nations Framework Convention on Climate Change
UWMP	Urban Water Management Plan
WIP	waste in place
WARM	Waste Reduction Model
WWTP	wastewater treatment plant
WER	water-energy relationship

1. Executive Summary

The City of Ontario (City) faces a demanding challenge to meet the targets established by the State of California to address global warming, through the requirements of Assembly Bill (AB) 32[1] and Senate Bill (SB) 375[2]. In response to these initiatives, the City is seeking to reduce greenhouse gas (GHG) emissions associated with its regional activities. In addition, the City is participating in a partnership with the San Bernardino Associated Governments (SANBAG) and many cities in San Bernardino County (County) to evaluate and achieve GHG emissions reductions in the County. The City has committed to undertake the following actions that will reduce GHG emissions associated with its community activities.

- Prepare a current year (2008) GHG emissions inventory for the City's community activities (Community Inventory).
- Prepare a future year (2020) GHG emissions estimate (or forecast) for the City's community activities.
- Adopt a GHG Emissions Reduction Plan that will include measures to reduce GHG emissions from community activities and that will seek to reduce emissions by at least 30% by 2020 "business as usual" (BAU) emissions[3].

In January 2010, the City approved The Ontario Plan, which provides a framework for the future community of Ontario (City of Ontario 2010). The Ontario Plan incorporates many policies and measures to improve the City's sustainability and reduce GHG emissions from City activities. The City also prepared a Draft Environmental Impact Report (DEIR) to evaluate the potential for implementation of The Ontario Plan to affect or be affected by global climate change (City of Ontario 2009). As part of the DEIR, the City conducted a community inventory for the year 2006. The Ontario Plan, DEIR, and a comparison of the 2006 inventory to the 2008 inventory are discussed in Section 2.1, *Inventory Background*.

This 2008 Community Greenhouse Gas Emissions Inventory summarizes emissions for the City of Ontario. Emissions were calculated for sectors as identified by AB 32 in the bullet above, as well as additional subsectors, including building energy use (natural gas and electricity in the residential, commercial, and industrial sectors), stationary fuel combustion (fuels besides natural gas, including industrial activities), light- and medium-duty vehicles, heavy-duty vehicles, off-road equipment, landfills and waste generation, wastewater treatment, water consumption, and agriculture (fugitive emissions from livestock and fertilizer). This 2008 inventory is a baseline from which to forecast future year 2020 emissions and establish GHG reduction targets. The 2020 emissions estimate, or forecast, represents BAU emissions. GHG reduction targets will be evaluated in subsequent documents, from which the City will develop GHG reduction goals and create a policy framework to support control and ultimate reduction of GHG emissions from the City's community activities.

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[1] In 2006, California passed 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% below current levels.

[2] SB 375 requires regional transportation plans, developed by metropolitan planning organizations (MPOs) to incorporate a "sustainable communities strategy" (SCS) in their regional transportation plans (RTPs).

[3] This plan must comply with the recommendations for local community emissions outlined in AB 32. The Plan must include climate action measures for the following sectors (as identified in AB 32): building energy, water, transportation, goods movement, waste, and stationary fuel combustion.

This report provides background information on GHG emissions in the City, the methodology used to prepare the inventory, and inventory results for each emissions sector listed above. GHGs in this inventory include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

1.1 Inventory Definitions

Community Inventory. The community inventory includes GHG emissions occurring within the City of Ontario's geographic or jurisdictional boundaries and generally consists of sources of emissions that the City's community can influence or control[4]. The boundaries of the community inventory are geographic; emissions included, or activities associated with emissions, must occur inside of the jurisdictional boundary of the City. The year 2008 was chosen for the current community inventory because it was the most recent year with the necessary data to perform a comprehensive inventory and because it is consistent with the subregional efforts. The 2020 emissions projection represents BAU emissions associated with the City's activities in 2020.

Municipal Inventory. The municipal inventory includes GHG emissions associated with the City's services and municipal operations. This inventory is not calculated or presented in this report but is under development.

Some emission sources are included in both inventories, as there are overlaps in the operational boundaries of the two inventories. For example, in the community inventory, light–medium-duty vehicle emissions include emissions from all light–medium-duty vehicles traveling in the City. The corresponding municipal inventory category is vehicle fleet emissions, which operate mostly in the City but also may operate outside City boundaries. The overlap between the community and municipal inventories for this sector involves those City vehicle emissions that occur in the City as these emissions are accounted for in the transportation modeling. Emissions from City vehicles traveling outside City boundaries are included in the municipal inventory but not the community inventory because they are under the City's municipal jurisdiction but are not included in the transportation modeling.

Unit of Measure. The unit of measure used throughout this GHG inventory is the metric ton (MT) of CO_2 equivalent (CO_2e) This is the international unit that combines the differing impacts of all GHGs 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 GHG contributes to global warming. GWP compares the relative warming effect of the GHG in question to CO_2.[5]

Emissions Type. 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 residential electricity use that occur at the

[4] The Ontario International Airport was not included in the inventory because Ontario and its community have little to no jurisdiction over operations at the airport.

[5] 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: CO2 = 1, CH4 = 21, N2O = 310, SF6 = 23,600 (Intergovernmental Panel on Climate Change 1996; United Nations Framework Convention on Climate Change 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 (Intergovernmental Panel on Climate Change 2007; U.S. Environmental Protection Agency 2010a).

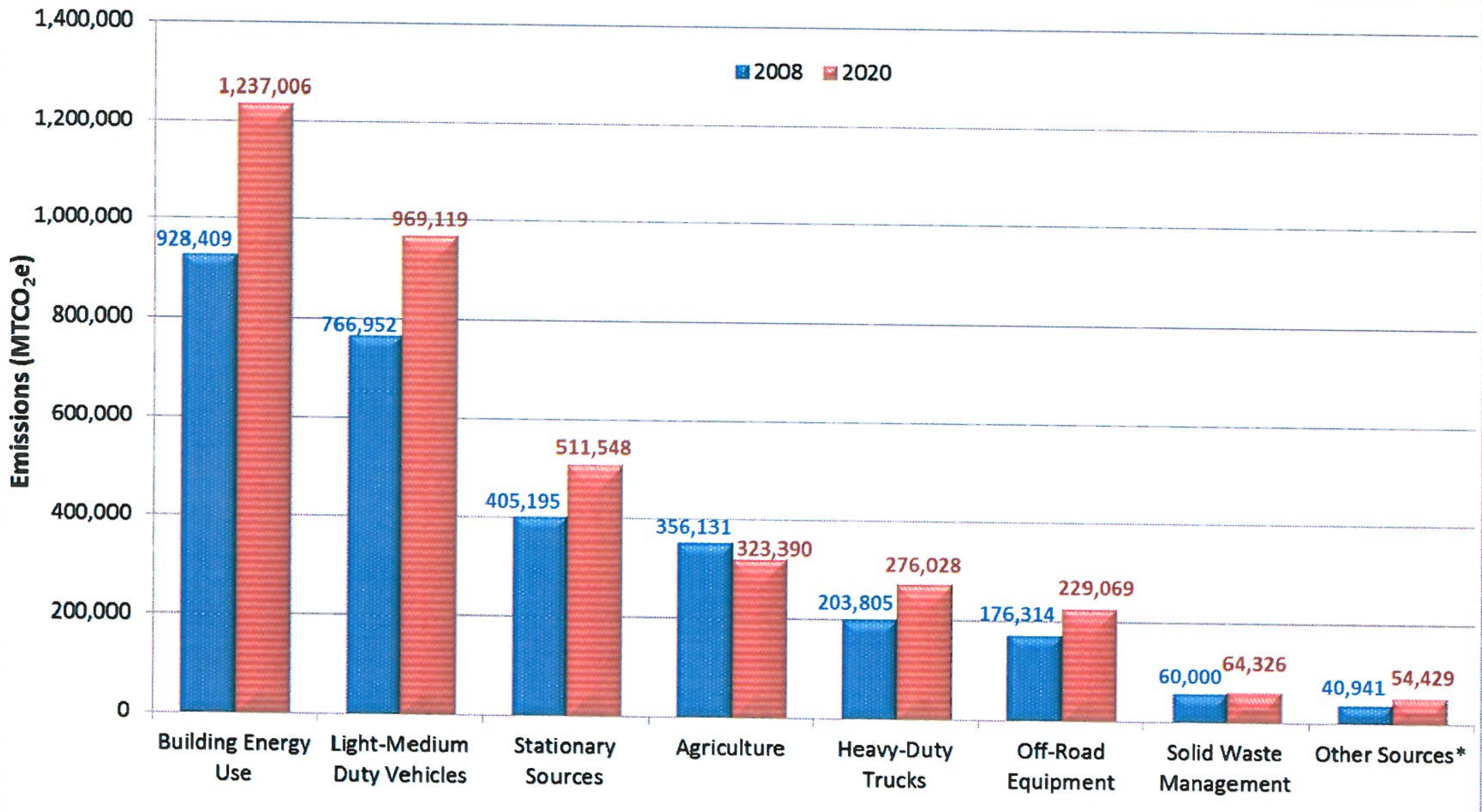
power plant itself but result from in-home appliance or other use). This report addresses both types of emissions. In addition, all references to emissions are referring to GHG emissions, not to emissions of air quality pollutants.

1.2 Inventory Results

In 2008, the largest source of community emissions for the City was building energy use, which represented 31.6% of total community emissions for 2008. This sector includes emissions associated with natural gas combustion and electricity consumption in residential, commercial, and industrial buildings in Ontario. Transportation emissions are often the largest source of emissions in community inventories, and Ontario is no exception. The second largest source of emissions was light–medium-duty vehicle emissions, which accounted for 26.1% of total community emissions for 2008. The third and fourth largest sources were stationary sources and agriculture, with a contribution of 13.8% and 12.1% of the total 2008 emissions, respectively. Stationary sources included combustion of fuels at industrial facilities and fugitive emissions from industrial processes. Agricultural emissions result from crop fertilizer use and from livestock. The remaining sources in order of greatest contribution were heavy-duty vehicles (6.9%), off-road equipment (6.0%), solid waste management (2.0%), water conveyance (1.0%), wastewater treatment (0.2%) and SF_6 emissions from electricity consumption (0.2%). Figures 1 and 2 present all GHG emissions for the City for 2008.

Community-wide, emissions are projected to increase by approximately 25% from 2008 to 2020. The increase from 2008 to 2020 will occur primarily because of an increase in building energy use, stationary source emissions, and vehicle miles traveled (VMT). As the population and employment in Ontario grow, energy consumption, industrial activity, and transportation increase. Emissions from all other sectors except agriculture will increase under the BAU scenario by 2020 because of growth in the City across all economic sectors (agricultural activity is expected to decline in the future). Emissions from individual sectors are discussed in more detail below. Figures 1 and 2 present the 2020 BAU forecast. Figure 3 presents a breakdown of minor GHG sources for 2008 and 2020, which are combined as *other sources* in Figure 1. Table 1 shows emissions for each sector and their contributions to the total inventory.

Figure 1. City of Ontario Community 2008 GHG Inventory and 2020 BAU Forecast – *By Sector*



** Other sources include Water Transport, Distribution, and Treatment; Wastewater Treatment; and SF6 from Electricity Consumption.*

Figure 2. City of Ontario Community 2008 GHG Inventory and 2020 BAU Forecast – *Total Emissions*

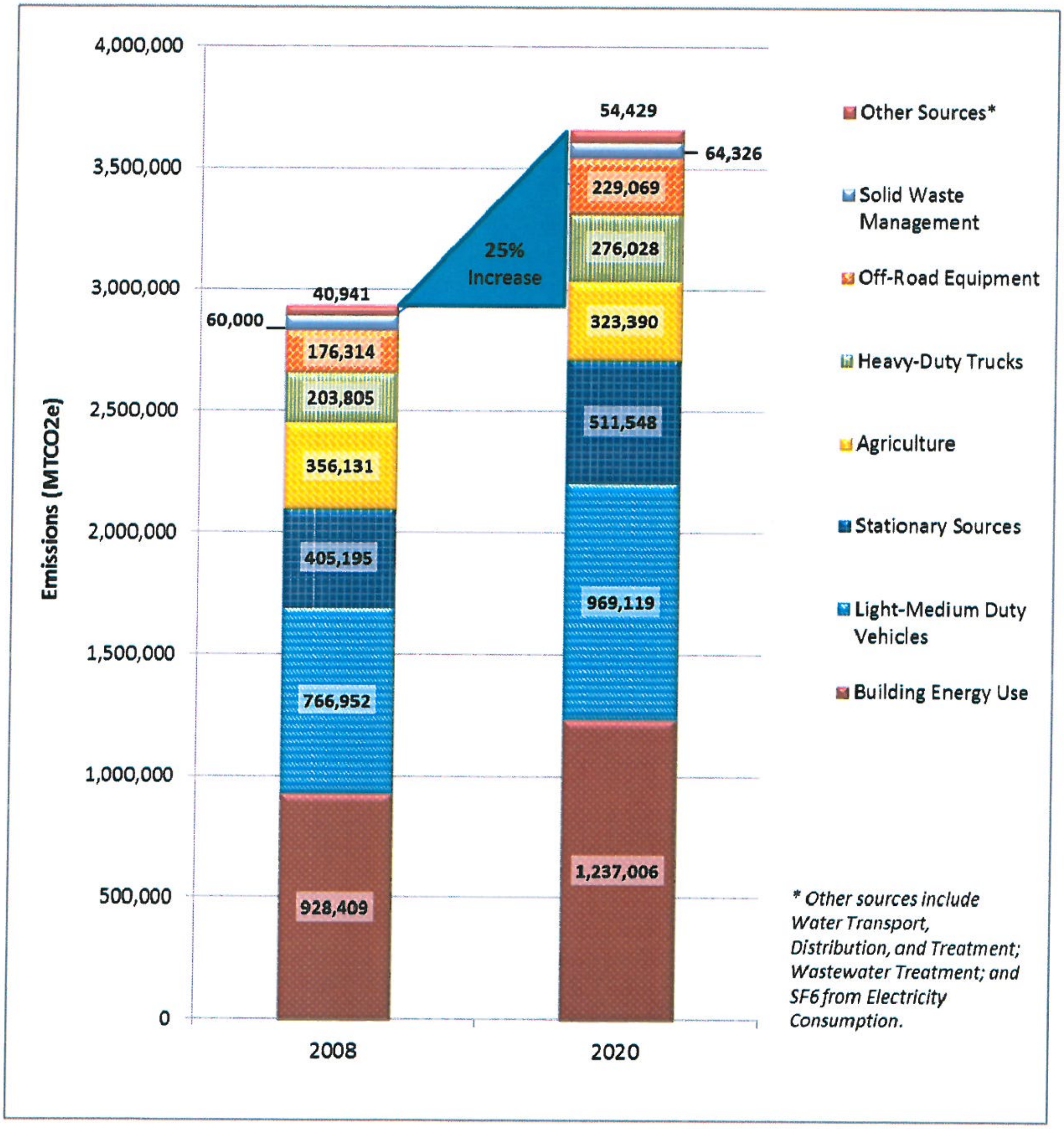


Figure 3. City of Ontario 2008 Community GHG Inventory and 2020 BAU Forecast – *Other Sources*

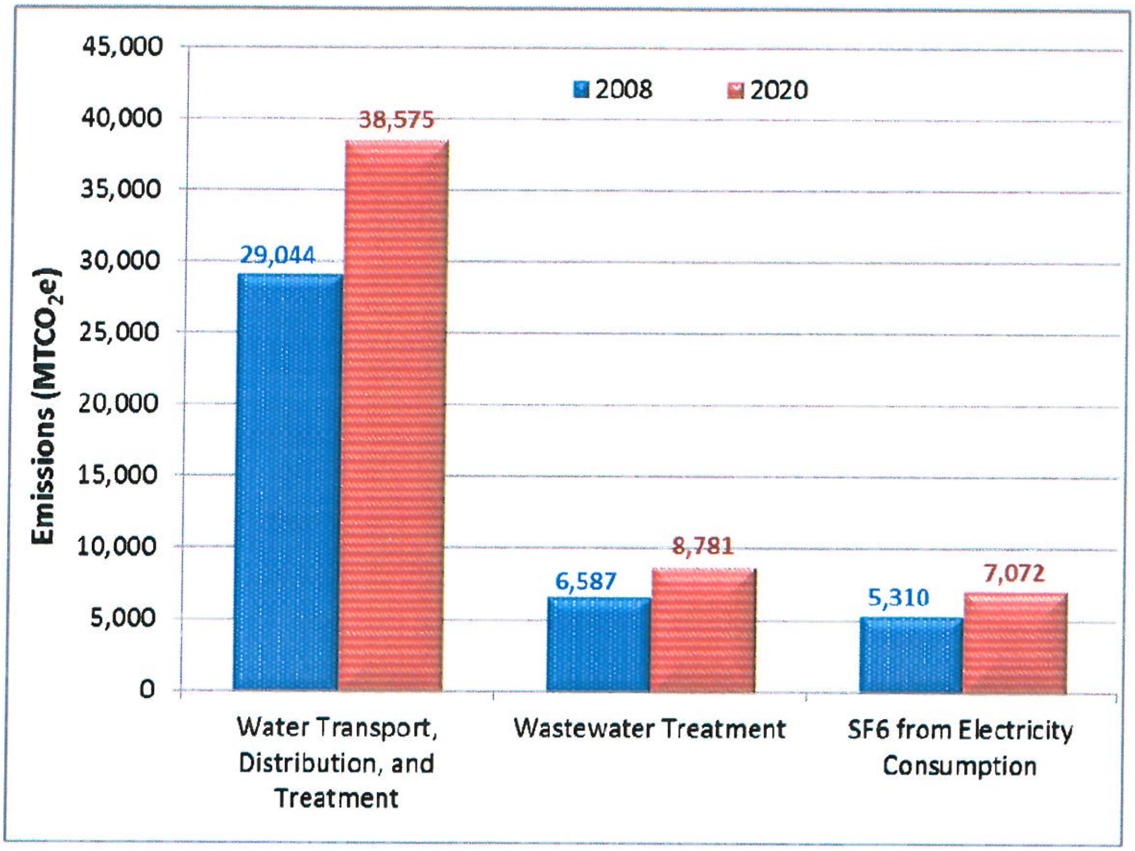


Table 1. City of Ontario 2008 Community GHG Inventory and 2020 BAU Forecast by Sector

Scope and Sector[1]	Description of Sector	2008 Inventory Emissions ($MTCO_{2}e$)	2008 Inventory Percent	2020 BAU Forecast Emissions ($MTCO_{2}e$)	2020 BAU Forecast Percent	Percent Increase from 2008 to 2020
Scope 1 Emissions	**Direct Emissions**					
Residential natural gas	Natural gas combustion	95,327	3.2%	130,539	3.6%	36.9%
Commercial/industrial natural gas	Natural gas combustion	368,456	12.5%	487,494	13.3%	32.3%
Stationary sources	Other fuels and processes	405,195	13.8%	511,548	14.0%	26.2%
Light and medium-duty vehicles	Vehicle fuel combustion	766,952	26.1%	969,119	26.4%	26.4%
Heavy-duty vehicles	Vehicle fuel combustion	203,805	6.9%	276,028	7.5%	35.4%
Off-road equipment	Off-road equipment	176,314	6.0%	229,069	6.3%	29.9%
Agriculture	Livestock and fertilizer	356,131	12.1%	323,390	8.8%	-9.2%
Subtotal Scope 1		**2,372,180**	80.7%	**2,927,188**	79.9%	15.3%
Scope 2 Emissions	**Indirect Emissions**					
Residential electricity	Electricity use	91,231	3.1%	124,930	3.4%	36.9%
Commercial/industrial electricity	Electricity use	373,395	12.7%	494,042	13.5%	32.3%
Solid waste management	Solid waste decomposition	60,000	2.0%	64,326	1.8%	7.2%
Wastewater treatment	Liquid waste treatment	6,587	0.2%	8,781	0.2%	33.3%
Water transport, distribution, and treatment	Electricity for water supply	29,044	1.0%	38,575	1.1%	32.8%
SF_6 from electricity consumption	Electrical transformers	5,310	0.2%	7,072	0.2%	33.2%
Subtotal Scope 2		**565,568**	19.3%	**737,727**	20.1%	30.4%
Total Scopes 1 and 2		**2,937,747**	100%	**3,664,915**	100%	24.8%

[1] Refer to Section 3.1, *Inventory Protocols* for a detailed discussion of scopes.

BAU = business as usual.

SF_6 = sulfur hexafluoride.

1.3 Inventory Limitations and Recommendations

This inventory serves as a baseline for emission reduction measures and as a starting point for future GHG emissions inventories. Future updates to the GHG emissions inventory presented in this report will be conducted every 3 years. Frequent inventory updates ensure that the inventory remains accurate and that data gaps are resolved in a timely manner, and enable efficient tracking of the effectiveness of any GHG reduction measures put in place to address these emission sources.

Although considerable efforts were made to obtain activity data from 2008, the inventory base year, in some cases these data were unavailable and data from another year were substituted (e.g., stationary source data for 2007 were scaled to 2008). Changes in emissions or activity from one year to the next are expected to be relatively minor, so any substitution in data will have a small effect on the inventory. In addition, data obtained for certain sectors were provided in an aggregated format. For example, building energy use data provided by the major utilities supplying electricity and natural gas to the City were aggregated by general sector (residential or commercial plus industrial) instead of by specific activity or entity. Commercial and industrial data had to be aggregated into one group to avoid confidentiality conflicts with large electricity users in the City. A greater level of detail and disaggregation would strengthen this inventory and greatly increase the potential for the City to identify, quantify, and monitor effective emission reduction actions. Specific data gaps and limitations are identified and discussed on a sector-by-sector basis below.

1.3.1 2020 Business as Usual Projection Limitations

Where possible, 2020 BAU projections were made using the best available information and estimates provided by City staff and experts on individual sectors. For many sectors (e.g., residential fuel combustion), projections were based on the future population estimate for the City using data provided by the Southern California Association of Governments (SCAG). This method assumes that emissions will remain proportionate to the current population, which may not be completely accurate. For example, per capita energy consumption may change over time as habits and technology change. For some sectors, especially where emissions are tied to infrastructure (e.g., stationary sources, agriculture) rather than population, estimates were made based on an anticipated maximum or buildout of infrastructure. It is possible that the ratio of certain emission sources (e.g., natural gas combustion in commercial buildings) to a quantity of infrastructure (e.g., commercial square feet) may change over time.

2. Introduction

The temperature on Earth is regulated by a system commonly known as the *greenhouse effect*. Greenhouse gases (GHGs) in the atmosphere absorb heat radiated from the earth's surface and reradiate that heat in all directions, including back to the surface. Without these gases, heat would escape the atmosphere and the temperature of the earth's surface would be much cooler. However, with too much of these gases, the amount of heat returning to the surface would continue to increase, leading to large-scale climatic changes. According to the U.S. Environmental Protection Agency (EPA), a GHG is any gas that absorbs infrared radiation in the atmosphere. Specifically, the following six GHGs are defined in Assembly Bill (AB) 32 and the California Environmental Quality Act (CEQA) guideline amendments: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Once emitted, GHGs remain in the atmosphere for decades or centuries and therefore can mix globally. Innumerable direct and indirect sources, both natural and anthropogenic, cause increased atmospheric concentrations of GHGs. The most common natural sources of GHGs include decomposition of organic matter and wildfires. Many human activities add to the levels of naturally occurring gases. When solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned, CO_2 is released to the atmosphere. Agricultural cultivation, industrial activities, and solid waste or fossil fuel combustion emit N_2O. CO_2 and N_2O are the two GHGs released in the greatest quantities from burning gasoline and diesel fuel in vehicles (mobile sources). CH_4, a highly potent GHG, results from off-gassing associated with agricultural practices and landfills, among other sources. The synthetic chemicals that form HFCs and PFCs are used to replace the ozone-depleting substances that are being phased out under the Montreal Protocol on Substances That Deplete the Ozone Layer (1987), an international agreement designed to protect the stratospheric ozone layer originally signed in 1987. Electric transmission and distribution systems emit SF_6, as do various industrial manufacturing processes.

As global, national, and state populations and economies have grown, anthropogenic emissions of GHGs have continued to increase. This increase is due primarily to the burning of fossil fuels for heating, cooking, and other consumer uses. The associated increases in atmospheric concentrations of GHGs are expected to 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 are sea-level rise, increased frequency and intensity of wildfires, decreased Sierra Nevada snowpack and associated consequences to water supply, changes in winter precipitation patterns and associated consequences to water supply, increased frequency and intensity of extreme heat events, and degradation in regional air quality as a result of warmer temperatures (California Energy Commission 2009; California Natural Resources Agency 2009).

2.1 Inventory Background

The City of Ontario (City) has committed to an in-depth review of emissions associated with activities in the community. The results of the community inventory for 2008 are presented in this report and define a baseline from which future emissions under business as usual (BAU) conditions can be projected. The 2020 emissions projection represents the BAU forecast and is based on anticipated growth in the City, specific to each inventory sector. The 2008 inventory is based on actual 2008 activity data and emission factors and includes all significant contributing sectors to GHG emissions, according to the guidelines of the California Air Resources Board

(CARB) Local Governments Operations Protocol (2010c), as stated below in Section 3.2, *Emission Factors*. This inventory was developed with detail sufficient to support identification of GHG reduction measures specific to the City's community emissions.

A BAU projection of community emissions was developed for the year 2020. 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), CARB, the California Department of Finance, and other appropriate data sources as listed in this report. The BAU projections do not assume the implementation of any federal, state, or local reduction measures but project the future emissions based on current energy and carbon intensity in the existing economy, consistent with CARB's analysis conducted for AB 32. The specific assumptions associated with the sector growth rates are provided in Table 2 below.

In January 2010, the City approved The Ontario Plan, which provides a framework for the future community of Ontario (City of Ontario 2010). The Ontario Plan incorporates many policies and measures to improve the City's sustainability and reduce GHG emissions from City activities. The City also prepared a Draft Environmental Impact Report (DEIR) to evaluate the potential for implementation of The Ontario Plan to affect or be affected by global climate change (City of Ontario 2009). The DEIR provides a comprehensive comparative analysis of the measures published by the California Air Pollution Control Officer's Association (CAPCOA) and the Attorney General to the policies contained in The Ontario Plan and mitigation measures incorporated into the DEIR. The Ontario Plan and the DEIR provide a comprehensive foundation for climate action planning in the City. This inventory aims to strengthen this foundation by providing a framework for the City's Climate Action Plan (CAP) subsequent to The Ontario Plan.

As part of The Ontario Plan and the DEIR, the City conducted a community inventory for the year 2006. The 2008 inventory provides additional refinements to the 2006 inventory in various ways. The key differences and refinements are discussed briefly in Table 2. Table 3 presents a comparison of emissions from each sector of the inventories, including percent changes. Major differences between the two inventories occur in the building energy sector (the 2006 inventory used electricity use factors instead of actual utility data), the stationary source sector (the 2006 inventory did not include these emissions), the off-road equipment sector (the 2006 inventory did not include these emissions), and the on-road transportation sector, including light- and medium-duty vehicles and heavy-duty vehicles (the 2006 inventory used an older model with different trip apportionment methodology).

Table 2. Methodology Comparison of the 2006 and 2008 Community Inventories for the City of Ontario

Sector	2006 Inventory Method	2008 Inventory Method	Main Improvement
Building electricity (residential, commercial, and industrial)	Electricity usage factors and emission rates from the U.S. Energy Information Administration	Actual electricity consumption from the utilities, and utility-specific emission factors	Utility data and emission factors
Building natural gas (residential, commercial, and industrial)[1]	URBEMIS[2] average natural gas usage rates and emission factors	Actual natural gas consumption from the utilities, and California Climate Registry emission factors	Utility data
Stationary sources	N/A	South Coast Air Quality Management District 2007 Inventory	New sector
Light- and medium-duty vehicles	SCAG 2006 RTP Model; all trips, including those with trip starts and ends outside of the City, are included (not consistent with methods described by the SB 375 RTAC)	Draft 2012 RTP on-road modeling from SCAG; travel data and VMT associated with TAZ zones, incorporating origin-destination information (consistent with methodology described by the SB 375 RTAC)	New Model and RTAC methodology
Heavy-duty trucks	Same as light- and medium-duty vehicles	Same as light- and medium-duty vehicles	New sector
Off-road equipment	N/A	OFFROAD2007 model	New sector
Agriculture	Dairy cattle operations in the NMC from an estimate of existing livestock in the City	Livestock counts for cattle and dairy cows, provided for the City. Swine counts for the County, apportioned using farmland data for Ontario. Also includes N_2O emissions from fertilizer.	Additional livestock and fertilizer
Solid waste management	Projected waste disposal and EPA's Waste Reduction Model (WARM)	Projected waste disposal and CARB's FOD Model	Regional model
Wastewater treatment	N/A	Inland Empire Utilities Data and CARB emission factors	New sector
Water transport, distribution, and treatment	Projected water demand and southern California energy-intensity factors from the 2005 California Energy Commission report *California's Water-Energy Relationship* (WER) (12,700 kWh/MG)	Projected water demand and southern California energy-intensity factors from the 2006 California Energy Commission report *Refining Estimates of Water-Related Energy Use In California* (WER) (13,022 kWh/MG)	Updated energy-intensity factors
SF_6 from electricity consumption	N/A	CARB emission factors and utility data for electricity consumption	New sector

Source: City of Ontario 2009.

[1] Called *Area Sources* in the 2006 inventory.

[2] URBEMIS is a computer program that can be used to estimate emissions associated with land development projects in California such as residential neighborhoods, shopping centers, and office buildings; area sources such as gas appliances, wood stoves, fireplaces, and landscape maintenance equipment; and construction projects. URBEMIS stands for *Urban Emissions Model*.

CARB = California Air Resources Board.
EPA = U.S. Environmental Protection Agency.
FOD = First-Order Decay model.
kWh/MG = kilowatt hours per million gallons.
N_2O = nitrous oxide.
NMC = New Model Colony
RTAC = Regional Target Advisory Committee.
RTP = Regional Transportation Permit.
SB = Senate Bill.
SCAG = Southern California Association of Governments
TAZ = Traffic Analysis Zone
VMT = vehicle miles traveled.

Table 3. Emissions Comparison of the 2006 and 2008 Community Inventories for the City of Ontario

Scope and Sector	2006	2008	Percent Change
Scope 1 Emissions			
Electricity	855,221	464,626	-45.7%[1]
Natural gas	207,533	463,783	123.5%[1]
Stationary sources	0[2]	405,195	N/A
On-road transportation	2,522,251	970,757	-61.5%[3]
Off-road equipment	0[2]	176,314	N/A
Agriculture	356,533	356,131	0.1%
Subtotal Scope 1	**3,941,538**	**2,836,806**	**-28.03%**
Scope 2 Emissions			
Solid waste management	56,298	60,000	6.6%
Wastewater treatment	0[2]	6,587	N/A
Water conveyance	50,394	29,044	-42.4%[4]
Sf_6 from electricity consumption	0[2]	5,310	N/A
Subtotal Scope 2	**106,692**	**100,942**	**-5.39%**
Total Scope 1 and 2	**4,048,230**	**2,937,747**	**-27.43%**

[1] The large change is because the 2006 inventory used average energy usage factors and emission rates, while the 2008 inventory used actual energy consumption data from the utilities.

[2] The 2006 inventory did not include emissions from these sources.

[3] The large change is because the 2006 inventory incorporated vehicles trips with starts and ends outside the City, while the 2008 inventory includes 100% of trips that begin and end within the City and 50% of trips that begin in the City and end outside the City, and 50% of trips that end in the City and begin outside the City.

[4] The change is due to updated methodology for calculating water emissions.

2.1.1 Purpose of the Inventory

The purpose of the inventory is threefold. First, the 2008 inventory allows for a projection of BAU emissions for 2020 to identify the total reductions necessary to achieve AB 32 and Senate Bill (SB) 375 goals, as well as the City's more stringent goal of reducing GHG emissions from community activities by at least 30% by 2020. Second, City officials will be able to identify the major contributing sectors or emissions categories of the City's community emissions. Third, candidate measures for reducing emissions can be determined and will be used for the development of the community CAP.

2.2 City of Ontario Background

The City of Ontario covers more than 50 square miles and is home to the Ontario International Airport[6] and the Ontario Mills Mall, southern California's largest outlet shopping mall, entertainment center, and one of its largest tourist attractions. The City is the fourth most populous in San Bernardino County (County), behind the cities of San Bernardino, Fontana, and Rancho Cucamonga. The County itself is home to 24 incorporated cities and is the fifth most populous county in California. As of January 1, 2011, the California Department of Finance estimated the population of Ontario at 165,392 (California Department of Finance 2011). In 2008 (the baseline year for the inventories), the City's total population was 162,871 (Southern California Association of Governments 2012). The City is anticipated to grow dramatically from 2008 to 2020, increasing housing by 37%, retail jobs by 23%, and nonretail jobs by 44% (Southern California Association of Governments 2010). These growth rates account for the current economic recession.

This report describes the data sources and methods used to calculate community GHG emissions for the City as well as the actual emissions inventory. The boundaries of the inventory are defined as geographic (i.e., jurisdictional or city limits). Emissions for a particular source were included in the City's inventory if either the source of emissions occurs within the geographic boundaries of the City, or the emissions are a result of the City's community activity but occur outside of the City's geographic boundary (such as emissions occurring at distant power plants as a result of residential electricity consumption in the City).

[6] The Ontario International Airport was not included in the inventory because Ontario and its community have little to no jurisdiction over operations at the airport.

3. Methodology

This section presents the methodology used to prepare the GHG emissions inventory for the year 2008. This section discusses the inventory protocols, emission factors, inventory boundaries, and analysis methods.

3.1 Inventory Protocols

A number of widely accepted protocols for estimating GHG emissions were used to prepare the community inventory. The protocols used in the development of this inventory include those following.

- **California Air Resources Board Local Governments Operations Protocol** (2010c). 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 and General Reporting Protocol** (2009a). This protocol provides guidance for preparing GHG inventories in California.
- **California Air Resources Board Greenhouse Gas Inventory Data 1990–2006** (2010a). This documentation provides background methodology, activity data, protocols, and calculations used for California's statewide inventory.
- **California Energy Commission Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004** (2006a). This inventory provides methodology and emission factors for statewide GHG emissions inventorying.
- **U.S. Environmental Protection Agency Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008** (2010a). This inventory provides methodology and emission factors for nationwide GHG emissions inventories, which are applied in absence of state or local methodology.
- **Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories** (2006a). This document is the international standard for inventories and provides much of the baseline methodology used in the national and statewide emission inventories.

The Local Governments Operations Protocol categorizes local government emission sources as Scope 1 (direct), Scope 2 (indirect), and Scope 3 (other indirect). The protocol defines these emissions as follows (California Air Resources Board 2010a).

- **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 and 2 emissions were quantified and included in the community inventory. For example, direct emissions associated with on-site natural gas use are included in Scope 1 because these emissions occur within the City and are subject to the community's influence or control. Indirect GHG emissions associated with electricity use are included in Scope 2 because these emissions can occur outside the City but are subject to the community's influence or control. Inclusion of Scope 3 emissions in the inventory is optional, and the City elected not to include them.

3.2 Emission Factors

Emission factors and references are summarized in Table 4. These emission factors were used to calculate GHG emissions from activity data, such as kilowatt-hours (kWh) of electricity consumed for lighting or gallons of gasoline fuel combusted for light- and medium-duty vehicle transportation.

Table 4. Greenhouse Gas Emission Factors

Source	Emission Factor	Reference
Energy and Stationary Fuels		
Electricity[1]	0.28617 kg CO_2/kWh[2]	CCAR 2009b (2007 data)
	0.309 kg CO_2/kWh[3]	EPA 2010b (2007 data)
	0.000013 kg CH_4/kWh	EPA 2010b (2007 data)
	0.000003 kg N_2O/kWh	EPA 2010b (2007 data)
Natural Gas[4]	53.3 kg CO_2/GJ	IPCC 2006a
	0.005 kg CH_4/GJ	IPCC 2006a
	0.0001 kg N_2O/GJ	IPCC 2006a
Vehicle Fuels		
Diesel[5]	10.15 kg CO_2/US gallon	CCAR 2009a
	0.00015 kg CH_4/US gallon	IPCC 2006a
	0.00015 kg N_2O/US gallon	IPCC 2006a
Gasoline[5]	8.78 kg CO_2/US gallon	CCAR 2009a
	0.00013 kg CH_4/US gallon	IPCC 2006a
	0.0002 kg N_2O/US gallon	IPCC 2006a
Propane[5]	5.79 kg CO_2/US gallon	CCAR 2009a
	0.000992 kg CH_4/US gallon	CCAR 2009a; NAFA 2010
	0.002631 kg N_2O/US gallon	CCAR 2009a; NAFA 2010
Compressed natural gas (CNG)[6]	1.906992 kg CO_2/m^3	IPCC 2006a
	0.011127 kg CH_4/m^3	IPCC 2006a
	0.00099kg N_2O/m^3	IPCC 2006a
Ethanol[5]	1.329026 kg CO_2/US gallon	EIA 2010
	0.000782 kg CH_4/US gallon	EPA 2010c; Cal EPA 2009
	0.000952 kg N_2O/US gallon	EPA 2010c; Cal EPA 2009
Water-Related Electricity Intensities for Southern California[7]		
Water supply and conveyance	9,727 kWh/MG	CEC 2006b
Water treatment	111 kWh/MG	CEC 2006b
Water distribution	1,272 kWh/MG	CEC 2006b

Source	Emission Factor	Reference

[1] Emission factors are presented in is kilograms (kg) of each GHG per kilowatt hour (kWh) of electricity.
[2] Emission factor applies to electricity delivered to Southern California Edison (SCE) customers.
[3] Emission factor applies to electricity delivered to all other utility customers.
[4] Emission factors are presented in is kilograms (kg) of each GHG per gigajoule (GJ) of natural gas.
[5] Emission factors are presented in is kilograms (kg) of each GHG per U.S. gallon of fuel.
[6] Emission factors are presented in is kilograms (kg) of each GHG per cubic meter (m^3) of CNG.
[7] Electricity intensities are presented in kilowatt hours (kWh) of electricity per million gallons (MG) of water.

Cal-EPA = California Environmental Protection Agency
CCAR = California Climate Action Registry.
CEC = California Energy Commission.
EIA = Energy Information Administration.
EPA = U.S. Environmental Protection Agency.
GJ = gigajoule.
IPCC = Intergovernmental Panel on Climate Change.
kg = kilogram
kWh = kilowatt hours
m^3 = cubic meters.
MG = million gallons
NAFA = National Association of Fleet Administrators.

3.3 Analysis Methods

The following emissions sectors are included in the inventory. These include the emissions sectors as identified by AB 32 in the Executive Summary above, as well as additional subsectors (e.g., residential is a subsector of building energy). The data source for each emission sector also is listed.

- **Residential—Scopes 1 and 2:** Natural gas and electricity consumption for the residential sector. Data provided by utilities.
- **Commercial/Industrial—Scopes 1 and 2:** Natural gas and electricity consumption for the commercial and industrial sector combined. Data provided by utilities.
- **Stationary Sources—Scope 1:** Fuel combustion, industrial process emissions etc. Data provided by the South Coast Air Quality Management District (SCAQMD) County-wide inventory for 2007 and 2020 and by CARB.
- **Light- and Medium-Duty Vehicles—Scope 1:** Fuel consumption for light- and medium-duty vehicles in the City. VMT data provided by SCAG and supplemented with vehicle data from CARB's EMFAC model.
- **Heavy-Duty Vehicles—Scope 1:** Fuel consumption for heavy-duty vehicles in the City. VMT data provided by SCAG and supplemented with vehicle data from CARB's EMFAC model.
- **Off-Road Equipment—Scope 1:** Fuel consumption for off-road vehicles and equipment in City. Data provided by the OFFROAD model.
- **Agriculture—Scope 1:** Enteric fermentation and manure management from agricultural operations as well as N_2O emissions from fertilizer application. Data provided by the Regional Water Quality Control Board, Santa Ana Region, and the Department of Food and Agriculture's Production Statistics.
- **Solid Waste Management—Scope 2:** CH_4 emissions from waste generated by the community and deposited in landfills. Data provided by CalRecycle.
- **Wastewater Treatment—Scope 2:** Fugitive emissions from domestic wastewater treatment. Data provided by the Inland Empire Utilities Agency (IEUA) and CARB.

- **Water Transport, Distribution, and Treatment—Scope 2:** Electricity consumption associated with water importation. Data provided by the Ontario 2005 Urban Water Management Plan and the California Energy Commission (CEC).
- **SF_6 from Electricity Consumption—Scope 2:** fugitive emissions of SF_6 from the transport of electricity to the City. Data provided by utilities and CARB.

The inventory was conducted primarily using ICF's proprietary Greenhouse Gas Inventory Database (GHG:ID) tool and supplemented with additional emissions calculations. The GHG:ID tool conforms to widely accepted protocol and provides a robust platform for emissions evaluation.

Table 5 presents the emissions sectors included in the community inventory; the data source for each emission sector; details on the methodology for scaling emissions to the City from County- or state-wide resources, as appropriate; and the methodology for projecting emissions to 2020. Population, housing, and employment data for both 2008 and 2020 are presented in Table 6.

Table 5. Community Inventory Data Sources and Methodology

Sector	Emission Sources	Source of Data (Data Level)	Scaling Methodology to City Level	Projection Methodology	Growth Factor
Stationary sources	Fuel combustion Industrial process emissions	SCAQMD (County-wide data)	City population and employment	Population and employment growth forecasts[1]	1.26
Residential	Electricity consumption Natural gas consumption Other fuel consumption by type (natural gas, liquefied petroleum gas, fuel oil, diesel, gasoline, etc.)	Electricity records from utilities (City-level data)[2] Gas records from utilities (City-level data)[3]	None	Growth in households	1.37
Commercial/industrial	Electricity consumption Natural gas consumption Other fuel consumption by type (natural gas, liquefied petroleum gas, fuel oil, diesel, gasoline, etc.)	Electricity records from utilities (City-level data)[2] Gas records from utilities (City-level data)[3]	None	Growth in total employment	1.32
Light- and medium-duty Vehicles	Fuel combustion in light- and medium-duty on-road vehicles	SCAG Draft 2012 RTP modeling	None	SCAG Draft 2012 RTP forecast	1.26
Heavy-duty vehicles	Fuel combustion heavy-duty vehicles	SCAG Draft 2012 RTP modeling		SCAG Draft 2012 RTP forecast	1.35
Off-road equipment	Off-road equipment fuel combustion	OFFROAD2008 (County-level data)	City population and employment	Population and employment growth forecasts[1]	1.30
Agricultural emissions	Enteric fermentation, manure management, and fertilizer application	Regional Water Quality Control Board livestock counts (City-level data) Department of Food and Agriculture's Production Statistics (County-level data)	Quantity of dairy, cattle, and swine; grazing land use	Linear projection of farmland acreage from 2008 to 2050.	0.91

Sector	Emission Sources	Source of Data (Data Level)	Scaling Methodology to City Level	Projection Methodology	Growth Factor
Solid waste management	Methane emissions from landfilled waste	City SWMD (City-level data) CalRecycle (City-level data) EPA Landfill Methane Outreach Program (LMOP) database (statewide data) CARB Landfill Emissions Report (statewide data)	None	Related to growth in population[4]	1.07
Domestic wastewater treatment and discharge	CH_4 and N_2O emissions from the treatment of wastewater from domestic sources (municipal sewage)	Inland Empire Utilities Agency (County-level data)	City population	Population forecast	1.33
Water transport, distribution, and treatment	Indirect electricity emissions for water supply, treatment, distribution, and wastewater treatment	California Energy Commission, Urban Water Management Plan (City-level data)	None	Urban Water Management Plan forecast	1.33
SF_6 from electricity consumption	Fugitive emissions of SF_6 from the transport of electricity to the City	Electricity records from utilities (City-level data)[2] California Energy Commission, Urban Water Management Plan (City-level data)	None	Varies based on source of electricity CARB emission factors	1.33

[1] Specific growth forecasts are based on individual emission sources within these sectors (e.g., for off-road, residential equipment emissions were projected based on population, while industrial equipment emissions were based on non-retail employment).

[2] The City's electric utility is Southern California Edison (SCE).

[3] The City's natural gas utility is Southern California Gas Company (SCG).

[4] Solid waste emissions are based on past waste generated by the City of Ontario, so the 2020 forecast accounts for past population growth in the City. See Section 4.7 for more detail.

Table 6. City of Ontario Population, Housing, and Employment Estimates and Forecasts

Category	2008	2020	Growth Factor
Population	162,871	215,765	1.32
Households	44,639	61,128	1.37
Single-Family Households	*26,395*	*36,026*	*1.36*
Multi-Family Households	*18,244*	*25,102*	*1.38*
Employment *(jobs)*	114,339	151,279	1.32
Retail Employment	*34,529*	*42,602*	*1.23*
Nonretail Employment	*79,810*	*108,677*	*1.36*
Growth projections were provided by SCAG and modified by the City of Ontario.			

Growth factors for 2008 through 2020 were calculated as the ratio of 2020 projections to year 2008 estimates. The 2008 emissions were multiplied by those growth factors to project 2020 emissions, as indicated in Table 5 and Table 6 above.

4. Inventory Results

This section presents the 2008 Community Greenhouse Gas Emissions Inventory, including the data collection and calculation methodology for each sector. The results of the community inventory for 2008 in MT of CO_2e are presented in Table 1 and Figures 1, 2, and 3. Each section below describes a different sector of the inventory. Introductory information for each sector is followed by data acquisition and sources, emission calculations and methodologies, data gaps, and emissions.

4.1 Building Energy Use

Building energy use from residential, commercial, and industrial buildings is a significant component of the community GHG inventory, accounting for 31.6% of the total regional emissions in 2008. Energy consumption includes electricity and natural gas usage. Electricity use can result in indirect emissions from the power plants that produce electricity outside of City boundaries; these are classified as Scope 2 emissions. Natural gas consumption results in direct emissions where the natural gas is combusted; these are classified as Scope 1 emissions.

4.1.1 Data Acquisition and Sources

The City obtains electricity from Southern California Edison (SCE). Electricity data were obtained from utility bills and aggregated into two major categories: residential and commercial/industrial. Commercial and industrial data had to be aggregated into one group to avoid confidentiality conflicts with large electricity users in the City.

Natural gas is supplied to the City by the Southern California Gas Company (SCG). SCG provided natural gas consumption data for single-family residences, multi-family residences, and commercial/industrial buildings. Similar to the electricity data, commercial and industrial consumption had to be grouped together to avoid confidentiality conflicts.

4.1.2 Emissions Calculations and Methodologies

Electricity and natural gas consumption quantities were multiplied by the emission factors presented in Table 2 to determine GHG emissions for 2008. Utility-specific emission factors were used to calculate emissions from electricity consumption for SCE (California Climate Action Registry 2009b). These factors represent all emissions related to electricity deliveries in 2007, including owned and purchased power.[7]

2020 BAU GHG emissions from natural gas and electricity consumption were estimated using City growth forecasts presented in Tables 5 and 6. For the residential sector, emissions were projected using the growth in

[7] The emission factor was only available for 2007 but was applied to the energy consumption in 2008. Also, the emission factor varies from year to year because of a variety of factors that influence a utility'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 a utility purchases more power to meet California electricity demand. Thus, the emission factor for any given year can vary and also varies widely by utility company (California Climate Action Registry 2009b).

households. For the commercial/industrial sector, emissions were projected using the growth in total employment.

4.1.3 Data Gaps

Commercial and industrial energy use data were grouped to avoid confidentiality conflicts. While disaggregation of these data would not change the overall City-wide inventory, it would help refine the inventory and aid in the CAP planning process. In addition, emission factors for electricity delivered by SCE for the year 2007 were used to calculate emissions for electricity consumed in 2008, because 2008 emission factors were not available.

4.1.4 Building Energy Use Emissions

Table 7 presents the 2008 and 2020 BAU emissions inventory for building energy use in the City of Ontario.

Table 7. 2008 and 2020 Business as Usual Forecast of Building Energy Use and Greenhouse Gas Emissions

	2008 Inventory			2020 BAU Forecast		
Sector	kWh	Therms	MT CO_2e	kWh	Therms	MT CO_2e
Residential	317,534,340	16,908,445	186,558	434,826,926	23,154,180	255,470
Commercial/Industrial	1,299,620,450	65,354,314	741,851	1,719,539,371	86,468,618	981,537
Total	**1,617,154,790**	**82,262,759**	**928,409**	**2,154,366,297**	**109,622,797**	**1,237,006**

4.2 Light- and Medium-Duty Vehicles

Light- and medium-duty vehicle emissions accounted for approximately 26.1% of the City's total community emissions in 2008. These emissions were direct Scope 1 emissions resulting from the vehicle fuel combustion.

This source includes emissions from on-road light- and medium-duty vehicles associated with activity within Ontario (i.e., trips that neither begin nor terminate within Ontario City limits are omitted from the inventory). Trips that have an origin, destination, or both within Ontario are counted. Emissions originate from the combustion of fossil fuels (such as diesel, gasoline, compressed natural gas, etc.) to power light- and medium-duty vehicles. These emissions are direct Scope 1 emissions and accounted for approximately 26.1% of the City's total emissions in 2008.

4.2.1 Data Acquisition and Sources

Data on trips and vehicle miles traveled (VMT) were obtained at the city level on an origin-destination basis from SCAG's 2012 regional travel demand[8] model for the years 2008 and 2020. The data were obtained for light- and medium-duty vehicles, which are defined by SCAG as all passenger cars, pick-up and single unit trucks, and recreational vehicles.

[8] Description and documentation for SCAG's 2012 model are available here: www.scag.ca.gov/modeling.

The 2008 data were based on the transportation network existing in 2008 and socioeconomic data (population and employment) for that year. The 2020 plan scenario was based on growth forecasts received from local jurisdictions and the planned network in that year. The VMT and trips data were obtained from SCAG for an average weekday and were multiplied by 347[9] to calculate the annual VMT. This is the factor used by SCAG to annualize the average weekday data.

For Ontario, SCAG provided VMT for trips that have an origin, destination, or both within the City. To allocate the VMT appropriately to the City, ICF used the methodology recommended by the SB 375 Regional Targets Advisory Committee (RTAC).[10] This methodology scales VMT to individual jurisdictions according to the following three accounting rules.

- VMT for vehicle trips that originate and terminate within the city are weighted by a factor of 1.
- VMT for vehicle trips that either originate or terminate (but not both) within the jurisdiction are weighted by a factor of 0.5.
- VMT for vehicle trips with neither originate nor terminate within the jurisdiction are weighted by a factor of 0. These trips are commonly called pass-through trips.

Essentially, ICF allocated to Ontario one half of the VMT for any trip with an origin or destination within the City. This method avoids apportioning through trips on freeways or major arterials to the cities containing them, while allocating emissions to the cities that can take responsibility for reducing them. The method was applied to both light- and medium-duty, and heavy-duty VMT.

In addition, at the county level, data on VMT by speed bin were obtained using a link-based analysis method based on traffic volumes on each link of the network, the distance traveled on each link, and speeds on each link in the County. If a link was split by the county boundary, a ratio was calculated by SCAG based on distance to determine the VMT falling within the County. The county-wide VMT by speed bin was used to estimate emissions for the City of Ontario.

4.2.2 Emissions Calculations and Methodologies

To quantify GHG emissions for 2008, ICF used the VMT and county-level average speed data from SCAG as inputs into CARB's EMFAC 2011 model to determine CO_2 emission factors for 2008 by speed bin and vehicle type for the South Coast Air Basin. Emission factors for CH_4 and N_2O were obtained from the 2012 Climate Registry. ICF weighted the emission factors by VMT (available in EMFAC) to obtain emission factors for the two required vehicle categories—light- and medium-duty vehicles, and heavy-duty vehicles. To calculate annual emissions, the VMT were multiplied by the appropriate emission factors for the City (by vehicle type) expressed in grams per mile.

A similar process was followed for the 2020 BAU analysis, using SCAG's VMT data from the 2020 Plan scenario and emission factors for that year.

[9] This number conforms to the methodology CARB uses in the Pavley I and LCFS policies. 347 days is used to account for the reduced vehicle activity on weekends as compared to weekdays. (California Air Resources Board 2010d)

[10] The origin/destination modeling methodology provides a better accounting of VMT associated with land use jurisdiction than approaches that apportion VMT on the basis of population shares or on the basis of VMT that occurs within the boundaries of a jurisdiction.

Finally, the resulting GHG emissions were calculated for the City, expressed in terms of annual MT CO_2e[11] generated by on-road vehicles, using the appropriate GWP data for CH_4 and N_2O.[12]

4.2.3 Data Gaps

The VMT by speed bin data available from SCAG was at the county level and was not available at the city level. It would take significant data processing effort from SCAG to make this available. Therefore, ICF used the proportion of the County's VMT in each speed bin to disaggregate each city's VMT by speed bin in order to apply the appropriate emission factors to calculate emissions. This method assumes that the City of Ontario hase a VMT by speed distribution that is the same as the overall County. Although the impact on the inventory is not likely to be significant, if city-level VMT were available by speed bin, it would lead to a more accurate inventory.

4.2.4 Light- and Medium-Duty Vehicles Emissions

Table 8 presents light- and medium-duty vehicle emissions.

Table 8. 2008 and 2020 Business as Usual Forecast Light- and Medium-Duty Vehicles Emissions

Category	2008 Inventory	2020 BAU Forecast
VMT	1,765,679,554	2,263,186,052
GHG Emissions ($MTCO_2e$)		
CO_2	750,532	961,861
CH_4	45	41
N_2O	50	21
Total Emissions ($MTCO_2e$)	**766,952**	**969,119**

4.3 Heavy-Duty Vehicles

Truck emissions accounted for approximately 6.9% of the City's total community emissions in 2008. These emissions were direct Scope 1 emissions resulting from the vehicle fuel combustion.

This source includes emissions from on-road heavy-duty vehicles associated with activity within Ontario (i.e., trips that neither begin nor terminate within Ontario City limits are omitted from that city's inventory). Trips that

[11] This is the international unit that combines the differing impacts of all GHGs into a single unit, by multiplying each emitted gas by its GWP.

[12] GWP compares the relative global warming effect of the GHG in question to CO_2 and is a measure of how much a given mass of GHG contributes to global warming. The GWP of CO_2 is, by definition, 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: CO_2 = 1, CH_4 = 21, N_2O = 310, SF_6 = 23,600 (Intergovernmental Panel on Climate Change 1996, United Nations Framework Convention on Climate Change 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 (Intergovernmental Panel on Climate Change 2007; U.S. Environmental Protection Agency 2010a).

have an origin, destination, or both within Ontario are counted. Emissions originate from the combustion of fossil fuels (such as diesel, gasoline, compressed natural gas, etc.) to power light- and medium-duty vehicles. These emissions are direct Scope 1 emissions and accounted for approximately 6.9% of the City's total emissions in 2008.

4.3.1 Data Acquisition and Sources

Data on trips and VMT were obtained at the city level on an origin-destination basis from SCAG's 2012 regional travel demand[13] model for the years 2008 and 2020. The data were obtained for heavy-duty vehicles, which are defined by SCAG as trucks with gross vehicle weight greater than or equal to 8,500 pounds.

Aside from the definition of light-duty vehicles and because heavy-duty and light- and medium-duty vehicles have the same data sources, refer to Section 4.2.1 for additional explanation of data acquisition and sources for heavy-duty vehicles.

4.3.2 Emissions Calculations and Methodologies

Because the same methodologies and calculations are used for both heavy-duty and light- and medium-duty vehicles, refer to Section 4.2.2 for the discussion of the emissions calculations and methodologies for heavy-duty vehicles.

4.3.3 Data Gaps

Because heavy-duty and light- and medium-duty vehicles have the same data sources, refer to Section 4.2.3 for discussion of data gaps.

4.3.4 Heavy-Duty Vehicle Emissions

Table 9 presents heavy-duty vehicle emissions.

Table 9. 2008 and 2020 Business as Usual Forecast Heavy-Duty Vehicles Emissions

Category	2008 Inventory	2020 BAU Forecast
VMT	201,779,568	264,437,532
GHG Emissions ($MTCO_2e$)		
CO_2	201,988	274,789
CH_4	7	5
N_2O	5	4
Total Emissions ($MTCO_2e$)	**203,805**	**276,028**

[13] Description and documentation for SCAG's 2012 model are available here: <http://www.scag.ca.gov/modeling>.

4.4 Stationary Sources

This category includes emissions from fuel combustion (such as diesel, gasoline, and propane) and fugitive emissions of CH_4 and N_2O from industrial facilities in the City. Emissions from these sources accounted for approximately 13.8% of the total City emissions in 2008.

GHG emissions from stationary sources result from fuel use other than natural gas consumption, which is accounted for in the building energy category (Section 4.1). The following categories were included in this sector:

- oil and gas production (combustion)
- manufacturing and industry
- food and agricultural processing
- fuel combustion
- coatings and related processes
- cleaning and surface coatings
- petroleum production and marketing
- chemical production
- mineral processes
- industrial processes
- asphalt paving and roofing
- sewage treatment
- service and commercial (combustion)
- residential (combustion)
- and cooking

Emissions associated with electricity use were not included in this category as they were quantified as part of Ontario's commercial and industrial building energy emissions (Section 4.1).

4.4.1 Data Acquisition and Sources

County-wide GHG emissions for stationary sources were obtained from the 2007 SCAQMD inventory (South Coast Air Quality Management District 2007). Population and employment statistics provided by SCAQMD and SCAG were used to scale the 2007 inventory to 2008 and to apportion emissions to the City.

4.4.2 Emissions Calculations and Methodologies

The 2007 SCAQMD inventory includes emissions from natural gas combustion (Section 4.1). To avoid double counting, the percentage of emissions associated with natural gas consumption was subtracted from the SCAQMD total stationary source inventory. The resulting fuel combustion emissions therefore include only emissions associated with fuel use other than natural gas (e.g., propane, diesel, fuel oil).

Since the SCAQMD inventory represents emissions for the year 2007, it was necessary to scale these emissions by a growth factor to estimate emissions for the year 2008. To estimate stationary source emissions for 2008, all sectors within the 2007 SCAQMD inventory (except resident fuel combustion) were scaled by the change in County-wide employment from 2007 to 2008 (South Coast Air Quality Management District 2007). This metric was determined to be the most accurate for scaling nonresidential emissions because stationary fuel combustion likely trends with employment in the County. (Employment by specific economic sector was not available, so total employment was used.) Residential fuel combustion emissions in 2007 were scaled by the change in County-wide population because fuel combustion in the residential sector most likely trends with the number of residents in the County. To determine emissions for the City, the calculated County-wide 2008 emissions were scaled by the respective ratios for City-wide employment and population, as provided by SCAG (2012).

2020 BAU GHG emissions were estimated by using City growth forecasts presented in Tables 5 and 6. All emissions except residential fuel combustion were projected using the growth in total employment. Residential fuel combustion was projected using the growth in population.

4.4.3 Data Gaps

Stationary source data were obtained from SCAQMD as discussed above. Because these data were for 2007, emissions were scaled by the change in population and employment from 2007 to 2008. These data then were apportioned to the City using City-wide population and employment statistics, as indicated in the table below. This approach is based on the assumption that stationary sources can be reasonably approximated with population and employment. This is not necessarily the case because various stationary source emissions may not be equally represented in the City based on population and employment. Moreover, the approach assumes a linear relationship between population and employment change from 2007 and 2008 and stationary source emissions.

To improve this analysis, stationary source data for 2008 specifically for Ontario should be obtained. This will require greater coordination between stationary source facilities, the City, and the SCAQMD, as well as better tracking systems for residential fuel combustion quantities.

4.4.4 Stationary Source Emissions

Table 10 presents the City-wide 2008 and 2020 BAU emissions from stationary sources, a brief definition of each source, and the metric used to scale County-wide emissions to the City. Stationary source emissions have been grouped into the following major source categories: industrial, commercial, sewage treatment, residential, agricultural, and miscellaneous.

Table 10. 2008 and 2020 Business as Usual Forecast Stationary Source Emissions

Sector	Description	Scaling Metric	2008 Inventory ($MTCO_2e$)	2020 BAU Forecast ($MTCO_2e$)
Industrial	Industrial fuel combustion[1]	Total employment	154,891	199,292
Commercial	Commercial fuel combustion[1]	Total employment	133,906	180,090
Waste	Diesel oil and digester gas [2]	Total employment	19,913	26,346
Residential	Residential fuel combustion[1]	Population	3,293	4,363
Agricultural	Farming operations and waste burning[3]	Total employment	92,836	100,987
Miscellaneous	Charbroiling emissions from cooking and other emission sources	Total employment	355	470
Total Emissions ($MTCO_2e$)			**405,195**	**511,548**

[1] Does not include natural gas combustion as these emissions are accounted for in the building energy sector (refer to Section 4.1)

[2] Includes emissions from stationary fuels combusted as part of the sewage treatment process. Please refer to the wastewater sector (Section 4.8) for a discussion of CH_4 and N_2O associated with the treatment and breakdown of waste.

[3] Represents combustion emissions from heavy-duty agricultural equipment (e.g., tractors) and the burning of agricultural waste. Refer to the agricultural sector (Section 4.6) for a discussion of emissions associated with livestock activity and the application of fertilizer.

4.5 Off-Road Equipment

Off-road equipment emissions accounted for approximately 6.0% of the total regional emissions in 2008. These emissions are direct Scope 1 emissions resulting from equipment fuel combustion. Off-road equipment includes recreational boats and vehicles and equipment for industry, construction, lawn and garden maintenance, military activities, and agriculture.

4.5.1 Data Acquisition and Sources

The CARB OFFROAD 2007 air quality model was used to calculate off-road equipment GHG emissions. Because the model provides County-level data, it was run for the year 2008 to calculate overall fuel consumption (gasoline, diesel, and liquefied petroleum gas) for off-road equipment in San Bernardino County. Equipment categories were refined to include those activities relevant to Ontario. The following equipment categories, as defined by the OFFROAD model, were included in the model run: recreational, construction and mining, industrial, lawn and garden, agricultural, transportation refrigeration units, entertainment, pleasure craft[14], and other portable equipment. Fuel consumption estimates by equipment type were apportioned by population and employment statistics to obtain emissions for Ontario.

4.5.2 Emissions Calculations and Methodologies

To obtain emissions for Ontario, City-wide population and employment by economic sector statistics were used to apportion the OFFROAD fuel combustion data. Table 11 outlines the scaling factors used in this analysis to

[14] There are no major bodies of water within City boundaries. However, it was assumed that residents in Ontario would travel to nearby bodies of water for recreation.

apportion the County-wide emissions to Ontario. The table also provides a rationale as to why these factors were selected to represent each equipment category. Once fuel consumption estimates were appropriated, the data were multiplied by fuel emission factors (see Table 4) to calculate CO_2, CH_4, and N_2O.

Table 11. Off-Road Equipment and Scaling Factors

Off-Road Equipment	Scaling Factor	Rationale
Recreational	Population	Equipment assumed to be owned by households
Construction and mining	Industrial employment	Equipment use assumed to be correlated with industrial employment and activity
Industrial	Industrial employment	Equipment use assumed to be correlated with industrial employment
Lawn and garden	Population	Equipment assumed to be owned by households
Light commercial	Retail and non-retail employment	Equipment use assumed to be correlated with general commercial activity
Agricultural	Agriculture employment	Equipment use assumed to occur on agricultural fields
Transport refrigeration units	Total employment	Equipment use could not be appropriately matched with a specific employment sector and therefore was assumed to correlate with total employment
Entertainment	Population	Equipment assumed to be owned by households
Pleasure craft	Population	Equipment assumed to be owned by households
Other portable equipment	Total employment	Equipment could not be appropriately matched with a specific employment sector and therefore was assumed to correlate with total employment

Fuel combustion associated with railyard and airport ground equipment was not included in this inventory because the City and its community have little to no jurisdiction over these activities. Oil drilling equipment was not included in the inventory because there is no activity associated with this equipment within the City.

2020 BAU GHG emissions were estimated by using City growth forecasts in employment provided by SCAG presented in Table 6. Growth in retail and non-retail employment was used to project emissions from light commercial equipment. Growth in industrial employment was used to project industrial, construction, and mining equipment. Similarly, agricultural employment growth was used to project agricultural equipment. Emissions from pleasure craft and recreational, lawn and garden, and entertainment equipment were projected using the growth in population.

4.5.3 Data Gaps

Off-road emissions were estimated based on the County-wide fuel combustion estimated generated by the OFFROAD model. Because activity data are not readily available on a scale smaller than the County level, the OFFROAD outputs were scaled by population and employment statistics to determine emissions associated with activities in Ontario. This approach assumes that off-road equipment can be reasonably approximated with population and employment. This is not necessarily the case, because various equipment emissions may not be equally represented in the cities based on population and employment. Area-specific data for off-road equipment are required to estimate more precise emissions at the city level.

4.5.4 Off-Road Equipment Emissions

Table 12 presents the 2008 and 2020 BAU emissions inventory for off-road equipment for Ontario.

Table 12. 2008 and 2020 Business as Usual Projected Off-Road Equipment Emissions

GHG Emissions	2008 Inventory ($MTCO_2e$)	2020 BAU Forecast ($MTCO_2e$)
Recreational equipment	1,629	2,158
Construction and mining equipment	112,881	149,541
Industrial equipment	18,518	23,826
Lawn and garden equipment	3,417	4,527
Light commercial equipment	6,334	9,131
Agricultural equipment	11,272	10,236
Transport refrigeration units	7,830	10,531
Entertainment equipment	56	74
Pleasure craft	14,348	19,008
Other portable equipment	28	38
Total Emissions ($MTCO_2e$)	**176,314**	**229,069**

4.6 Agriculture

Agriculture emissions accounted for approximately 12.1% of the City's total emissions in 2008. These emissions are direct Scope 1 emissions resulting from livestock activity and the application of fertilizer. Emissions of CH_4 and N_2O can result from livestock production through enteric fermentation and manure management (Intergovernmental Panel on Climate Change 2006b). CARB and Intergovernmental Panel on Climate Change (IPCC) Tier 1 methodology were used to calculate emissions. Emissions of N_2O can result from anthropogenic inputs of nitrogen into soil through fertilizers by way of direct (directly from the soils to which the nitrogen is added or released) and indirect (following volatilization of ammonia and nitrogen oxides from managed soils) pathways (Intergovernmental Panel on Climate Change 2006b). Both direct and indirect emissions of N_2O were calculated.

The three general sources of agricultural emissions evaluated in this inventory are livestock enteric fermentation, livestock manure management, and N_2O emissions from the application of fertilizer.

4.6.1 Data Acquisition and Sources

Data from the California Department of Conservation, Division of Land Resource Protection Farmland Mapping and Monitoring Program (FMMP) and additional geographic information systems (GIS) analysis using City data were used to determine grazing land and farmland acreage within the City (California Department of Conservation, Division of Land Resource Protection 2008). Counts of City of Ontario livestock for the year 2008 were obtained through the state Department of Food and Agriculture's Agricultural Statistics (California Department of Food and Agriculture 2008) and the Regional Water Quality Control Board for the Santa Ana

Region (Kashak pers. comm.). Counts of City of Ontario swine were obtained from the U.S. Department of Agriculture's (USDA's) Census of Agriculture, using 2007 data as a proxy for the year 2008.

4.6.2 Emissions Calculations and Methodologies

All agriculture emissions were calculated using CARB and IPCC methodology (Intergovernmental Panel on Climate Change 2006b; California Air Resources Board 2010b). Livestock counts were provided for the City of Ontario. County swine counts were apportioned based on the percent of grazing land in the City, as determined by the FMMP data and the additional GIS analysis. A count of San Bernardino County chickens did not specify any activity for the City (Krygier pers. comm.).

Emissions of N_2O from inputs of nitrogen into soil through fertilizers were calculated using an average quantity of nitrogen applied in synthetic fertilizer for crops of 140 pounds per acre per year (Miyao pers. comm.). It was assumed that all crops in Ontario use the same rate of fertilizer application, and that all crops use synthetic fertilizer to be conservative (organic fertilizers produce much lower N_2O emissions). Crop acreage was determined through the 2007 FMMP report and additional GIS analysis by summing acreage under the categories labeled *Farmland*. The N_2O emissions from fertilizer application on farmland were calculated using the equations provided by CARB (California Air Resources Board 2010b).

The 2020 BAU GHG emissions were based on the City's estimate that all agricultural activities would be transitioned by 2050. A linear extrapolation of farmland and grazing land was used to forecast the amount of land available in 2020 for livestock activity and the application of fertilizer. This resulted in an annual decline rate of about 3% for all agriculture activities.

4.6.3 Data Gaps

Emission factors can vary depending on the specific type of livestock and manure management system. The emission factors used in the inventory were based on averages that were determined for CARB's statewide inventory. In addition, the actual quantity of nitrogen-based fertilizer applied to farmland within City boundaries, on a per-acre basis, would refine the estimate of N_2O emissions from fertilizer application.

4.6.4 Agriculture Emissions

Table 13 presents agriculture emissions for Ontario for enteric fermentation, manure management, and fertilizer application.

Table 13. 2008 and 2020 Business as Usual Projected Agriculture Emissions by Source

Category	2008 Inventory ($MTCO_2e$)	2020 BAU Forecast ($MTCO_2e$)
CH_4 (Enteric fermentation and manure management)	335,690	304,828
N_2O (Enteric fermentation, manure management, and fertilizer application)	20,441	18,562
Total Emissions ($MTCO_2e$)	**356,131**	**323,390**

4.7 Solid Waste Management

Total emissions from solid waste generated by the City of Ontario accounted for approximately 2.0% of the City's 2008 inventory. These emissions occur at numerous landfills throughout the state and are considered a Scope 2 emission source. The materials disposed of by the City are recycled, composted, or placed in a landfill. Landfill-related emissions from waste are primarily CH_4, which is released over time when waste decomposes in a landfill. Organic waste that is buried in landfills decomposes under anaerobic conditions to produce CH_4, which has a GWP that is 21 times that of CO_2.

Waste generated in the City is either diverted or transported to a landfill. Both of the landfills currently used for disposal of City waste are located outside the City. According to CalRecycle, approximately half of the cities in the County have landfills located within their own city limits. Landfill emissions do not occur within the boundaries of every city generating the waste; however, every city is responsible for creating this waste and subsequent landfill emissions. Thus, emissions from the decomposition in landfills of waste produced by Ontario in 2008 are included in the inventory.

Milliken Sanitary Landfill's current status and characteristics are listed in Table 15. The emissions from this landfill are included as an informational item only as a CAP planning tool. Because this landfill accepts waste from many jurisdictions, landfill-related emissions are not related to City population, waste generated by City or municipal facilities, or behavioral or regulatory changes related to waste generation that happen within the City.

4.7.1 Data Acquisition and Sources

In 2009, the CARB conducted a study to examine the CH_4 reduction potential of proposed landfill regulation (California Air Resources Board 2009). The report contains data on the majority of landfills in the state, including opening year, closing year, 1990 waste in place, 2006 waste in place, and estimated 2020 waste in place, as well as the control technologies installed at each landfill. This report was used for calculating both site-based and generation-based emissions.

Additional data for the landfill within the City were collected from CalRecycle and the EPA Landfill Methane Outreach Program (LMOP) database (U.S. Environmental Protection Agency 2009). This information included annual waste disposal during 1995–2009 for each landfill. Specific CH_4 capture data, including measured flow rates of landfill gas, were obtained from the EPA LMOP database (U.S. Environmental Protection Agency 2009). These data were supplemented by a report detailing CH_4 capture rates for a few landfills in California (Themelis and Ulloa 2007).

Projection data used to estimate waste disposed prior to 1995 and after 2009 were obtained from SCAG and the California Department of Finance (Southern California Association of Governments 2012; California Department of Finance 2010a, 2010b, 2010c, 2010d).

4.7.2 Emission Calculations and Methodologies

There are two methods for calculating emissions from solid waste disposed in landfills: site-based and generation-based. Generation-based emissions were included in the inventory; site-based emissions were not included (but are provided for informational purposes).

4.7.2.1 Site-Based Emissions

Site-based emissions, which include emissions from the landfill located within the City boundaries, were estimated as an informational item but were not included in the inventory. This is because Milliken Sanitary Landfill accepts waste from numerous cities, and Ontario is not responsible for generating much of this waste. Ontario also has no jurisdiction to reduce waste disposal from these other cities as part of the CAP. Emissions from waste disposed of by Ontario are included in the inventory as generation-based emissions discussed in the following section.

Site-based emissions were included as an informational item to help Ontario identify site-based waste control measures to reduce CH_4 emissions from Milliken Sanitary Landfill (such as landfill caps and CH_4 flaring systems). The site-based approach calculates landfill emissions for the inventory year based on the landfills located within the geographic boundaries of the jurisdiction, regardless of when the waste was disposed of. This method is also known as waste in place and is a suitable method for calculating the amount of landfill gas available for flaring, heat recovery, and energy generation.

CARB's First Order Decay model was used to estimate CH_4 emissions from landfills (California Air Resources Board 2010c) for the site-based method. This is an Excel-based model that is consistent with IPCC-recommended methodologies for estimating waste decay rate, CH_4, and CO_2 emissions. The model requires the following inputs: year of opening, year of closing, annual waste deposition, and local annual precipitation rate. For site-based emissions, specific landfill data from CalRecycle, the EPA, and a CH_4 generation study (CalRecycle 2010a; U.S. Environmental Protection Agency 2009; Themelis and Ulloa 2007) were input to the model. Only total waste in place data were available. For disposal in the landfills for all years, it was assumed that waste was deposited evenly over each year of operation. A landfill-specific CH_4 capture rate of 63% was used based on research conducted for San Bernardino County.

For estimating site-based emissions in 2020, a linear extrapolation of population growth for Ontario, combined with the average per-capita waste disposal rate in 2009, was used (CalRecycle 2010b). It was assumed that the cities would deposit waste generated in 2020 in the same landfills accepting waste from the cities in 2009. The CH_4 capture efficiency for landfills in 2020 also was assumed to be equal to 2009.

4.7.2.2 Generation-Based Emissions

Generation-based emissions for 2008 and 2020 were estimated and included in the inventory. These emissions can help the City identify generation-based waste control measures to reduce CH_4 emissions from landfills (such as source reduction or recycling programs). This approach estimates baseline landfill emissions based on the amount of current annual waste generated within City boundaries and the landfills where the waste is deposited, regardless of whether the waste is deposited in a landfill within the jurisdiction. This approach discloses the annual landfill emissions associated with annual waste generation.

CARB's First Order Decay model was used to estimate CH_4 emissions from landfills (California Air Resources Board 2010c). For generation-based emissions, the First Order Decay model was run for the City of Ontario assuming the City was a hypothetical landfill. For landfills listed as having CH_4 capture or flaring technologies installed, but not having specific information on the efficiency of the CH_4 capture, a default CH_4 destruction efficiency of 75% was assumed (U.S. Environmental Protection Agency 1998).

The waste generated in the City, along with the destination landfill of that waste, was provided by the City, and landfill details were identified based on CalRecycle data for the years 1995–2009. For each landfill, the CH_4 capture efficiency was determined using the EPA's LMOP database and a CH_4 generation study (U.S. Environmental Protection Agency 2009; Themelis and Ulloa 2007). Waste deposited in 2008 in each landfill was compared to the landfill's CH_4 capture efficiency for the given year, if applicable, to develop a profile of CH_4 emissions for each ton of waste landfilled by the City in 2008. It was assumed that the k-value for each City landfill was 0.02, which represents areas with annual average rainfall of less than 20 inches because most of the waste generated by the cities ends up in landfills located in the region.

For estimating waste generation in 2020, a linear extrapolation of population growth for the City, combined with the average per-capita waste disposal rate in 2008, was used (California Department of Finance 2010d; CalRecycle 2010b). It was assumed that the City would deposit waste generated in 2020 in the same landfills accepting waste from the cities in 2009. The CH_4 capture efficiency for landfills in 2020 was also assumed to be equal to 2008.

4.7.3 Data Gaps

Site-specific landfill CH_4 capture rates would improve this sector of the inventory. Landfill emissions are based on the consolidated landfill report prepared by CARB and data from CalRecycle for 2008. The CARB report contained waste in place information for all landfills in the County. Although individual landfill operators may collect data on site related to the maintenance and operation of gas flaring systems, these data are not always sufficient to estimate precise CH_4 destruction efficiency. This information was not included in the summary report prepared by CARB in 2009 (California Air Resources Board 2009). Individual landfill operators were not contacted for the purposes of data collection. Additional CH_4 capture rates were found by Themelis and Ulloa (2007) but not for all landfills where the City is sending its waste.

4.7.4 Solid Waste Management Emissions

Table 14 presents generation-based solid waste emissions. Table 15 shows the landfills used by the City but located outside of City jurisdictional boundaries. This table also states whether the landfill is open or closed, the amount of waste in place at the landfill in 2008, and the associated CH_4 emissions.

Table 14. Generation-Based Solid Waste Management Greenhouse Gas Emissions for 2008 and 2020 Business as Usual Forecast

Category	2008 Inventory	2020 BAU Forecast
Waste disposed of (tons)	256,328	288,659
Waste disposed of 1950–2008 and 1950–2020 (tons)	10,158,605	13,171,007
Total CH_4 Emissions (MTCO2e)	**60,000**	**64,326**

Table 15. Site-Based Solid Waste Management Emissions for 2008 and 2020 Business as Usual Forecast

	2008 Inventory			2020 Projection		
Landfill Name	Open/ Closed	Waste in Place (tons)[1]	CH_4 Emissions ($MTCO_2e$)	Open/ Closed	Waste in Place (tons)[1]	CH_4 Emissions ($MTCO_2e$)
Milliken Sanitary Landfill (SWIS # 36-AA-0054)	Closed	12,011,629	60,787	Closed	12,011,629	47,817
Total Emissions ($MTCO_2e$)			**60,787**			**47,817**

[1] The 2008 value was estimated based on the full capacity of the landfill and the amount of waste in place in 2006, as provided by the CARB (2009).

Sources: California Air Resources Board 2009, 2010c.

4.8 Wastewater Treatment

There is one wastewater treatment plant (WWTP) located within the boundaries of this inventory. Wastewater generated by Ontario is treated at IEUA Regional Water Recycling Plant No. 1 (RP-1). This facility serves the cities of Ontario, Rancho Cucamonga, Upland, Montclair, and Fontana and an unincorporated area of San Bernardino County. The GHG emissions result from electricity and/or natural gas used to power the facility. These emissions are classified as Scope 1 (natural gas) and Scope 2 (electricity) and are included in the inventory in the building energy sector above. Additional emissions of CH_4 and N_2O result from the treatment and breakdown of waste in the facility. These are commonly referred to as fugitive emissions, are classified as Scope 1 emissions, and are included in the inventory. Although the IEUA RP-1 plant captures some fugitive emissions (biogas) on site and uses it for local power, the total amount captured was unavailable at the time of analysis. Therefore, all fugitive emissions are included in the inventory.

Wastewater generated in the City will be sent to IEUA RP-1, along with wastewater generated by the other regions served by this facility. Only the fugitive emissions occurring as a result of treating wastewater generated by the City were included in the inventory because the City is not responsible for generating all of the wastewater treated by IEUA RP-1. GHG emissions due to fugitive emissions at these facilities are listed in Table 16. These emissions represented 0.2% of the total emissions.

4.8.1 Data Acquisition and Sources

For each of its WWTPs, IEUA provided daily influent flow, population served, amount of digester gas combusted, average nitrogen load, and biochemical oxygen demand (BOD_5) load (Tam pers. comm.).

4.8.2 Emissions Calculations and Methodologies

Equations 10.3 and 10.4 in CARB's Local Government's Operating Protocol (California Air Resources Board et al. 2010) were used to estimate fugitive emissions of CH_4 and N_2O resulting from wastewater treatment. These equations require the following inputs: daily influent flow, population served, amount of biogas produced, average nitrogen load, and BOD_5 load. These standard equations are recommended for use by local governments in preparing GHG inventories and consistent with methodologies used for national and state-level inventories.

4.8.3 Data Gaps

The estimate of GHG emissions associated with wastewater treatment by the City is based on the City's population, and not on actual emissions resulting from WWTP activities within City boundaries. If these activities at IEUA RP-1 could be disaggregated to the City level, this information would provide for a more accurate estimate of GHG emissions from wastewater treatment. In addition, the amount of biogas produced at the IEUA RP-1 plant was unavailable at the time of analysis. This information would refine the estimate of fugitive emissions in the inventory.

4.8.4 Wastewater Treatment Plant Emissions

Table 16 presents GHG emissions from WWTPs.

Table 16. 2008 and 2020 Business as Usual Projected Fugitive Wastewater Treatment Emissions

Greenhouse Gas Emissions	2008 Inventory ($MTCO_2e$)	2020 BAU Forecast ($MTCO_2e$)
CH_4 emissions	149	198
N_2O emissions	11	15
Total Emissions ($MTCO_2e$)	**6,587**	**8,781**

4.9 Water Transport, Distribution, and Treatment

Emissions related to the transport, distribution, and treatment of water accounted for approximately 1.0% of total emissions in 2008. The City's water consumption results in indirect emissions from the following activities: electricity consumption for water supply and conveyance, water treatment, water distribution, and wastewater treatment. All wastewater treatment emissions are accounted for in Section 4.1, *Building Energy Use,* and Section 4.8, *Wastewater Treatment.* The emissions were calculated based on whether the source of water was located in the City and whether the water consumption–related activity occurred in the City. For local sources of water, the emissions resulting from water supply and conveyance, water treatment, and water distribution also have been included in this sector (electricity provided by SCE in a general *Water* category). Additional emissions from electricity associated with other local water-related activities were accounted for in Section 4.1, *Building Energy Use*, as these activities were assumed to be occurring within the City. For non-local sources of water, such as the State Water Project, this sector includes:

- Transporting water to the City from other areas in the state (water supply and conveyance).;
- Treatment of water at facilities not located in the City (water treatment).
- Distributing this water to the City (water distribution).

Where utility data are not available, emissions from water consumption can be estimated using an activity-based approach. The CEC 2006 report, *Refining Estimates of Water-Related Energy Use in California*, provides proxies for embodied energy use for water in southern and northern California (California Energy Commission 2006b).

This hybrid approach using both utility data and activity data was used to minimize double-counting of emissions for the City. Table 17 presents how utility data were used in conjunction with the activity-based approach to estimate emissions for local and non-local sources of water, as applied specifically to the City.

Table 17. Water Transport, Distribution, and Treatment Data Source Mapping

Source/Activity	Water Supply and Conveyance	Water Treatment	Water Delivery
Local	Utility data	Activity data	Utility data
Nonlocal	Activity data	Activity data	Utility data

4.9.1 Data Acquisition and Sources

Water supply data were provided by the *City of Ontario 2005 Urban Water Management Plan* (UWMP) (City of Ontario 2005). For all sectors described below, water supply data were provided for 2005, 2010, 2015, and 2020.

Because the UWMP provides water quantity forecasts every 5 years starting in 2005, the water quantity for the 2008 base year of the inventory was estimated based on an average growth rate, using the 2005 data and the 2010 forecast. This estimate then was combined with the electricity emission factors to develop the indirect emissions estimate.

4.9.2 Emission Calculations and Methodologies

Methods for calculating emissions associated with City municipal water consumption, including water supply and conveyance, water treatment, and water distribution are described below.

4.9.2.1 Water Supply and Conveyance

Water supply involves indirect emissions from the generation of electricity required to supply each city with water. The City's water includes a mix of local and non-local sources of water. The local sources of water include groundwater and recycled water from the wastewater treatment plant located in the City. For local sources of water, the emissions are assumed to be included either in the utility data category in Table 18 or in Section 4.1, *Building Energy Use*. The non-local sources of water include deliveries from the State Water Project, transfers from third parties, and desalinated water. For non-local sources, the energy intensity associated with water supply and conveyance in southern California is approximately 9,727 kWh/million gallons (MG) (California Energy Commission 2006b).

Information in the CEC report regarding electricity usage and loss factors, and imported water quantities provided by the UWMP, was used to calculate indirect emissions from water importation to the City in 2008 (California Energy Commission 2006b; City of Ontario 2005). Electricity emission factors for the CAMX/WECC California region were used to calculate GHG emissions (724.12 pounds CO_2/megawatt hour [MWh], 30.24 pounds CH_4/gigawatt hour [GWh], and 8.08 pounds N_2O/GWh) because electricity used to transport water to the City facilities is supplied by many utilities within this region (U.S. Environmental Protection Agency 2010b).

The emissions for the BAU forecast for 2020 were estimated using projected water quantities for the City in 2020 obtained from the UWMP and emission factors discussed above.

4.9.2.2 Water Treatment

Before water is pumped to each city, it is purified by passing through various treatment processes. Because the City does not own or operate any water treatment plants, most electricity consumed to treat water for City use is not included in the utility data provided in Section 4.1, *Building Energy Use*. However, the City does own groundwater wells in the Chino Basin, and any treatment of this water occurring in the City is included in the utility data in Table 18. Because the City relies on water treatment services occurring outside City boundaries, emissions associated with electricity consumed for water treatment processes were included in the inventory. The energy intensity for water treatment is approximately 111 kWh/acre-foot of water (California Energy Commission 2006b).

The emissions for the BAU forecast for 2020 were estimated using projected water quantities for the City in 2020 obtained from the City of Ontario UWMP and emission factors discussed above.

4.9.2.3 Water Distribution

Water distribution involves distributing water to end users within a region. The energy intensity in distribution is directly related to the distance and lift involved in transporting water from the conveyance terminus to the retail customers. Because the City operates its own water utility, it is assumed that water distribution electricity use was included in either the utility data category in Table 18 or the utility data provided above in Section 4.1., *Building Energy Use*. Consequently, emissions associated with this electricity were not included as a separate category in the inventory.

The emissions for the BAU forecast for 2020 were estimated using the same methodology for the building energy use section and emission factors discussed above.

4.9.3 Data Gaps

Emission estimates related to the City's water consumption uses two methods that can result in varying degrees of accuracy. Applying the methodology used in the CEC report can result in higher estimates of emissions if the City's water infrastructure is less energy-intensive than the average water infrastructure in the state. Conversely, relying only on utility data can result in a lower emissions estimate because some activities are occurring outside of the City's boundary.

4.9.4 Water Consumption Emissions

Table 18 presents water consumption and the emissions associated with water supply and conveyance, water treatment, and water distribution for 2008 and for the 2020 BAU Forecast.

Table 18. 2008 and 2020 Business as Usual Forecast Water Transport, Distribution, and Treatment Emissions

Category	2008 Inventory	2020 BAU Forecast
Water Consumption (acre-feet)	54,610	76,585
GHG Emissions ($MTCO_2e$)		
Water supply and conveyance	19,933	25,787
Water treatment	568	796
Water distribution[1]	0	0
Utility data (local water activity)[2]	8,544	11,993
Total Emissions ($MTCO_2e$)	**29,044**	**38,575**

[1] Emissions are accounted for in the *Utility data* category or in Section 4.1, *Building Energy Use.*

[2] Includes energy-consuming activities related to water occurring in the City, such as groundwater pumping, water distribution, and local water treatment. Emissions from all other categories in this table are occurring outside of City boundaries, but are due to activities necessary to provide water to the City itself.

4.10 Indirect Emissions of Sulfur Hexafluoride due to Electricity Consumption

Emissions of SF_6 from transmission of electricity to the City accounted for approximately 0.2% of total emissions in 2008. These emissions include leaked SF_6 from electrical transmission and distribution systems, and are classified as a Scope 2 emissions source. SF_6 is used to insulate power switching equipment and transformers (CEC 2006c). SF_6 emissions are based on electricity consumption in Ontario.

Table 19 presents 2008 and 2020 BAU forecast GHG emissions of SF_6 from electricity consumption. SF_6 emissions are generally a function of population and employment in Ontario, as population and employment are good indicators of electricity consumption.

4.10.1 Data Acquisition and Sources

Electricity consumption data were obtained from Southern California Edison, as described in Section 4.1.1. The emission factor for SF_6 was obtained from CARB (2010b).

4.10.2 Emission Calculations and Methodologies

Total electricity consumption for the City was multiplied by the SF_6 emission factor obtained from CARB. CARB estimates the California statewide emissions of SF_6 from electricity transmission and distribution to be fairly constant from 2000 to 2008, and emissions are not expected to increase very much by 2020. The CARB's per-kWh emission rate for SF_6 in 2008 was used to estimate emissions from each city in 2008 and 2020 (California Air Resources Board 2010b). Emissions of SF_6 were multiplied by the GWP of SF_6, which is 23,900.

4.10.3 Data Gaps

The current methodology assumes a statewide average emission rate of SF_6 from electrical power switching equipment and transformers in the City. It is possible that the emission rate in the county is different from the statewide average, so a region-specific emission factor would improve the estimate of emissions in this sector. In addition, because this sector is dependent on the amount of electricity consumed by Ontario, the data gaps listed in the building energy sector also apply to this sector.

4.10.4 SF6 from Electricity Consumption Emissions

Table 19 presents SF6 from Electricity Consumption Emissions for 2008 and for the 2020 BAU Forecast.

Table 19. 2008 and 2020 Business as Usual Forecast SF6 from Electricity Consumption Emissions

Category	2008 Inventory	2020 BAU Forecast
Total Electricity Consumption (kWh)	1,617,154,790	2,154,366,297
SF6 Emissions (kg)	222	296
Total Emissions ($MTCO_2e$)	**5,310**	**7,072**

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Krygier, J. Environmental Health Specialist. Mosquito and Vector Control Program. San Bernardino County Department of Public Health. San Bernardino, CA. September 21, 2010—email communication with Kapil Kulkarni, ICF Jones & Stokes.

Miyao, Gene. Farm advisor, Vegetable Crops, Yolo, Solano and Sacramento Counties. University of California Cooperative Extension. Woodland, CA. December 19 and 22, 2008—email correspondence with Lindsay Christensen, ICF Jones & Stokes, Sacramento, CA.

Tam, Kenneth. Environmental Compliance Officer. Inland Empire Utilities Agency. Chino, CA. September 17, 22, and 24, 2010—email correspondence with Kapil Kulkarni, ICF Jones & Stokes.