City of Santa Ana
Energy Savings Analysis

Prepared for
Southern California Edison

Prepared by
ICLEI-USA and AECOM
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1. Introduction

The purpose of this report is to provide an energy savings analysis for the electricity component of the Santa Ana Climate Action Plan (CAP). This information is provided in detail to ensure that the analysis of electricity-related emissions in Santa Ana is transparent and reproducible.

Greenhouse gas (GHG) emissions generated from community and municipal electricity usage is accounted for in the energy consumption sector of the City of Santa Ana 2008 Communitywide and Municipal Greenhouse Gas Emissions Inventory and Business-as-Usual Forecasts for 2020 and 2035. Electricity-related GHG emissions are considered indirect emissions. Indirect emissions are those *generated* as a result of activities occurring within Santa Ana, but that *occur* in a different geographic area. For example, a Santa Ana resident may consume electricity within the city, but the electricity may be generated at a power plant in a different location. However, consumers are considered accountable for the generation of those emissions and therefore electricity-related emissions are included in a jurisdiction's GHG inventory.

This report includes information related to the estimation of electricity-related GHG emissions in Santa Ana for the calendar year 2008 and estimated GHG reductions based on existing GHG reduction measures. Additional reductions are anticipated as a result of implementation of the CAP. The City of Santa Ana 2008 Communitywide and Municipal Greenhouse Gas Emissions Inventory and Business-as-Usual Forecasts for 2020 and 2035 is provided as Appendix A and the Existing Measures report detailing current reductions is provided as Appendix B.

2. Electricity-related Emissions Estimates

Electricity-related GHG emissions are calculated using activity data kilowatt-hours (kWh) multiplied by the GHG-intensity (emission factor) of the activity.

Activity Data

Southern California Edison (SCE) provided electricity consumption data in kilowatt-hours (kWh) for 2008; SCE provides all electricity used in Santa Ana except for electricity generated by solar systems. Table 1 includes electricity consumption for the community; Table 2 includes electricity consumption for local city operations. SCE includes usage from SCE-supplied electricity as well as direct access electricity. Direct Access electricity refers to electricity purchased directly by industries from power generation facilities, which is then delivered through the transmission lines of public or private utility, and accounts for 8.8% of the electricity usage reported for Santa Ana.

Table 1. Santa Ana Community-wide Electricity Usage, 2008

Sector	kWh
Residential	378,988,235
Commercial and Industrial	1,398,181,157
Total	**1,777,169,392**

Table 2. Santa Ana Municipal Operations Electricity Usage, 2008

Sector	kWh
Buildings and Facilities	30,096,817
Public Lighting	10,978,141
Water and Wastewater Transport	11,639,798
Total	**52,714,756**

Emission Factors

Santa Ana receives electricity produced by SCE and through direct access electricity. SCE-produced GHG emissions were quantified using utility-specific emissions factors; these were taken from SCE's *2007 Annual Emissions Report* for the California Climate Action Registry. SCE did not report an emissions factor for 2008; therefore, the 2007 emissions factor was used as a proxy. Emissions from electricity supplied by direct access providers through SCE's transmission system were quantified using a California average emissions factor from the Local Government Operations Protocol (LGOP) as specific emissions factors are not available for direct access electricity. Emissions factors for CH_4 and N_2O were obtained from the LGOP, which provides a statewide average emissions factor for electricity. Table 3 summarizes emission factors used in this analysis.

Table 3. Electricity-related Emission Factors in lbs/MWh

SCE CO_2 [1]	Direct Access CO_2 [2]	CH_4 [2]	N_2O [2]
630.89	919.64	0.029	0.01

1 - 2007 Annual Emissions Report available at:
http://www.climateregistry.org/carrot/Reports/CREntityEmissionReport.aspx

2 - LGOP Table G.7 California Grid Average Electricity Emission Factors (1990-2007)

Conversion Factors

GHGs have different capacities for trapping heat and therefore GHG emissions are normalized using their global warming potential (GWP). GWP refers to how much heat a unit of GHG traps compared to a unit of CO_2 over a specified time period. This allows all GHG emissions to be reported as "CO_2 equivalents" (CO_2e). Table 4 shows the 100-year GWP of CO_2, CH_4, and N_2O.

Table 4. Global Warming Potentials

GHG	Name	GWP[1]
CO_2	Carbon Dioxide	1
CH_4	Methane	21
N_2O	Nitrous Oxide	310

1 – IPCC Second Assessment Report

Emissions

Electricity-related emissions were calculated using the following equation:

$$\text{GHG Emissions } (CO_2e) = \text{Activity Data X Emission Factor X GWP}$$

GHG emissions for Santa Ana are shown in Table 5.

Table 5. Santa Ana Electricity Usage and CO_2e Emissions, 2008

Sector	MWh[1]	Metric Tons CO_2e[2]
Community - Commercial and Industrial	1,275,141	367,048
Community - Commercial and Industrial, Direct Access	123,040	35,417
Community - Residential	345,637	99,491
Community Residential Direct Access	33,351	13,968
Total Community Electricity-related Emissions	**1,777,169**	**515,924**
Municipal – Buildings	30,097	8,663
Municipal - Streetlights	10,978	3,160
Municipal – Water Delivery	11,639	3,351
Total Municipal Electricity-related Emissions	**52,714**	**15,174**

1: Mega-Watt Hours
2: Metric tons carbon dioxide equivalent

3. Energy Savings

The CAP will provide a roadmap for the City to reduce GHG emissions. The CAP will include measures and strategies to reduce consumption and increase efficiency across multiple sectors, including electricity. The emissions reductions will be captured in future GHG emissions inventories with the implementation of the CAP. However, Santa Ana has been committed to energy savings before embarking on a CAP and has already demonstrated GHG reductions associated with electricity. This section summarizes electricity-based programs and projects at the municipal and community level that have resulted in GHG reductions prior to CAP development. Details regarding emissions calculations, which were prepared by ICLEI, are provided in Appendix B.

Municipal Energy Savings

LED Street Lighting

Santa Ana has reported saving an annual 287,119 kWh/year by replacing 253 high pressure sodium fixtures with LED. This translates to an annual emissions reduction of **83 $MTCO_2$/year**.

It should be noted that Santa Ana had established the use of LED traffic signals prior to the 2008 baseline and since 2008 have not produced any additional reduction. Due to the fact that traffic signals operate constantly year round, they produce substantial energy savings for the City, saving 1.2 million kWh/year. While these savings cannot be counted towards meeting a reduction goal, they are an excellent example of what can be achieved with new efficient technologies.

Building Retrofits

The City estimates that recent retrofits to City facilities accomplished with American Recovery and Reinvestment Act (ARRA) funding are saving 820,000 kWh/year. The resulting emissions reduction is **236 $MTCO_2$/year**. Additional natural gas savings were not quantified for these projects.

Municipal Lighting Upgrades

Between 2010 and 2012 the City has engaged with Southern California Edison on a number of incentivized projects that reduce energy from lighting in many of Santa Ana's parks and other facilities. These projects reduce electricity use by 1,702,446 kWh/year and save Santa Ana taxpayers $184,325/year. Emissions reductions from these projects total **490 MTCO$_2$/year.**

Water Wells Motor Efficiency Upgrade

Energy efficient motors were recently retrofitted at City water wells saving 1.1 million kWh/ year. The resulting emissions reduction from this action is **317 MTCO$_2$/year**. This represents electricity-based GHG reductions.

Community Energy Savings

Building Efficiency

Many building efficiency measures have been brought about through successful partnership with Southern California Edison in the Direct Install for Business program. The specific actions that have been employed are diverse depending on the specific program, but include rebate programs, bulb giveaways, and direct install projects. The annual reduction resulting from these programs amounts to **4,059 MTCO$_2$**. Table 6 contains a summary of these actions along with their associated emissions reductions.

Table 6. Edison Direct Install Program Impact

Program Name	Annual kWh Saved	Emissions Reduced (MTCO$_2$/Year)
SCE Direct Install for Business	10,200,000	2,938
Residential Energy Efficiency Kits	2,287,550	659
Residential Lamp Exchange	596,387	172
LED Holiday Light String Exchange	388,470	112
Residential CFL Bulbs Giveaway	361,375	104
Refrigerator Rebates	173,638	50
Elementary School Living Wise Program	84,000	24
Total Savings	14,091,420	4,059

In addition to the retrofits from Southern California Edison programs, natural gas retrofits were accomplished through equivalent programs from Southern California Gas. As displayed in Table 7, together those programs are reducing an estimated **1,726 MTCO$_2$/year**.

Table 7. Reductions from Southern California Gas Programs

Sector	Measure Category	Annual Energy Savings (Therms)	Emissions Reduced (MTCO2)
Commercial	Food industry, restaurant equipment	22,777	122
	Process improvement, equipment modernization	59,393	317
	Pipe insulations	111,016	593
	Stream traps	17,995	96
	Tankless water heater	6,571	35
	Storage water heater	1,707	9
	Tank insulation	87	0
	Boiler upgrade/replacement	21,130	113
	System new construction	813	4
	Commercial Pool Heater	4,367	23
Single Family	Central Gas Furnace	1,635	9
	Gas Storage water heater	576	3
	Tankless Water Heater	579	3
	Attic Insulation	10,674	57
	Wall Insulation	18,846	101
	Cloth Washers	6,626	35
	Dish Washers	890	5
Multi Family	Central Sys WHTR	1,957	10
	Water Heater Control	14,400	77
	Boiler Control	11,248	60
	Dish Washers	1.96	0
Point of Sales	Storage water heater	7,181	38
	Cloth Washers	1,473	8
	Dish Washers	1,153	6

The Weatherization program is delivered through Community Action Partnership and funded through Federal grants and local utilities reached 3,291 low-income households with weatherization assistance since 2008. Actions taken in homes can include combinations of a number of energy savings measures such as; air duct sealing, insulation, window glazing, HVAC tune ups, and replacement air conditioning and furnaces. Table 8 details the energy savings and emissions reduction estimates for these homes. The combined impact of gas and electricity savings equals a reduction of **1,553 $MTCO_2$/year.**

Table 8. Emissions Reduced through Weatherization program

Homes Weatherized	Annual Therms Saved /Household[1]	Total Therms Saved	Gas Emissions Reduced / year ($MTCO_2$)	Annual kWh Saved / Household[2]	Total kWh Saved	Electrical Emissions Reduced / year ($MTCO_2$)
3,291	72	236,952	1,298	271	891,861	255

Solar Power

According to the website Go-Solar California, there have been 6.5 MW of solar capacity installed in Santa Ana since 2008. Total electricity generated from these systems was calculated using the average annual kWh production per kW installed capacity of 1,678 for systems in the South Coast Air District[3]. This resulted in a value of 10,900 MWh of electricity produced per year and a subsequent emissions reduction of **4,700 $MTCO_2$/year**.

Water Conservation

The extraction, delivery, and treatment of water consume large amounts of energy. By conserving water, energy consumption is also reduced. Within the City of Santa Ana, large volumes of water are conserved annually through the Water$mart and other programs. For the calculation of this measure, water conserved was converted to energy consumption using the same values for water use intensity as were used in the development of the baseline inventory[4].

[1] California Energy Commission. Options for Energy Efficiency in Existing Buildings. CEC-400-2005-039-CMF. Table B-11.
[2] ibid
[3] Calculated from Table AE-2.1.CAPCOA, Quantifying Greenhouse Gas Mitigation Measures. August 2010. http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf
[4] CEC. 2006. Refining Estimates of Water-Related Energy Use in California prepared by Navigant Consulting, Inc.

Table 9.Water Conservation Programs Energy Savings

Water $mart Program	Water Conserved MG/Year	Indoor/Outdoor Use	Energy Intensity (kWh/MG)	Total Energy Conserved (kWh)	Emissions Reduced (MTCO2e)/Year
Clothes Washers	8.3	Indoor	13,021	108,362	31
Irrigation Controllers	6.2	Outdoor	11,110	68,454	20
Synthetic Turf	0.2	Outdoor	11,110	2,005	0.6
ULF Toilets	17.8	Indoor	13,021	232,359	67
Save A Buck rebates	462.9	Indoor	13,021	6,026,936	1,734

As a result of the water conserved, the total energy savings is 6,438,116 kWh/year. Total annual emissions reductions from water conservation programs in Santa Ana are **1,853 MTCO$_2$/year**.

<u>Reclaimed Water</u>

Since 2008, Santa Ana has progressively increased the volume of reclaimed water used in non-potable applications by 53.4 million gallons, from 62.3 to 115.7 million gallons. Each gallon of reclaimed water reduces energy use because it avoids being pumped over long distances like much of the extracted potable water is. Also because it will be used for non-potable applications, less treatment is necessary and therefore less energy is used to provide the resource. The estimated energy intensity of recycled water in the Los Angeles area is 1,841 kWh/million gallon[5]. Compared with the value of 11,110 kWh/million gallon for potable water used in outdoor applications, significant savings are achieved by utilizing reclaimed water. Total annual energy savings are estimated to be 494,928 kWh, resulting in emissions reductions of **142 MTCO$_2$/year.**

[5] Navigant Consulting. 2008. The Role of Recycled Water in Energy Efficiency and Greenhouse Gas Reduction. Table 4-13

4. Conclusion

The City of Santa Ana is committed to increasing energy efficiency in the community and municipal operations. This is evident from the numerous programs that have been implemented prior to embarking on the CAP process and have resulted in quantifiable GHG emissions reductions.

Efficiencies gained in municipal operations have led to **1,043 $MTCO_2$/year** reductions since the 2008 CAP baseline year and can be "credited" toward the City's CAP reduction goals. These reductions come from the facility energy efficiency improvements that were paid for with ARRA funds, Southern California Edison incentivized lighting retrofits in city streetlights, parks, and other facilities, and motor upgrades that the City made to its motors used to pump water from wells.

There have also been emissions reductions achieved at the community level prior to CAP development. These reductions are the result of the installation of solar panels (4,700 $MTCO_2$), SCE energy efficiency programs (4,059 $MTCO_2$), Southern California Gas efficiency programs (1,726 $MTCO_2$), weatherization programs (1,553 $MTCO_2$) and water conservation throughout the community (1,995 $MTCO_2$), totaling **14,033 $MTCO_2$/year**. These efforts have been made since 2008 and therefore may be applied as reductions since the baseline year.

One caveat to note relates to the energy savings with regard to water conservation and use of reclaimed water. The calculations made in these cases rely on average energy intensity for water systems in Southern California, rather than specific values from the City of Santa Ana and the Metropolitan Water District. Actual savings from these activities may vary slightly.

Clearly, the City is committed to energy efficiency and has accomplished energy and GHG reductions through internal municipal efforts, outreach, and with local and federal partnerships and funding. This effort will be augmented through the development of additional energy saving strategies that will be included in the City's CAP to achieve statewide GHG emissions reductions in accordance with AB 32, California Global Warming Solutions Act. The partnership between Southern California Edison and the City will be an important ongoing component to this effort.

Appendix A

City of Santa Ana

2008 Communitywide and Municipal Greenhouse Gas Emissions Inventory and Business-as-Usual Forecasts for 2020 and 2035

Prepared by
ICLEI and AECOM
May 2012

Contents

EXECUTIVE SUMMARY

This report presents the City of Santa Ana's (City) greenhouse gas (GHG) emissions inventory and forecasts for communitywide and local municipal operations. The purpose of the GHG emissions inventory is to identify sources, distribution, and overall magnitude of GHG emissions to enable City policy makers to implement the most effective GHG-reduction strategies (in terms of GHG-reduction potential, political feasibility and cost-effectiveness) in areas over which they have operational or discretionary control. The business-as-usual (BAU) forecasts estimate the level of GHG emissions for communitywide activities and local municipal operations if GHG-reduction strategies were not implemented.

AECOM has developed a GHG emissions inventory (inventory) for communitywide and municipal GHG emissions sources for the 2008 base year. The forecasts are for the years 2020 and 2035. The inventory and forecasts will be used to support the City's Climate Action Plan (CAP).

Communitywide Emissions and Forecast

The GHG inventory is the first step in effectively managing emissions from community activities and municipal operations. In 2008, the community of Santa Ana generated approximately 1.96 million metric tons of carbon dioxide equivalent (MMT CO_2e) emissions. Emissions have been broken down by sector to facilitate the CAP planning process. As shown in Figure ES1 and Table ES1, the largest sector in the communitywide inventory was the transportation sector, which accounted for 48% of emissions. Because communities vary demographically and geographically, emissions are often standardized based on population to produce a per-capita emissions estimate. Applying the City's 2008 population, baseline emissions were approximately 5.5 MT CO_2e per person. This is moderate compared to the per capita emissions level of the City of Los Angeles which was 13.5 (Los Angeles 2007).

Using local demographic information, future emissions were forecast to 2020 and 2035 under a business-as-usual path, assuming no action was taken to reduce GHG emissions. As shown in Figure ES2, community emissions are estimated to increase by about 5% from 2008 to 2020 and by about 11% from 2008 to 2035, with emissions totaling 2.06 MMT CO_2e in 2020 and 2.17 MMT CO_2e in 2035.

Figure ES1: 2008 Communitywide Greenhouse Gas Emissions Inventory

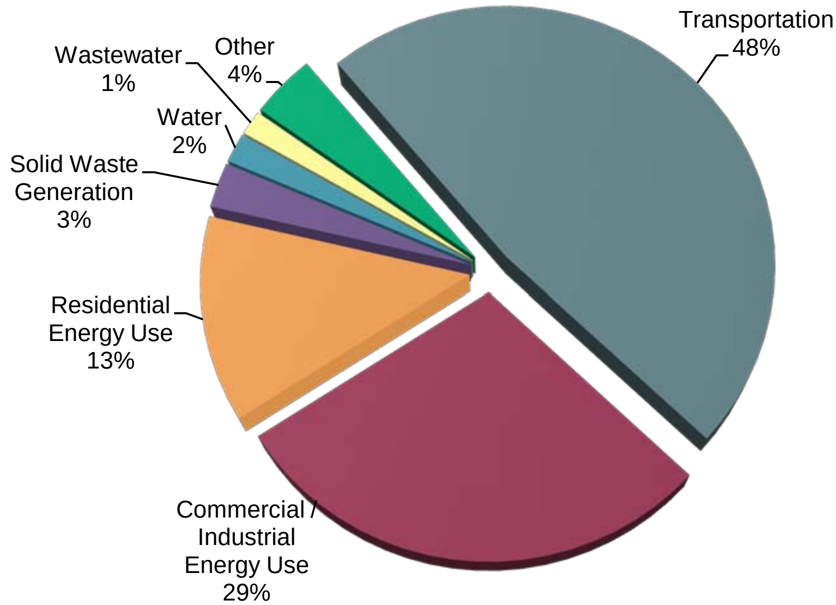
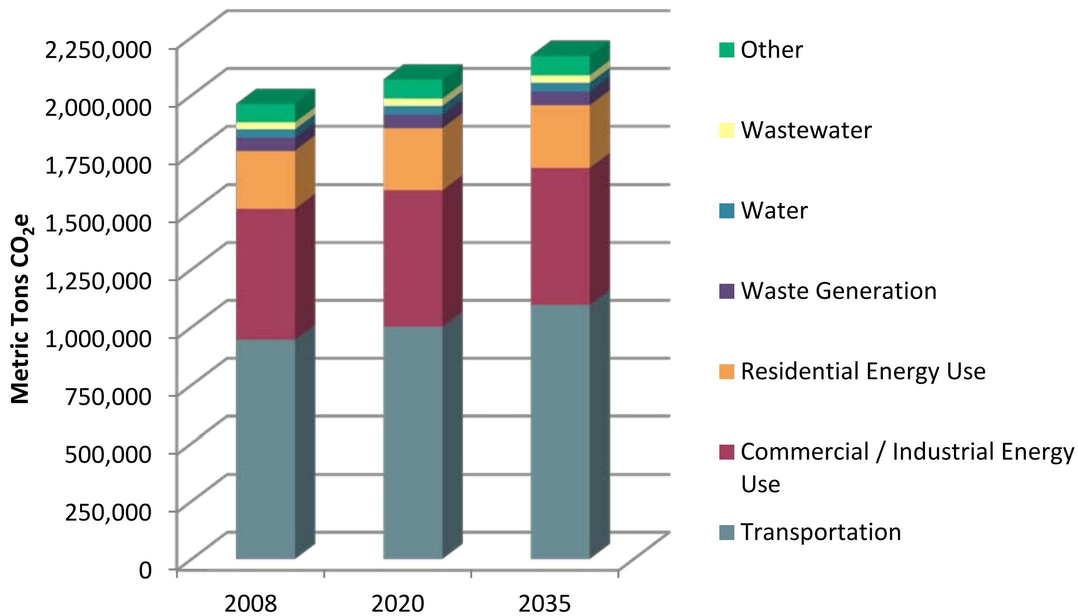


Table ES1: 2008 Communitywide Greenhouse Gas Emissions Inventory

Sector	MT CO_2e	% of Total CO_2e
Transportation	943,033	48%
Commercial / Industrial Energy Use	565,681	29%
Residential Energy Use	249,834	13%
Waste Generation	55,193	3%
Water	36,231	2%
Wastewater	30,223	1%
Other	79,236	4%
Total	**1,959,431**	**100%**

Figure ES2: Communitywide Business-as-Usual Emissions Forecasts



Municipal Operations Emissions and Forecast

Municipal operations are considered a subset of communitywide emissions. However, the City has greater control over its own emissions sources and by separating the municipal operations emissions, the City can better identify opportunities for applying GHG-reduction measures. GHG-reduction measures applied to municipal operations can serve as examples for the community. Municipal operations emissions accounted for approximately 1.4% of total communitywide emissions, or 27,793 MT CO_2e. These emissions were also estimated by sector, as shown in Figure ES3 and Table ES 2.

The largest sector in the municipal inventory was the buildings and facilities sector, which is made up of emissions from on-site fuel consumption and indirect electricity usage; these accounted for 35% of all municipal emissions. Indirect electric emissions are those generated as a result of activities occurring within Santa Ana, but that occur in a different geographic area such as electricity generation.

Municipal operations are not expected to grow and therefore emissions from municipal operations in the future under a business-as-usual path would be nearly the same as baseline emissions.

Figure ES3: 2008 Municipal Greenhouse Gas Emissions Inventory

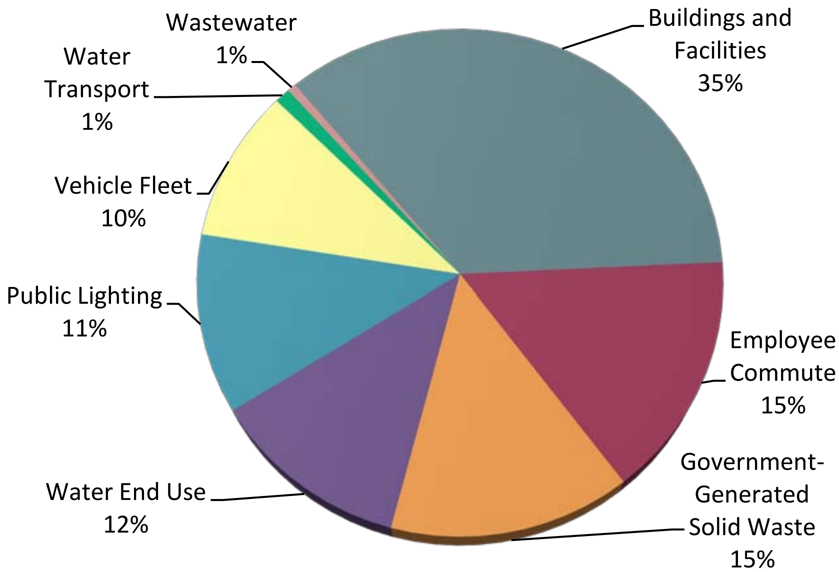


Table ES2: 2008 Municipal Greenhouse Gas Emissions

Sector	MT CO_2e	% of Total CO_2e
Buildings and Facilities	9,830	35%
Employee Commute	4,280	15%
Government-Generated Solid Waste	4,012	15%
Water End-Use (irrigation, etc.)[1]	3,351	12%
Public Lighting	3,160	11%
Vehicle Fleet	2,730	10%
Water Transport (electricity embedded in water)[1]	274	1%
Wastewater Treatment	156	1%
Totals	**27,793**	**100%**

[1]End-use water-related emissions refers to pumping water from point of delivery to the final use (irrigation, wastewater, etc.). Electricity embedded in water refers to the energy to convey water from the source to point of delivery.

Next Steps

The next steps in development of a CAP include setting a reduction target, working with the community and City staff to develop feasible actions to reduce GHG emissions in the City, and preparation of the CAP document. The City is currently conducting public meetings to gather input into how the community can best mitigate emissions to achieve GHG reductions.

GREENHOUSE GAS EMISSIONS INVENTORY

OVERVIEW

A GHG emissions inventory describes the amount of GHGs emitted by various sources over a specific period of time. The inventory is often developed by local governments and used in plans that estimate emissions over time and to establish measures that can reduce emissions. This is generally in conformance with the Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32), which requires statewide emissions levels in 2020 to be reduced to 1990 levels.

An inventory for communitywide activities and local government operations was developed for the City of Santa Ana by emissions sector. An emissions sector is a distinct subset of a market, society, industry, or economy, whose components share similar characteristics. The 2008 inventory addresses the following emissions sectors: energy consumption (electricity and natural gas use), on-road transportation, solid waste, water and wastewater treatment, and non-road fuel consumption (e.g., emergency generators, off-road recreational vehicles, lawn equipment). Government-related GHG emissions are considered a subset of the communitywide emissions inventory and are conducted because local governments have much greater control over emissions from municipal operations. By quantifying and reducing emissions from municipal operations, the City can serve as a leader in reducing communitywide GHG emissions.

This inventory focuses on the three GHGs most relevant to local government policymaking: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Converting non-CO_2 gases to units of carbon dioxide equivalent (CO_2e) emissions allows GHGs to be compared on a common basis (i.e., on the ability of each GHG to trap heat in the atmosphere). Non-CO_2 gases are converted to CO_2e using internationally recognized global warming potential (GWP) factors. GWPs were developed by the Intergovernmental Panel on Climate Change (IPCC) to represent the heat-trapping ability of each GHG relative to that of CO_2 and are consistent with the GWPs used by the California Air Resources Board (ARB) for California statewide emissions. For example, the GWP of CH_4 is 21 because 1 metric ton of CH_4 has 21 times more ability to trap heat in the atmosphere than 1 metric ton of CO_2. The GWP of N_2O is 310.

BASELINE YEAR

Reporting GHG inventories on a calendar year basis is considered an international standard. The United Nations Framework Convention on Climate Change, the Kyoto Protocol, The European Union Emission Trading System, The Climate Registry, California Climate Action Registry (CCAR), California's mandatory reporting regulation under AB 32 and the U.S. Environmental Protection Agency's (EPA) GHG reporting program all require GHG inventories to be tracked and reported on a calendar year basis. The communitywide and municipal inventories for Santa Ana were prepared for the year 2008. This year was selected since the City had the most complete data compared to other years.

INVENTORY APPROACH

The municipal inventory was prepared using the Local Government Operations Protocol (LGOP), which was developed by ARB, CCAR, and ICLEI - Local Governments for Sustainability (ICLEI), in collaboration with The Climate Registry (ARB 2010). The LGOP provides a standardized set of guidelines to assist local governments to quantify and report GHG emissions associated with their government operations. The LGOP strongly encourages local governments to utilize operational control when defining their organizational boundary. Operational control describes the emissions sources that local governments can influence and is the consolidation approach required under AB 32's mandatory reporting program. It is also consistent with the requirements of many other types of environmental and air quality reporting. This inventory was prepared using the operational control approach.

To assist the City in making easy future updates to their GHG baseline inventory, ICLEI's Master Data Workbooks (MDW) and Clean Air & Climate Protection (CACP) software was utilized. The MDW provide a central file for storing all documents, emissions factors, and working files related to a municipal or community inventory. CACP is an emissions management software program that allows local governments the ability to easily convert activity data into emissions. CACP was used for all emissions calculations except transportation, water, and wastewater, which used more sector-specific methodologies described below.

Currently, there is no standard community emissions protocol; however, many documents have been developed to guide development of community inventories. Specific sources and methodologies are outlined in each of the sectors below. The boundary for defining community emissions is generally the physical geographic boundary of the community. The community inventory, then, will include governmental, residential, industrial, and commercial activities. While the geographic definition of a community's boundary works well for stationary sources, mobile source emissions are more challenging and the methodology used for mobile-source emissions is detailed below.

METHODOLOGY

City staff and AECOM collected data from various sources, including City departments, public utilities, and private entities that provide services within the community. Data collection included activities specific to city/municipal operations (e.g., building energy, and vehicle fuel usage) and community-wide activities (e.g., total tons of solid waste collected) that occurred in 2008.

AECOM used emissions factors recommended by the LGOP and the IPCC to estimate CO_2e emissions for municipal operations and communitywide activities. Emissions factors may be refined and improved to reflect better measurement technology and research or changes in technology that alter the GHG intensity of the activity (e.g., the carbon content in gasoline).

Energy Consumption – Electricity and Natural Gas

The energy consumption sector includes the use of electricity and natural gas in residential, commercial, and industrial land uses within the city. Although emissions associated with electricity production are likely to occur in a different jurisdiction, consumers are considered accountable for the generation of those emissions. Electricity-related GHG emissions are considered indirect emissions. Indirect emissions are those *generated* as a result of activities occurring within Santa Ana, but that *occur* in a different geographic area. For example, a Santa Ana resident may consume electricity within the city, but the electricity may be generated at a power plant in a different location. By contrast, direct emissions are emissions where the activity directly generates the emissions (e.g., natural gas combustion for heating or cooling).

Southern California Edison (SCE) provided electricity consumption data in kilowatt-hours per year for 2008. Southern California Gas Company provided natural gas consumption data in therms per year for 2008. These two entities provide all electricity and natural gas used in Santa Ana.

Electricity-related GHG emissions were quantified using utility-specific emissions factors, taken from SCE's 2007 Annual Emissions Report for the California Climate Action Registry, for SCE supplied electricity. For electricity supplied by direct access providers through SCE's transmission system, a California wide average emissions factor, from the LGOP, was used because less information is known about this electricity. SCE was not able to isolate direct access by rate type, but did note that direct access electricity makes up 8.8% of all electricity provided by SCE; this percentage was then multiplied by both the residential and commercial/industrial emissions sectors to estimate the amount of electricity supplied by direct access providers. SCE did not report an emissions factor for 2008; therefore, the 2007 emissions factor was used as a proxy. Emissions factors for CH_4 and N_2O were obtained from the LGOP, which provided a statewide average emissions factor. Emissions factors for CO_2, CH_4, and N_2O for natural gas were provided by ICLEI's CACP software, which utilizes LGOP emissions factors.

Transportation

The transportation sector includes the operation of vehicles on roads. Emissions from mobile combustion can be estimated based on vehicle fuel use and miles traveled. CO_2 emissions account for most emissions from mobile sources and are directly related to the quantity of fuel combusted. Thus, CO_2 emissions can be calculated using fuel consumption data. CH_4 and N_2O emissions depend more on the emission control technologies employed in the vehicle and the distance traveled. Calculating CH_4 and N_2O emissions requires data describing vehicle characteristics (which takes into account emission control technologies) and vehicle miles traveled (VMT).

Communitywide VMT, as well as City employee-commute data were provided by Fehr & Peers. To calculate communitywide VMT, Fehr & Peers used the Orange County Transportation Authority (OCTA) regional travel demand model. Once communitywide VMT estimates were calculated, trips that started in Santa Ana and ended outside of the City and trips that started outside and ended within the City were discounted by 50% to reflect the fact that some of these emissions will occur outside of Santa Ana's jurisdictional boundaries. Trips that are external to Santa Ana (i.e., pass-through trips) were excluded from all VMT calculations. This exclusion of pass-through trips ensures that Santa Ana is not penalized with the emissions from traffic traveling through the City without stopping. This approach is consistent with the Regional Targets Advisory Committee document entitled *Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375.* Once daily VMT was calculated, a factor of 347 was applied to the VMT data to convert the data from daily to annual VMT; this conversion factor was identified by ARB. For full transportation methodology details please see the Fehr and Peers Memorandum dated February 15, 2012 titled *Travel Model Data for the*

Santa Ana GHG Inventory (Estimates & Forecasts)- Updated, which can be found at the end of this document as Appendix A. The City provided total fuel consumption and VMT data for the City vehicle fleet in 2009, which was used as a proxy year for 2008.

Emissions factors for the community transportation sector, municipal vehicle fleet, and municipal employee commute were derived from ARB's vehicle emissions model, EMFAC. EMFAC is a mobile source emissions model for California that provides vehicle emissions factors by both county and vehicle class. This was used instead of CACP because EMFAC uses data such as local vehicle registration to provide a more accurate estimation of vehicle type in the Santa Ana region. For the emissions inventory, Orange County emissions factors were used. Pursuant to EPA guidance, CO_2e emissions were calculated by dividing CO_2 emissions by 0.95, which accounts for other GHGs such as N_2O, CH_4, and other high GWP gases.

Solid Waste

The solid waste sector includes emissions resulting from the collection, processing, and disposal of solid waste. Fugitive CH_4 emissions are released from solid waste facilities, namely landfills, that accept organic waste. Solid waste disposal creates CO_2 emissions, which occur under aerobic conditions, and CH_4 emissions, which occur under anaerobic conditions.

Community- and municipal-generated solid waste data were provided by the City. City and community waste is handled by Waste Management, the City's hauler for residential, commercial, industrial, and construction and demolition debris. Ware Disposal also provides construction and demolition debris hauling services. These contractors recycle, recover, or dispose of (in landfills) the waste. The Frank R. Bowerman, Olinda Alpha, and Prima Deshecha sanitary landfills are the primary landfills for Santa Ana. Although the landfills are located outside of Santa Ana's municipal jurisdiction, emissions related to waste disposal may be affected by Santa Ana and are therefore included in the emissions inventories.

GHG emissions resulting from solid waste collected within the community and from government services were estimated using ICLEI's CACP, which utilizes emissions factors from the EPA's Waste Reduction Model (WARM 2009) and waste characterization information from the California Integrated Waste Management Board's 2008 waste characterization study.

Wastewater

The wastewater sector includes emissions resulting from wastewater treatment processes, including wastewater collection, managing septic systems, primary and secondary treatment, solids handling, and effluent discharge. Wastewater treatment processes can encompass many different sources of GHG emissions. The primary GHG emissions from wastewater treatment facilities are CH_4 and N_2O emissions created by septic systems and centralized wastewater treatment.

Community wastewater is treated by the Orange County Sanitation District (OCSD) at their two treatment plants. Because OCSD does not directly monitor wastewater generated by specific jurisdictions or individual users, such as the City, an estimate of wastewater generated by community and municipal sources was provided by the City. The City estimated that 75% of nonirrigation water consumed in the City was sent to wastewater treatment plants.

GHG emissions associated with wastewater treatment were calculated using the IPCC methodology for centralized, aerobic wastewater treatment plants (IPCC 2006). Wastewater information required by the IPCC methodology includes influent biochemical oxygen demand and effluent nitrogen content; this information was provided by OCSD. Because OCSD does not track effluent nitrogen content, effluent nitrogen content was assumed to be 2 milligrams greater than ammonia levels, which are tracked by OCSD. (Influent is flowing in and effluent is flowing out.)

Water Consumption

The water sector includes emissions from energy associated with water treatment, distribution, and conveyance of water to the community.

Many Southern California communities must import water from remote locations via the Colorado River and State Water Project. Water for community and municipal operations is provided by the City, which obtains 34% of its water from these remote locations via the Metropolitan Water District (MWD), and the remaining 66% locally from groundwater sources. The California Energy Commission has published water-energy intensity studies that estimate the energy required to convey, treat, and distribute water. All water is treated to be potable, but water used in outdoor activities, such as landscape irrigation, is not subject to wastewater treatment. Energy demand associated with water supply and conveyance for local groundwater was not included, and wastewater treatment is not included in outdoor water consumption estimates. This is due to local groundwater pumping and conveyance is already accounted for in energy use. Conveying and distributing MWD water from remote locations involves a considerable amount of electricity to run pumps and other facilities; therefore, MWD-derived water accounts for over 4/5 of total water-related GHG emissions, although it supplies only 1/3 of the City's water (Figure 1a &1b).

Figure 1a: Santa Ana 2008 water usage by supplier

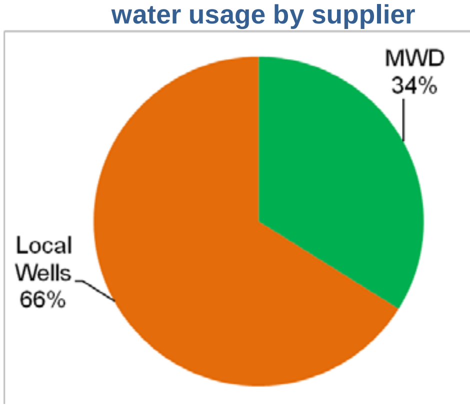
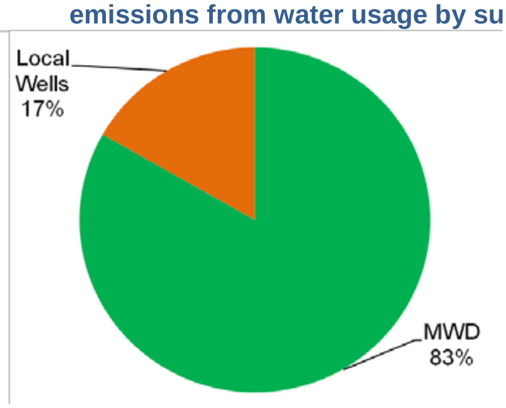


Figure 1b: Santa Ana 2008 emissions from water usage by supplier



Other Sources

This sector groups emissions from construction, light commercial, industrial, lawn and gardening, and off-road vehicle emissions.

Data for community activities were estimated using OFFROAD2007, which provides county-level emissions for off-road equipment. For municipal operations the fuel use and hours of operation is not tracked for small equipment, therefore this sector was excluded from the municipal operations inventory.

OFFROAD2007 is an off-road mobile source emissions model for California, which provides emissions by county for equipment such as construction, light commercial, industrial, and lawn and garden, and for recreational vehicles. Applicable indicators specific to the City were used to allocate the total countywide emissions. Indicators include statistics such as demographic data from Southern California Association of Governments (SCAG), the US Census Bureau, and US Department of Housing and Urban Development.

RESULTS

Reporting emissions by sector provides a useful way to understand the sources of a community's and a local government's emissions. By better understanding the relative scale of emissions from each sector, the City can more effectively focus emissions reduction strategies to achieve the greatest emissions reductions.

Communitywide Inventory Discussion

Santa Ana's 2008 communitywide GHG emissions inventory showed that total emissions was approximately 1.96 MMT CO_2e. Of all the sectors that make up this total, transportation was the largest, accounting for approximately 48% of all community emissions, followed by commercial and industrial energy (29%) and residential energy (13%). As shown in Table 1 and Figure 2, these three sectors of GHG emissions in the 2008 community inventory accounted for 90% of total emissions:

1. Transportation (48%)
2. Commercial / Industrial Energy Use (29%)
3. Residential Energy Use (13%)

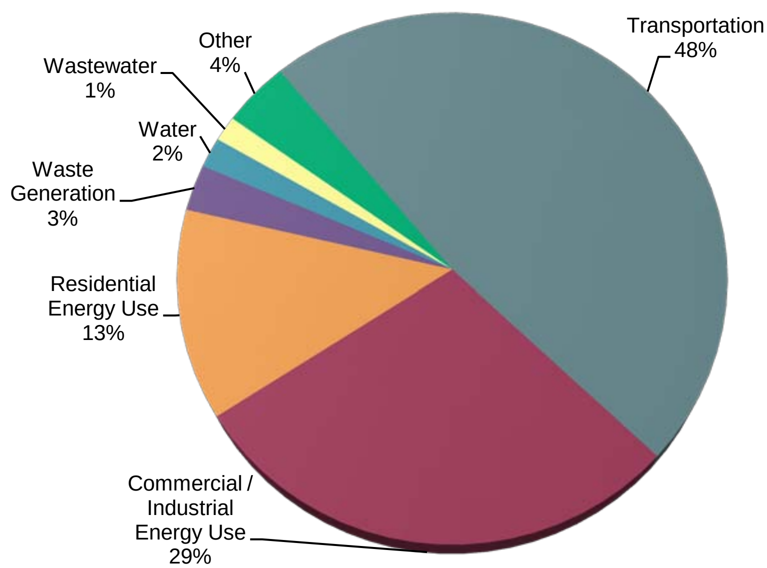
The remaining sources, generating 10% of total 2008 GHG emissions, included:

1. Water (2%)
2. Solid Waste Generation (3%)
3. Wastewater (1%)
4. Off-road vehicles and portable equipment (4%)

Table 1: 2008 Communitywide Greenhouse Gas Emissions Inventory

Sector	MT CO_2e	% of Total CO_2e
Transportation	943,033	48%
Commercial / Industrial Energy Use	565,681	29%
Residential Energy Use	249,834	13%
Waste Generation	55,193	3%
Water	36,231	2%
Wastewater	30,223	1%
Other	79,236	4%
Total	**1,959,431**	**100%**

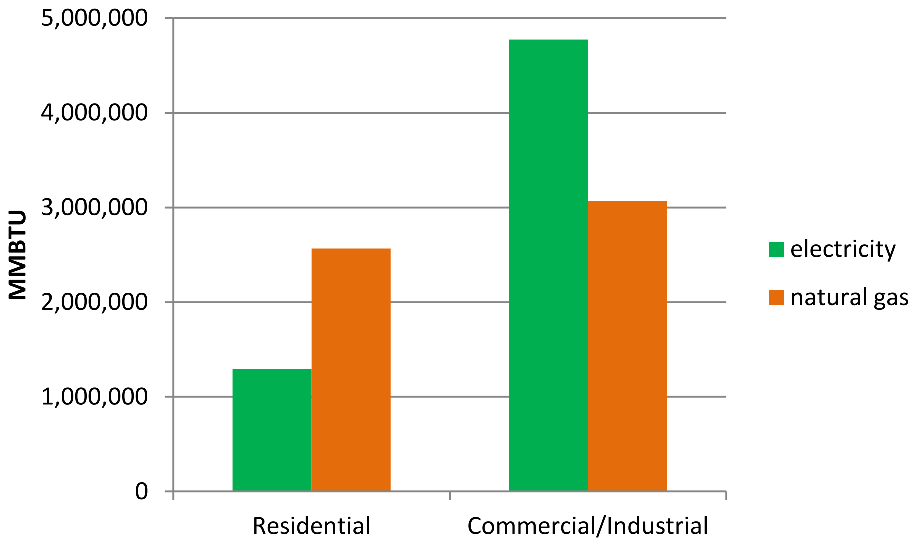
Figure 2: 2008 Communitywide Greenhouse Gas Emissions Inventory



Another common way to look at communitywide emissions data is to evaluate emissions on a per-metric basis. Using demographic data such as population and employment numbers, communities can compare emissions while accounting for the differing population size and makeup. Santa Ana's per-capita emissions were 5.5 MT CO_2e and the per-service population (residential population plus employment population) emissions were 3.7 MT CO_2e in 2008.

To provide more information about the residential energy use and commercial/industrial energy use sectors the activity data was converted from kWhs and therms to MMBTUs (Figure 3). This allows for a comparison of all energy used in the community to identify which types of energy efficiency programs would be best suited for which sector. For example, a program targeted for the residential energy use sector might include a focus on natural gas consumption, while commercial/industrial energy efficiency programs might focus more on electricity savings.

Figure 3: Communitywide Energy Use



Municipal Inventory Discussion

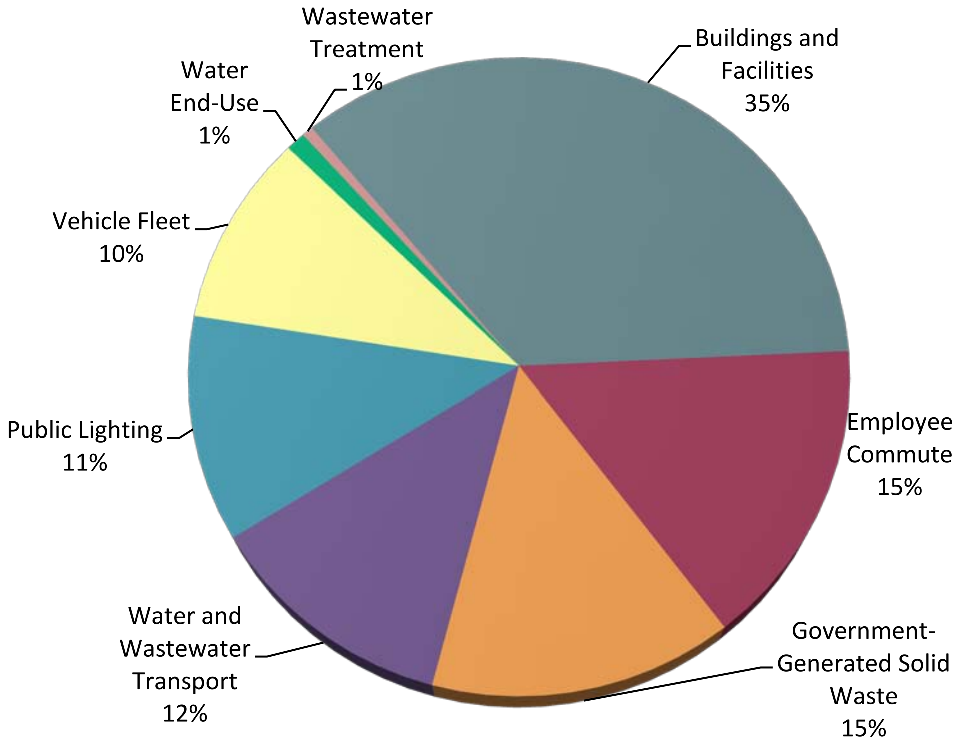
Municipal operations within the City during 2008 accounted for approximately 1.4% of total communitywide GHG emissions, totaling 27,793 MT CO_2e. **The largest source of municipal emissions was energy consumption within the buildings and facilities sector, which accounted for 35% of all municipal emissions** (Table 2 and Figure 4)**.** The City will likely be able to achieve the largest, most cost-effective municipal emissions reductions from energy conservation measures.

Table 2: 2008 Municipal Greenhouse Gas Emissions

Sector	MT CO_2e	% of Total CO_2e
Buildings and Facilities	9,830	35%
Employee Commute	4,280	15%
Government-Generated Solid Waste	4,012	15%
Water End-Use (irrigation, etc.)[1]	3,351	12%
Public Lighting	3,160	11%
Vehicle Fleet	2,730	10%
Water Transport (electricity embedded in water)[1]	274	1%
Wastewater Treatment	156	1%
Totals	**27,793**	**100%**

[1]End-use water-related emissions refers to pumping water from point of delivery to the final use (irrigation, wastewater, etc.). Electricity embedded in water refers to the energy to convey water from the source to point of delivery.

Figure 4: 2008 Municipal Greenhouse Gas Emissions Inventory



Since the city's government has control over operations, there is more opportunity to affect change than at the community level . To better assess the largest emissions sector, emissions were evaluated from the City's top-emitting facilities (Figure 5). As shown, the largest emitting facility is the police department building, which emitted 2,276 MT CO_2e and accounted for 23% of all building and facility emissions. This is typical for municipal operations because many police departments operate 24 hours per day, 7 days per week, and require greater resources than other government buildings. However, this facility may also provide the greatest opportunity to focus energy-efficiency improvements that will result in GHG reductions. Other facilities that may provide opportunities for energy-efficiency improvements include City Hall, Bowers Museum, and the various facilities that are accounted for in the Parks, Recreation and Community Services Agency.

An analysis of Municipal-generated solid waste was also conducted to identify which facilities or departments sent the most waste to the landfill (Figure 6). In this sector, the Santa Ana Stadium produces nearly half (49%) of all municipal solid waste sent to landfills. This indicates an opportunity to focus solid waste reduction efforts on this facility to reduce municipal GHG emissions.

Figure 5: Municipal Energy Emissions by Facility

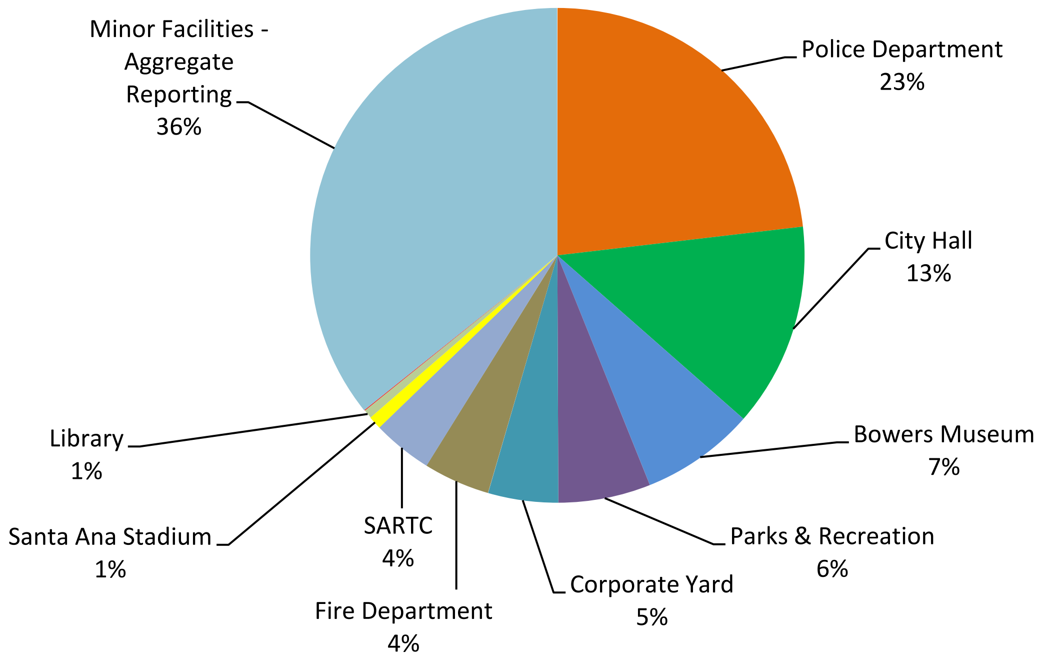
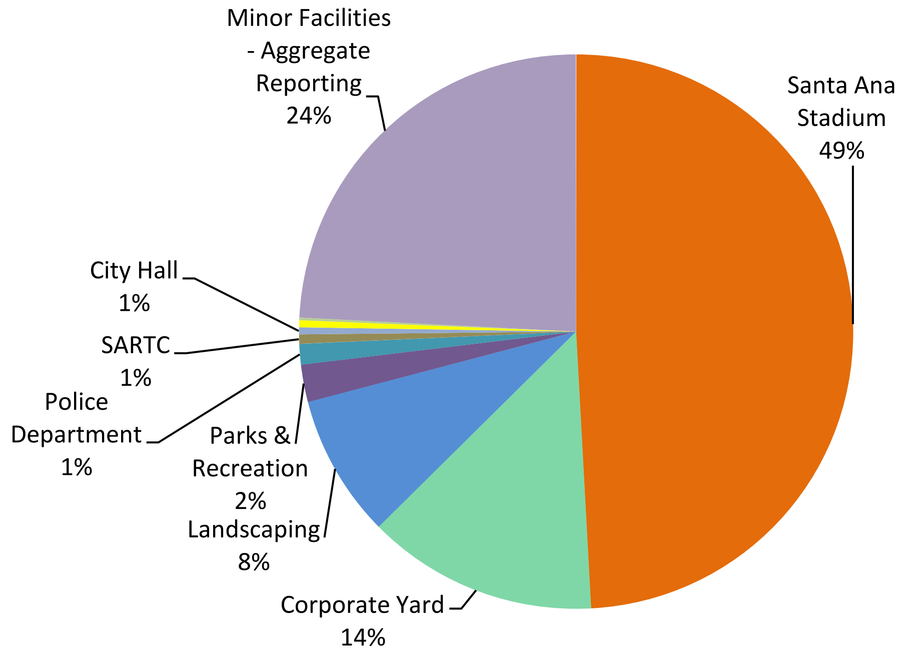


Figure 6: Municipal-Generated Solid Waste Emissions by Facility



BUSINESS-AS-USUAL EMISSIONS FORECASTS

OVERVIEW

Community and municipal operations GHG emissions were projected for 2020 and 2035 under a Business-As-Usual (BAU) scenario. The community BAU scenario estimates future trends in energy, solid waste, wastewater, water, and other sectors based on the SCAG forecasts of population, housing, and employment for the City, and assuming that historic trends in energy consumption and waste generation continue. Future VMT forecasts were created by Fehr & Peers using the OCTA regional travel demand model prepared to accompany the Orange County Subregional Sustainable Communities Strategy, based on *Orange County Projections* (OCP) data for 2035. Using the 2008 and 2035 VMT data, Fehr & Peers interpolated a 2020 VMT scenario.

The City's municipal staff has decreased significantly in recent years, and may decrease further in coming years. Because of this trend, it was assumed that no growth would occur in municipal operations, and in resulting emissions, between 2008, 2020, and 2035.

The 2020 and 2035 BAU scenarios describe what would likely occur without the implementation of a CAP or other statewide GHG-reducing measures, such as the Low Carbon Fuel Standard, which requires 10% reduced carbon content in gasoline by 2020; Pavley vehicle fuel efficiency legislation, which covers passenger auto and light trucks; and the Renewable Portfolio Standard, which requires investor-owned utilities to obtain 33% of their energy supply from renewable sources by 2020. These statewide emissions reduction measures were excluded from the BAU scenario, but will be accounted for in the GHG reduction measures to be presented in the CAP.

RESULTS

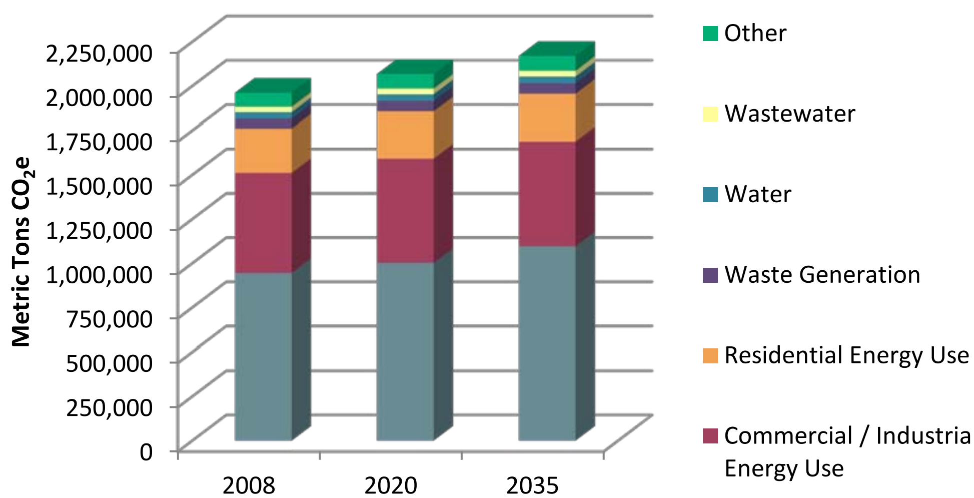
Similar to the baseline GHG inventory, each BAU emissions forecast is separated into sectors. This allows the City to evaluate emission changes by sector, which may be useful for the CAP. Overall, communitywide emissions are estimated to increase by 5%, or by 105,832 MT CO_2e/yr, by 2020; and 11%, or 208,319 MT CO_2e/yr, by 2035. These increases would bring total communitywide emissions to 2.06 MMT CO_2e/yr in 2020, and 2.17 MMT CO_2e/yr in 2035 (Table 3 and Figure 7). The largest emissions increases would occur within the transportation sector, which is estimated to increase by 6% by 2020, and 16% by 2035.

Table 3: Communitywide Business-as-Usual Emissions Forecasts

Sector	2008 MT CO_2e	2020 MT CO_2e	2035 MT CO_2e	% Change from 2008 to 2020	Annual Growth Rate from 2008 to 2020	% Change from 2008 to 2035	Annual Growth Rate 2008 to 2035
Transportation	943,033	999,732	1,093,632	6%	0.29%	16%	0.28%
Commercial / Industrial	565,681	589,476	591,972	4%	0.28%	5%	0.03%
Residential	249,834	265,459	268,463	6%	0.41%	7%	0.08%
Waste Generation	55,193	58,645	59,309	6%	0.41%	7%	0.08%
Water	36,231	37,313	37,477	3%	0.33%	3%	0.03%
Wastewater	30,223	32,113	32,477	6%	0.41%	7%	0.08%
Other	79,236	82,526	84,420	4%	0.31%	7%	0.17%
TOTAL	**1,959,431**	**2,065,263**	**2,167,750**	**5%**		**11%**	

*Sectors may not add to the totals due to rounding.

Figure 5: Communitywide Business-as-Usual Emissions Forecasts



NEXT STEPS

Creating a baseline and BAU emissions forecast allows Santa Ana to understand its emissions sources now and in the future. This will assist the City in the next steps of the CAP process, which is setting aggressive but achievable GHG-reduction goals and developing GHG-reduction strategies to attain those goals. Emissions reduction goals are set for selected years in the future, typically 2020, 2035, and occasionally 2050. Because of this, it is important to account for predictable changes in community and municipal operations that will affect GHG emissions in various sectors. Understanding the BAU forecasts, the City can create a package of emissions reduction measures that will enable it to approach or exceed established reduction goals. BAU forecasts that align with emissions reduction targets are also used as a baseline for quantifying GHG reduction measures.

AECOM

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California Air Resources Board (ARB)

2010 *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*. Version 1.1. May.

California Integrated Waste Management Board (CIWMB)

2008 *California 2008 Statewide Waste Characterization Study*. Available at http://www.calrecycle.ca.gov/Publications/General/2009023.pdf.

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2006 *IPCC Guidelines for National Greenhouse Gas Inventories*. Chapter 6 – Wastewater Treatment and Discharge.

City of Los Angeles (Los Angeles)

2007 *GREEN LA An Action Plan to Lead the Nation In Fighting Global Warming. Available at:* http://www.ci.la.ca.us/ead/pdf/GreenLA_CAP_2007.pdf

APPENDIX A

TRAVEL MODEL DATA FOR THE SANTA ANA GHG INVENTORY (ESTIMATES & FORECASTS)-UPDATED

APPENDIX B

SANTA ANA GHG EMISSIONS INVENTORY AND PROJECTIONS SUPPLEMENTAL DATA TABLES

MEMORANDUM

Date: February 15, 2012

To: Brian Holland- ICLEI
Cheryl Laskowski- AECOM

From: Chris Gray - Fehr & Peers

Subject: ***Travel Model Data for the Santa Ana GHG Inventory (Estimates & Forecasts)***

OC12-0192

The purpose of this memorandum is to present information regarding the existing conditions related to the Community Emissions for the City of Santa Ana Greenhouse Gas (GHG) Inventory. Information documented in this memorandum includes:

- Background information on the Orange County Transportation Authority (OCTA) Travel Demand Model
- Background on the use of the OCTA Travel Demand Model
- VMT Accounting Rules
- Discussion of land use categories in the OCTA Travel Demand Model
- Description of Traffic Analysis Zones (TAZ's) in the OCTA Travel Demand Model corresponding to Santa Ana
- Our review of the OCTA Travel Demand Model land use data for TAZ's corresponding to the City of Santa Ana
- Summary of Existing land use data in the OCTA Travel Demand Model for the City of Santa Ana
- Daily VMT Forecasts for Existing and Future Years for Community Emissions
- Annual VMT Forecasts for Existing and Future Years for Community Emissions

Additional information regarding each of these items is provided below.

BACKGROUND INFORMATION ON THE OCTA TRAVEL DEMAND MODEL

OCTA maintains a regional travel demand model (OCTAM) for use in various projects throughout Orange County including the recent Sub-Regional Sustainable Communities Strategy (SCS) document that was recently prepared by OCTA and the Orange County Association of Governments. The OCTA Model is also the basis for many of the City models developed for Orange County including the Irvine Model, the

Anaheim Model, and the South County Model which includes San Clemente and other nearby cities. While a regional model is also maintained by SCAG, we concluded that the use of the OCTA Model would ensure consistency with the Orange County SCS document and other studies within Orange County. The OCTA Model also has additional detail which is unavailable in the SCAG model, allowing greater refinement of the VMT estimates and forecasts. The main components of the model include:

- Land use data by Traffic Analysis Zone (TAZ)
- Roadway networks including freeways and most major roadways within the Orange County with additional detail for the larger SCAG region to allow the analysis of regional travel
- Transit networks including bus and rail lines

The information described above is available for 2005 and 2035. 2005 represents the Base Year or the Existing Year when development of the OCTA model initially began. 2035 represents the forecast year and is the same year as the Regional Transportation Plan and other long-range planning documents.

The 2005 and 2035 data is derived through the use an extensive process using various data sources and supplemented through meetings with the local jurisdictions. OCTA uses the services of the Center for Demographic Research at Cal State Fullerton to work with local jurisdictions to estimate future population and employment growth.

APPLICATION OF THE OCTA TRAVEL DEMAND MODEL

For this analysis, the OCTA Model was used to develop estimates of vehicle miles traveled (VMT) for the City of Santa Ana. A key input to the VMT estimates is the land use data, particularly the citywide totals since VMT is being estimated for the City as a whole. Since we are not utilizing the model to forecast roadway and intersection volumes, we are less concerned about the distribution of land uses for each TAZ within the City. However, we are concerned with the distribution of land uses to those TAZ's on the boundaries of the City since it could affect the citywide total.

VMT ACCOUNTING RULES

The following approach is recommended for calculating VMT and is applied in this analysis:

- Trips which are internal to Santa Ana (those that begin and end inside the City boundaries) are assumed to count 100% within any VMT calculations.
- Trips which either begin or end within Santa Ana are assumed to count 50% to any VMT calculations. This approach ensures that there is no double counting of VMT at the City level. For example, if there is a trip that begins in Santa and ends in Los Angeles, this approach ensures that Santa Ana is partially responsible for this VMT and the recipient City (Los Angeles) would be responsible for the remaining portion of the VMT.
- Trips which are external to Santa Ana are excluded from any VMT calculations. This exclusion of through trips ensures that Santa is not penalized by traffic which travels through City without stopping.

The approach above is consistent with the Regional Targets Advisory Committee (RTAC) document entitled *Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375* (September 2009).

LAND USE CATEGORIES IN THE SCAG MODEL

The land use data for each TAZ includes the following information, though not all categories are applicable to Santa Ana:

- Total number of persons
- Residential population
- Group quarters population
- Number of single-family dwelling units
- Number of multi-family dwelling units
- Persons per household
- Retail employment
- Service employment
- Other employment (industrial, warehouse, and other uses)

Please note that the OCTA model does not provide data based on non-residential land use such as acres by various types of uses, acreage by use, or other similar data.

TRAFFIC ANALYSIS ZONES FOR SANTA ANA

Our review of the OCTA Travel Model indicates that there are 114 traffic analysis zones that lie entirely or partially within the City of Santa Ana boundaries. The zones are provided in Figure 1.

OUR REVIEW OF SANTA ANA TAZ DATA

We performed an initial analysis of the Santa Ana TAZ data, primarily focusing on the total population. Our review of the total population numbers is that they appear to be reasonable.

SUMMARY OF EXISTING AND FUTURE LAND USE DATA FOR CITY OF SANTA ANA

Table 1 documents the land use information for 2005 as defined by the latest version of OCTAM. Table 2 provides the same data for 2035 while Table 3 provides a comparison of the two years and indicates the anticipated growth in 2035 from existing levels. Tables 2 and 3 reflect the information as currently defined in OCTAM.

VMT ESTIMATES AND FORECASTS

Table 4 documents the VMT estimates obtained from the OCTA Travel Model for the existing and future years. Please note that OCTA does not provide 2008 or 2020 data, therefore the 2008 and 2020 data is interpolated between 2005 and 2035. Annual VMT (vehicle miles traveled) estimates were developed based on the application of a factor of 347, which was identified by the California Air Resources Board (CARB) for the conversion of daily to annual VMT.

We hope you find this information helpful. Please contact Chris Gray (c.gray@fehrandpeers.com or 949-859-3200) if you have any questions or need more information from us at this time.

Figure 1- Santa Ana TAZ Boundaries

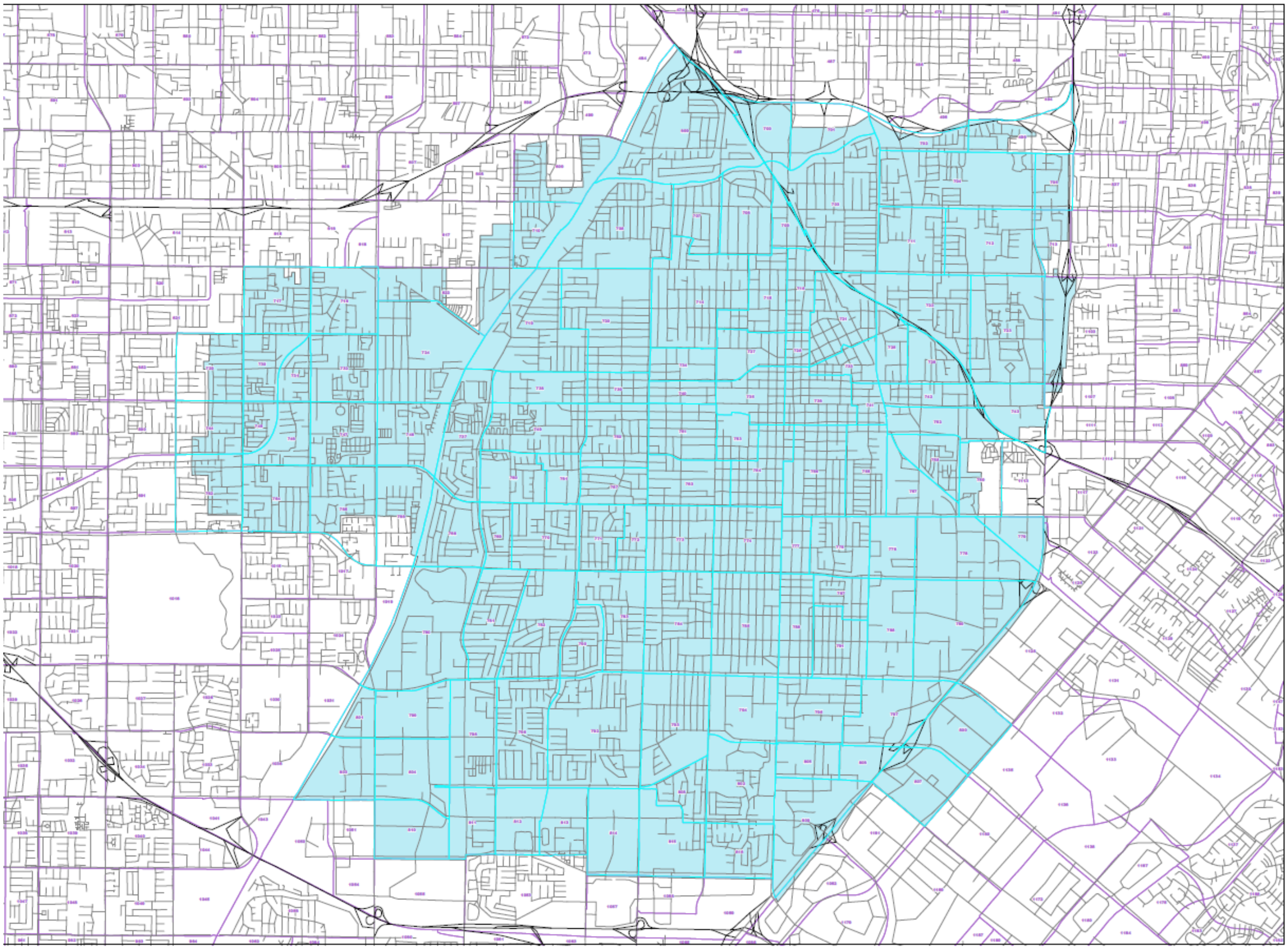


Table 1 2005 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
699	5425	2711	156	794	748	1542
703	4020	2163	0	1110	138	1248
704	4855	1764	19	629	1118	1747
705	1829	948	0	97	461	558
706	1409	399	0	409	123	532
707	1065	289	6	275	106	381
708	4737	2229	47	743	362	1105
709	1064	262	69	147	111	258
710	1664	406	127	244	91	335
711	1464	355	0	180	184	364
712	2758	1484	153	408	563	971
714	6171	2640	15	838	758	1596
715	8532	2527	33	150	1563	1713
716	5958	2572	68	86	1211	1297
717	3861	1803	10	588	138	726
718	3590	1829	16	357	313	670
719	6135	2591	0	665	430	1095
720	6301	2558	116	759	402	1161
721	4511	1369	205	187	746	933
722	2774	1344	0	452	254	706
723	3276	1486	62	402	1056	1458
724	7093	2477	92	539	579	1118
725	1117	318	129	42	160	202
726	1102	445	0	156	96	252
727	547	92	68	1	88	89
728	448	91	16	82	46	128
729	3391	1309	80	534	134	668
730	1924	444	0	135	360	495
731	2002	477	0	50	367	417
732	4170	1803	0	210	859	1069
733	2631	549	0	94	367	461
734	4543	755	2473	88	299	387
735	3447	539	2	89	986	1075
736	5775	975	67	324	713	1037
737	4158	1561	4	394	542	936
738	643	114	0	82	22	104
739	1978	983	95	174	129	303
740	2270	833	0	194	374	568
741	30	5	0	1	6	7

Table 1 2005 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
742	840	160	6	69	109	178
744	3255	1735	23	455	280	735
745	1360	646	0	51	310	361
746	2156	723	0	225	201	426
747	5512	2387	0	133	1238	1371
748	4567	1866	0	299	512	811
749	5573	1905	164	243	740	983
750	4501	1560	31	456	232	688
751	5879	2527	8	482	446	928
752	891	169	0	77	120	197
753	2268	933	21	117	283	400
754	5116	1761	34	402	489	891
755	8466	2723	0	323	1037	1360
756	8266	3521	0	656	747	1403
757	2	0	0	0	1	1
758	3077	449	0	7	693	700
760	6899	2951	0	203	905	1108
761	3405	1135	19	102	398	500
762	3106	1729	11	597	187	784
763	7472	2887	19	430	743	1173
764	3877	1621	5	504	265	769
765	3103	1305	12	477	284	761
766	2236	535	6	287	240	527
767	2924	976	0	384	23	407
768	3119	1449	2	468	41	509
769	2028	836	0	248	64	312
770	5631	2594	3	597	233	830
771	3702	1240	6	455	112	567
772	2546	430	0	272	141	413
773	4337	745	3	483	191	674
774	4005	1711	49	613	142	755
775	3138	1175	0	495	42	537
776	3466	1074	0	85	513	598
777	1653	841	0	228	33	261
778	1	0	0	0	1	1
779	0	0	0	0	0	0
780	0	0	0	0	0	0
781	5450	2304	23	716	161	877
782	4151	1648	12	455	201	656
783	4997	2260	19	440	395	835
784	5344	2212	18	845	65	910

Table 1 2005 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
785	6542	2262	0	970	181	1151
786	3345	1291	20	423	150	573
787	3319	1086	0	202	268	470
788	1	0	0	0	1	1
789	2	0	0	0	1	1
790	2636	1185	62	425	29	454
791	4533	1161	6	645	137	782
792	6087	2944	33	1042	316	1358
793	6264	2746	441	553	528	1081
794	3	0	0	2	0	2
795	2260	424	235	283	108	391
796	3932	2186	15	926	18	944
797	290	55	0	40	16	56
798	3786	1121	11	94	1144	1238
799	0	0	0	0	0	0
800	7	0	0	0	1	1
801	0	0	0	0	0	0
802	5060	2518	6	373	1082	1455
803	0	0	0	0	0	0
804	0	0	0	0	0	0
805	0	0	0	0	0	0
806	0	0	0	0	0	0
807	0	0	0	0	0	0
808	1607	714	0	378	11	389
809	853	425	0	4	335	339
810	0	0	0	0	0	0
811	1908	859	52	26	585	611
812	2236	818	0	70	916	986
813	1122	378	0	126	458	584
814	1447	945	0	1	843	844
815	5672	3071	0	165	1742	1907
816	2378	1402	6	428	218	646
	342840	**132227**	**5515**	**33318**	**39131**	**72449**
Source: Fehr & Peers, 2012						

Table 2 2035 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
699	6607	3301	190	838	881	1719
703	4327	2329	0	1113	139	1252
704	5249	1908	20	629	1125	1754
705	1968	1021	0	97	463	560
706	1512	428	0	411	123	534
707	1150	312	7	275	108	383
708	5178	2436	52	747	363	1110
709	1618	398	105	147	238	385
710	1734	423	132	244	91	335
711	1573	382	0	180	184	364
712	2979	1603	165	408	567	975
714	6469	2767	16	838	764	1602
715	9095	2694	35	180	1570	1750
716	6176	2665	71	86	1216	1302
717	3968	1852	11	588	138	726
718	3768	1920	17	357	315	672
719	6337	2676	0	665	430	1095
720	6522	2647	120	759	407	1166
721	5814	1764	264	187	939	1126
722	2992	1449	0	453	256	709
723	3588	1627	68	402	1061	1463
724	7230	3547	94	540	583	1123
725	2172	619	139	42	338	380
726	1162	470	0	156	96	252
727	565	95	70	1	88	89
728	475	96	17	82	47	129
729	3597	1394	83	538	140	678
730	2063	476	0	135	362	497
731	2145	511	0	50	368	418
732	4462	1930	0	210	863	1073
733	3839	800	0	94	552	646
734	4721	785	2567	88	301	389
735	4037	632	2	89	1085	1174
736	6494	1605	75	324	806	1130
737	4357	1636	4	394	542	936
738	661	118	0	83	22	105

Table 2 2035 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
739	2043	1016	98	175	130	305
740	2342	860	0	194	374	568
741	31	5	0	1	6	7
742	882	168	6	69	113	182
744	3493	1858	26	458	283	741
745	1390	660	0	51	312	363
746	2240	751	0	226	201	427
747	5928	2567	0	133	1243	1376
748	4772	1949	0	299	515	814
749	5778	1975	170	243	744	987
750	4619	1601	32	456	232	688
751	6020	2588	8	482	450	932
752	918	174	0	77	120	197
753	2322	956	21	119	282	401
754	5232	1801	35	402	493	895
755	8661	2786	0	323	1042	1365
756	8458	3602	0	656	752	1408
757	2	0	0	0	1	1
758	3275	478	0	7	693	700
760	7117	3044	0	203	910	1113
761	3521	1174	19	102	398	500
762	3382	1885	12	613	192	805
763	7645	2954	19	430	748	1178
764	4174	1744	6	505	267	772
765	3274	1387	13	493	287	780
766	3343	792	6	300	446	746
767	3018	1008	0	384	23	407
768	3517	1634	2	470	82	552
769	2076	856	0	248	64	312
770	5759	2654	3	600	233	833
771	3790	1270	6	457	112	569
772	2608	441	0	272	141	413
773	4438	763	3	483	193	676
774	4098	1751	51	613	145	758
775	3213	1203	0	495	42	537
776	3651	1131	0	85	513	598
777	1688	859	0	229	33	262
778	1	0	0	0	1	1
779	0	0	0	0	0	0

Table 2 2035 Land Use Data by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
780	0	0	0	0	0	0
781	5869	2481	24	719	161	880
782	4465	1773	13	456	202	658
783	5373	2430	20	440	398	838
784	5749	2380	19	849	65	914
785	6675	2307	0	973	183	1156
786	3425	1322	20	423	152	575
787	3395	1112	0	202	268	470
788	1	0	0	0	1	1
789	2	0	0	0	1	1
790	2833	1273	66	425	29	454
791	4639	1187	6	647	138	785
792	6669	3225	36	1042	321	1363
793	6864	3010	482	553	528	1081
794	3	0	0	2	0	2
795	2376	446	247	283	110	393
796	4309	2395	17	926	18	944
797	299	56	0	40	16	56
798	4073	1206	12	94	1148	1242
799	0	0	0	0	0	0
800	7	0	0	0	1	1
801	0	0	0	0	0	0
802	5546	2759	7	373	1087	1460
803	0	0	0	0	0	0
804	0	0	0	0	0	0
805	0	0	0	0	0	0
806	0	0	0	0	0	0
807	0	0	0	0	0	0
808	1758	782	0	378	11	389
809	3890	1938	0	5	1369	1374
810	0	0	0	0	0	0
811	2047	921	56	26	587	613
812	2469	904	0	70	920	990
813	1225	413	0	126	460	586
814	2378	1553	0	1	1199	1200
815	6216	3365	0	165	1750	1915
816	2610	1539	7	428	218	646
	370488	**144438**	**5892**	**33429**	**41728**	**75157**
Source: Fehr & Peers, 2012						

Table 3 2005-2035 Land Use Data Increase by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
699	1182	590	34	44	133	177
703	307	166	0	3	1	4
704	394	144	1	0	7	7
705	139	73	0	0	2	2
706	103	29	0	2	0	2
707	85	23	1	0	2	2
708	441	207	5	4	1	5
709	554	136	36	0	127	127
710	70	17	5	0	0	0
711	109	27	0	0	0	0
712	221	119	12	0	4	4
714	298	127	1	0	6	6
715	563	167	2	30	7	37
716	218	93	3	0	5	5
717	107	49	1	0	0	0
718	178	91	1	0	2	2
719	202	85	0	0	0	0
720	221	89	4	0	5	5
721	1303	395	59	0	193	193
722	218	105	0	1	2	3
723	312	141	6	0	5	5
724	137	1070	2	1	4	5
725	1055	301	10	0	178	178
726	60	25	0	0	0	0
727	18	3	2	0	0	0
728	27	5	1	0	1	1
729	206	85	3	4	6	10
730	139	32	0	0	2	2
731	143	34	0	0	1	1
732	292	127	0	0	4	4
733	1208	251	0	0	185	185
734	178	30	94	0	2	2
735	590	93	0	0	99	99
736	719	630	8	0	93	93
737	199	75	0	0	0	0
738	18	4	0	1	0	1
739	65	33	3	1	1	2
740	72	27	0	0	0	0

Table 3 2005-2035 Land Use Data Increase by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
741	1	0	0	0	0	0
742	42	8	0	0	4	4
744	238	123	3	3	3	6
745	30	14	0	0	2	2
746	84	28	0	1	0	1
747	416	180	0	0	5	5
748	205	83	0	0	3	3
749	205	70	6	0	4	4
750	118	41	1	0	0	0
751	141	61	0	0	4	4
752	27	5	0	0	0	0
753	54	23	0	2	-1	1
754	116	40	1	0	4	4
755	195	63	0	0	5	5
756	192	81	0	0	5	5
757	0	0	0	0	0	0
758	198	29	0	0	0	0
760	218	93	0	0	5	5
761	116	39	0	0	0	0
762	276	156	1	16	5	21
763	173	67	0	0	5	5
764	297	123	1	1	2	3
765	171	82	1	16	3	19
766	1107	257	0	13	206	219
767	94	32	0	0	0	0
768	398	185	0	2	41	43
769	48	20	0	0	0	0
770	128	60	0	3	0	3
771	88	30	0	2	0	2
772	62	11	0	0	0	0
773	101	18	0	0	2	2
774	93	40	2	0	3	3
775	75	28	0	0	0	0
776	185	57	0	0	0	0
777	35	18	0	1	0	1
778	0	0	0	0	0	0
779	0	0	0	0	0	0
780	0	0	0	0	0	0
781	419	177	1	3	0	3
782	314	125	1	1	1	2
783	376	170	1	0	3	3

Table 3 2005-2035 Land Use Data Increase by TAZ (OCTAM)						
TAZ	Pop	Households	Retail Employment	Office Employment	Industrial/Wholesale Employment	Total Employment
784	405	168	1	4	0	4
785	133	45	0	3	2	5
786	80	31	0	0	2	2
787	76	26	0	0	0	0
788	0	0	0	0	0	0
789	0	0	0	0	0	0
790	197	88	4	0	0	0
791	106	26	0	2	1	3
792	582	281	3	0	5	5
793	600	264	41	0	0	0
794	0	0	0	0	0	0
795	116	22	12	0	2	2
796	377	209	2	0	0	0
797	9	1	0	0	0	0
798	287	85	1	0	4	4
799	0	0	0	0	0	0
800	0	0	0	0	0	0
801	0	0	0	0	0	0
802	486	241	1	0	5	5
803	0	0	0	0	0	0
804	0	0	0	0	0	0
805	0	0	0	0	0	0
806	0	0	0	0	0	0
807	0	0	0	0	0	0
808	151	68	0	0	0	0
809	3037	1513	0	1	1034	1035
810	0	0	0	0	0	0
811	139	62	4	0	2	2
812	233	86	0	0	4	4
813	103	35	0	0	2	2
814	931	608	0	0	356	356
815	544	294	0	0	8	8
816	232	137	1	0	0	0
	28211	**12625**	**383**	**165**	**2819**	**2984**

Table 4 VMT Forecast & Estimates 2005-2035		
Year	VMT Estimates (Daily Vehicle Miles Traveled)	VMT Estimates (Annual Vehicle Miles Traveled)
2005	5,667,323	1,966,561,081
2008	5,717,915	1,984,116,488
2020	5,920,283	2,054,338,114
2035	6,173,243	2,142,115,148
Source: Fehr & Peers, 2012		

Appendix B: GHG Emission Inventory and Projections Supplemental Data Tables

Emissions Factors

Emissions factors are used to convert activity data, which represent actions, to greenhouse gas (GHG) emissions. For example the CO_2 emissions factor for natural gas is 5.302 kg/therm, this means that for every therm of natural gas consumed 5.302 kg of CO_2 are emitted. Each emissions factor is related to a specific GHG, so if there are multiple types of GHG emissions created by an action there may need to be multiple emissions factors. Unless otherwise noted emissions factors are used for baseline and projections.

Energy

The utility specific emissions factor is generated based on the specific mix of fuels used by Southern California Edison (SCE) for 2007 while the direct access emissions factor uses an average fuel mix for all state electricity. These emissions factors were used for the municipal inventory's buildings and facilities, water end-use, and public lighting sectors as well as the community inventory's commercial / industrial and residential energy use sectors.

	Electricity provided Southern California Edison[1]		Direct access electricity[2]		All electricity[2]			
	CO_2	Units	CO_2	Units	CH_4	Units	N_2O	Units
Electricity	630.89	lbs/MWH	919.64	lbs/MWH	0.029	lbs/MWH	0.01	lbs/MWH

1 - Southern California Edison's California Climate Action Registry 2007 Annual Emissions Report available at: http://www.climateregistry.org/carrot/Reports/CREntityEmissionReport.aspx

2 - Local Government Operations Protocol Table G.7 California Grid Average Electricity Emission Factors (1990-2007)

	CO_2	Units	CH_4	Units	N_2O	Units
Natural Gas	5.302	kg/therm	0.5	g/therm	0.01	g/therm

Local Government Operations Protocol Table G.3 Default Methane and Nitrous Oxide Emission Factors by Fuel Type and Sector

Water Transport

The table below was used to calculate the electricity used to supply, treat, and distribute water to the community as well as treat wastewater generated by the use of that water. This is called the amount of electricity embedded in water. Electricity embedded in water is different than water end-use electricity because embedded electricity accounts for energy used before the water reaches its final user. Once the electrical usage was calculated it was multiplied by the statewide electrical emissions factor (identified as direct access electricity above) because electrical consumption took place in multiple locations. It is important to note that not all water has the same electricity factor. For example local ground water does not include any electricity for water supply and conveyance and water used for landscaping does not include electricity for wastewater treatment.

-	Indoor (kWh/MG)		Outdoor (kWh/MG)	
	Northern CA	Southern CA	Northern CA	Southern CA
Water Supply & Conveyance*	2,117	9,727	2,117	9,727
Water Treatment*	111	111	111	111
Water Distribution*	1,272	1,272	1,272	1,272
Wastewater Treatment	1,911	1,911	-	-
Regional Total	**5,411**	**13,021**	**3,500**	**11,110**
CEC. 2006 (December).Refining Estimates of Water-Related Energy Use in California prepared by Navigant Consulting, Inc. * These reflect embedded electricity in water; this is different than water end-use electricity because embedded electricity represents energy consumed before the water reaches its final user.				

Transportation

These emissions factors, which were generated by the 2007 Emissions Factor (EMFAC 2007) model created by the California Air Resources Board (CARB), were used to convert fuel usage activity data to GHG emissions. The emissions factor for CNG was only used in the municipal inventory because municipal on-road vehicles, such as street sweepers, are classified as off-road vehicles by CARB and therefore an emissions factor was not generated for them by EMFAC 2007.

-	CO_2	Unit
2008		
Gasoline	8,704	Gram CO_2 per gallon of fuel (g/gal)
Diesel	10,094	g/gal
CNG[1]	54	g/ Standard cubic foot
2020		
Gasoline	8,795	g/gal
Diesel	10,080	g/gal
CNG[1]	54	g/ Standard cubic foot
2035		

Gasoline	8,825	g/gal
Diesel	10,055	g/gal
CNG[1]	54	g/ Standard cubic foot
All gas and diesel emissions factors are from EMFAC 2007 models for Orange County.		
1. Table G.11. Default CO_2 Emission Factors for Transport Fuels		

Solid Waste

These waste characterization percentages were used to estimate the specific contents in the community-wide and municipal generated solid waste. The emissions factors were then used to estimate methane emissions that will be created by the waste when it is stored in a landfill.

Waste Characterization				
Paper Products	Food Waste	Plant Debris	Wood/Textile	All Other Waste
17.3%	15.5%	7.1%	19.9%	40.2%
CalRecycle - 2008 waste characterization				

Waste Type	CH_4 Emission Factor (MT CH_4/MT waste)
Paper Products	2.1383
Food Waste	1.2103
Plant Debris	0.6859
Wood/Textiles	0.6052
All Other Waste	0.0000
ICLEI's Clean Air and Climate Protection Software	

Wastewater

These wastewater inputs were used with the Intergovernmental Panel on Climate Change emission quantification methodology for centralized aerobic wastewater treatment plants (IPCC 2006) to calculate emissions from community wastewater sent to wastewater treatment plants.

Influent Biochemical Oxygen Demand (BOD) (mg/L)	Methane Correction Factor	Effluent Nitrogen Content (mg/L)
300	0.2	28

Source: Orange County Sanitation District

Other (Off-road Transportation)

Off-road emissions were calculated using OFFROAD 2007, which calculates GHG emissions directly so no emissions factors were needed.

Activity Data

Municipal Inventory

Energy - 2008

	Electricity (kWh)	Natural Gas (therms)
Buildings and Facilities	30,096,817	219,529
Public Lighting	10,978,141	N/A*
Water and Wastewater Transport	11,639,798	N/A*
Total	52,714,756	219,529

* N/A = Not applicable
Source: Southern California Edison

Transportation – Employee Commute – 2008 / Vehicle Fleet - 2009

	Annual VMT	Gasoline (gal)	Diesel (gal)	CNG (cu.ft.)
Employee Commute	9,005,971	439,215	24,130	N/A*
Vehicle Fleet	4,245,088	255,933	36,079	26,948
Total	13,251,059	695,148	60,209	26,948

* N/A = Not applicable
Source: Employee commute - Fehr & Peers
Source: Vehicle fleet – City of Santa Ana (Steve Parmenter - Senior Fleet Equipment Supervisor)

AECOM

Scope 3 Emissions - 2008

Scope 3 emissions represent GHG emissions which occur outside of the City's boundaries but are caused by actions within the City.

	Total water consumption (gal)	Water from MWD (million gallons)	Water from local sources (million gallons)
Water	117,003,997	39.781	77.223
	Tons of waste landfilled		
Government-Generated Solid Waste	24,342		
	Wastewater sent to wastewater treatment plants (gal)		
Wastewater	50,006,792		

Source: Water – City of Santa Ana
Source: Government generated solid waste – City of Santa Ana (Christy Kindig - Projects Manager)
Source: Wastewater – City of Santa Ana (water department)

Community Inventory

Energy - 2008

	Electricity (kWh)	Natural Gas (Therm)
Residential	378,988,235	25,655,540
Commercial and Industrial	1,398,181,157	30,705,031
Total	1,777,169,392	56,360,571

Source: Southern California Edison

Transportation

	Annual VMT	Gasoline (gal)	Diesel (gal)
2008	1,984,116,488	96,764,042	5,316,019
2020	2,054,338,114	98,365,422	8,398,274
2035	2,142,115,148	103,608,852	12,393,633

Source: Fehr & Peers

Other (Off-road Transportation) - 2008

Gasoline (gal)	Diesel (gal)	CNG (cu.ft.)
129,648	301,687	37,880

Source: OFFROAD 2007

Scope 3 Emissions - 2008

	Total water consumption (million gallons)	Water from MWD (million gallons)	Water from local sources (million gallons)
Water	13,347	4,524	8,823
	Tons of waste landfilled		
Generated Solid Waste	334,908		
	Wastewater sent to wastewater treatment plants (gal)		
Wastewater	9,688,170,800		

Source: Water – City of Santa Ana
Source: Generated solid waste – City of Santa Ana (Christy Kindig - Projects Manager)
Source: Wastewater – City of Santa Ana (water department)

Appendix B

City of Santa Ana

Report on Emissions Reductions from Existing Measures

Introduction

This document presents a summary of existing climate action measures that have been implemented or planned for the City of Santa Ana (City) prior to implementation of the 2012 Climate Action Plan (CAP) and provides the estimated greenhouse gas (GHG) reductions that the City may anticipate from these measures. The purpose of this report is to assess the impact existing actions have achieved in the intervening years between the 2008 baseline inventory year and 2012, and existing measures that are planned but not implemented, such as long-term transportation projects. This analysis will provide a starting point for further actions to be developed for the CAP. The measures that are evaluated include state, federal, and local measures that will result in GHG reductions beyond those captured in the baseline emissions inventory.

Overview of the Approach

The approach for estimating emissions reductions from measures is similar to that for calculating emissions generated in a GHG inventory; although rather than calculating emissions generated from energy consumed, it accounts for emissions reduced from energy saved. Once emissions reductions have been estimated, they can be subtracted from the City's business-as-usual forecast to estimate the level of reductions achieved without implementation of a CAP. The timing of when measures might be implemented and interactions between related measures must be considered during this process.

This document describes the impact of existing measures for the City of Santa Ana. Information regarding existing local measures is largely drawn from the *City of Santa Ana Sustainability Accomplishments* document, dated January 2012, with additional input from Southern California Edison, Southern California Gas Company and City staff.

Existing Municipal Operations Reductions

The City staff has implemented several programs that are leading by example and reducing operating and maintenance costs.

LED Street Lighting

LED lighting has several advantages for street lighting and traffic signals. In addition to reduced energy consumption, the lifetime of LED lights is considerably longer than many other types of lighting and can reduce operating and replacement costs. LED fixtures can also provide greater directionality for outdoor lighting thereby reducing light pollution. Santa Ana has reported saving an annual 287,119 kWh/year by replacing 253 high pressure sodium fixtures with LED fixtures. This translates to an annual emissions reduction of 83 metric tons of carbon dioxide per year ($MTCO_2$/year).

Santa Ana had established the use of LED traffic signals prior to the 2008 baseline and since 2008 has not produced any additional reduction. Because traffic signals operate constantly year round, they produce substantial energy savings for the City, saving 1.2 million kWh per year. While these savings cannot be counted towards meeting a reduction goal, they are a good example of what can be achieved with new efficient technologies.

American Recovery and Reinvestment Act of 2009 (ARRA)

The City estimates that recent retrofits to City facilities accomplished with ARRA funding are saving 820,000 kWh/year. The resulting emissions reduction is 236 $MTCO_2$/year.

Municipal Lighting Upgrades

Between 2010 and 2012 the City has engaged with Southern California Edison on a number of incentivized projects that reduce energy from lighting in many of Santa Ana's parks and other facilities. These projects reduce energy use by 1,702,446 kWh/year and save Santa Ana energy costs of $184,325/year. Emissions reductions from these projects total 490 $MTCO_2$/year

Water Wells Motor Efficiency Upgrade

Energy-efficient motors were recently retrofitted at City water wells saving 1.1 million kWh/year. The resulting emissions reduction from this action is 317 $MTCO_2$/year. The Santa Ana groundwater wells produce one of the best tasting water in the country.

Alternative Fuel Vehicle Policy

The City's Alternative Fuel Vehicle Policy is achieving emissions reductions from the purchase of hybrid vehicles in the general purpose fleet, as well as compressed natural gas (CNG) powered street sweeping equipment, and five hydrogen fueled vehicles.

For hybrid vehicles, fuel reduction calculations were performed by taking the average annual miles from each vehicle and calculating the fuel that would be consumed to cover those miles for each of the hybrid vehicles in the fleet. This was also done for an equivalent non-hybrid version of the same make and model to represent the business-as-usual case. The difference between the totals is the overall reduction. Using this method based on reported fuel economies on FuelEconomy.gov, an annual gasoline savings of 3,909 gallons was computed, resulting in 34 $MTCO_2$/year reduced.

For CNG street sweepers, traditional accounting based on published fuel economy and odometer readings was not feasible because this information does not exist for these vehicle types. In this case the total volume of CNG consumed in one year was converted to an equivalent amount of diesel fuel on the basis of their energy densities. Emissions from the volume of each fuel were calculated and compared, resulting in an emissions reduction of 0.5 $MTCO_2$/year.

For the hydrogen powered fleet, the reduction was calculated by first determining the volume of fuel that would have been consumed in a standard model with an assumed fuel efficiency of 25 mpg, saving 263 gallons of gasoline. Since hydrogen vehicles produce no tailpipe GHGs, the emissions from this entire volume of fuel was reduced, reducing 2.3 $MTCO_2e$ per year. However, at this time it is assumed that the hydrogen at the station is produced through an electrolysis process at the station using grid electricity, which does have an emissions impact. The resulting net annual emissions production for the hydrogen (H2) powered vehicles is 0.1 $MTCO_2$. Table 2 contains a summary of the assumptions made to calculate the electricity consumption and emissions generated that reduce the overall impact of hydrogen fueled vehicles.

Table 2. Emissions Produced in Hydrogen Fuel Production

Average Annual Miles	Assumed mpkg H_2*	kg H_2 Consumed	kWh/kg H_2**	kWh Consumed	Emissions Reduced $MTCO_2e$
6,594	52	127	60.5	7,672	2.2

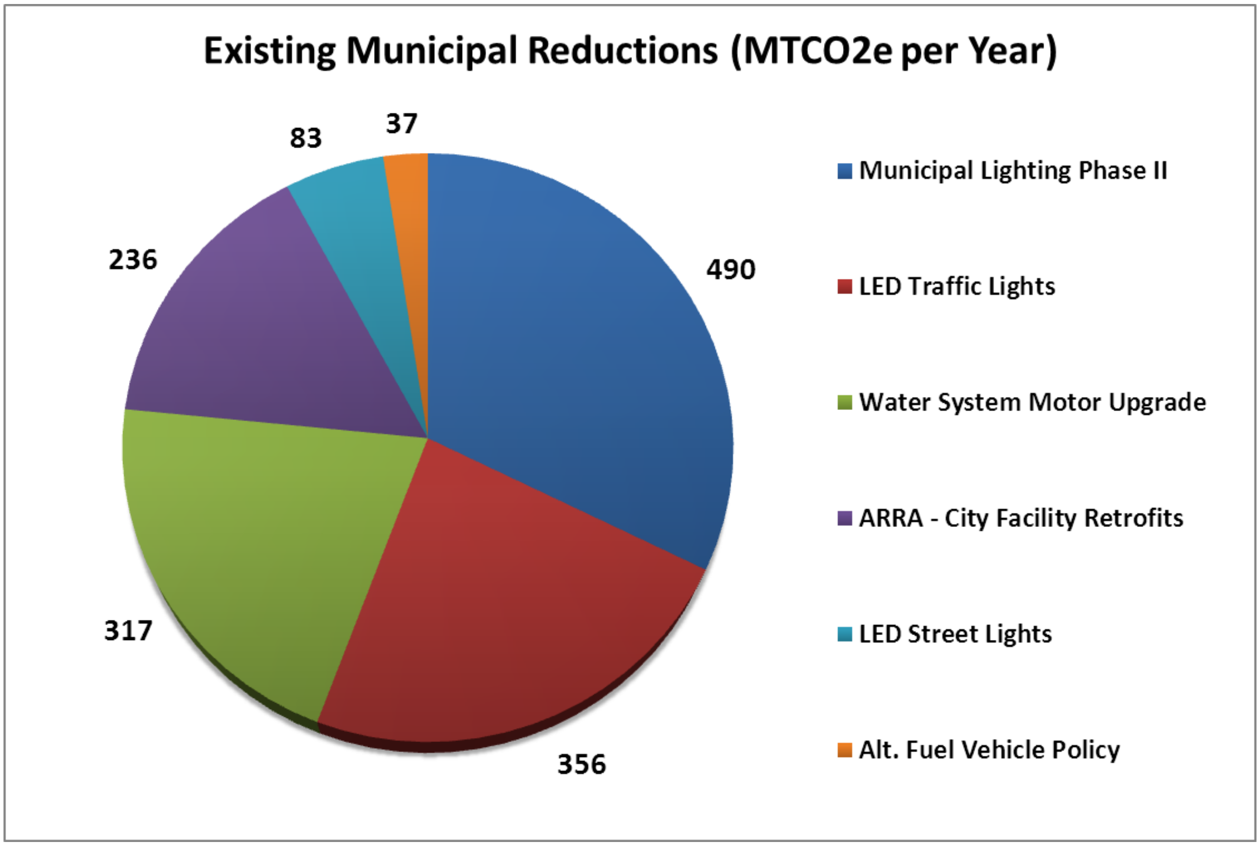
* http://www.fueleconomy.gov/feg/fcv_sbs.shtml value for “small station wagon”.mpkg – miles per kilogram; 1kg of hydrogen is roughly equivalent to one gallon of gasoline

**NREL 2004. Summary of Electrolytic Hydrogen Production.NREL/MP-560-36734.Value for electrolysis plus pressurization.

Municipal Operations Summary

Figure 1 displays the relative portion of emissions reductions from municipal operations measures, which total 1,519 $MTCO_2e$ per year. While these may seem to be modest reductions, they are significant within the scope of the City of Santa Ana’s operations. Some of the policies reflected here may need additional time to mature and reach their full potential. It will take time to replace enough high-mileage vehicles for the City’s alternative fuel vehicle policy to make a widespread impact on fuel use.

Figure 1.



LED street lights have only been implemented in a small number of cases. Moving forward in the preparation of the Climate Action Plan, municipal operations measures will focus on those actions that can have the largest impact by addressing energy consumption systematically through comprehensive building strategies and high consumption activities.

Community

At the community scale, several initiatives are underway that improve livability in Santa Ana by making it easier for residents to meet their needs without dependence on fossil fuels, for businesses to thrive in the face of rising energy shortages, and for everyone in the community to have less of an impact on the natural resources. The following section contains an overview of some of the major initiatives accomplished.

Building Efficiency

Many building efficiency measures have been brought about through successful partnership with Southern California Edison in business and residential focused programs. The actions that have been employed are diverse depending on the specific program, but because these have been carried out through the utility partnership, reliable estimates of energy savings are available. The annual reduction resulting from these programs amounts to 4,059 $MTCO_2$. Table 3 contains a summary of these actions along with their associated emissions reductions.

Table 3. Southern California Edison Direct Install Program Impact

Program Name	Annual kWh Saved	Emissions Reduced ($MTCO_2$/Year)
SCE Direct Install for Business	10,200,000	2,938
Residential Energy Efficiency Kits	2,287,550	659
Residential Lamp Exchange	596,387	172
LED Holiday Light String Exchange	388,470	112
Residential CFL Bulbs Giveaway	361,375	104
Refrigerator Rebates	173,638	50
Elementary School Living Wise Program	84,000	24

In addition to the retrofits from Southern California Edison programs, natural gas retrofits were accomplished through equivalent programs from Southern California Gas. As displayed in Table 4, together those programs are reducing an estimated 1,726 $MTCO_2$/year.

Table 4. Reductions from Southern California Gas Programs

Sector	Measure Category	Annual Energy Savings (Therms)	Emissions Reduced (MTCO2)
Commercial	Food industry, restaurant equipment	22,777	122
	Process improvement, equipment modernization	59,393	317
	Pipe insulations	111,016	593
	Stream traps	17,995	96
	Tankless water heater	6,571	35
	Storage water heater	1,707	9
	Tank insulation	87	0
	Boiler upgrade/replacement	21,130	113
	System new construction	813	4
	Commercial Pool Heater	4,367	23
Single Family	Central Gas Furnace	1,635	9
	Gas Storage water heater	576	3
	Tankless Water Heater	579	3
	Attic Insulation	10,674	57
	Wall Insulation	18,846	101
	Cloth Washers	6,626	35
	Dish Washers	890	5
Multi Family	Central Sys WHTR	1,957	10
	Water Heater Control	14,400	77
	Boiler Control	11,248	60
	Dish Washers	1.96	0
Point of Sales	Storage water heater	7,181	38
	Cloth Washers	1,473	8
	Dish Washers	1,153	6

The Weatherization program delivered through the Community Action Partnership and funded through Federal grants and local utilities reached 3,291 low-income households with weatherization assistance since 2008. Actions taken in homes can include combinations of a number of energy savings measures such as; air duct sealing, insulation, window glazing, HVAC tune ups, and replacement air conditioning and furnaces. Table 5 details the energy savings and emissions reduction estimates for these homes. The combined impact of electricity and natural gas savings equals a reduction of 1,553 $MTCO_2$/year.

Table 5. Emissions Reduced through Weatherization Program

Homes Weatherized	Annual Therms Saved per Household[1]	Total Therms Saved	Gas Emissions Reduced per year ($MTCO_2$)	Annual kWh Saved per Household[2]	Total kWh Saved	Electrical Emissions Reduced per year ($MTCO_2$)
3,291	72	236,952	1,298	271	891,861	255

Solar Power

According to the website Go-Solar California, there have been 6.5 MW of solar capacity installed in Santa Ana since 2008. It is likely that this number underestimates the total slightly due to the fact that Go-Solar California only tracks installations that occurred as part of the California Solar Initiative rebate program. Total electricity generated from these systems was calculated using the average annual kWh production per kW installed capacity of 1,678 for systems in the South Coast Air District[3]. This resulted in a value of 10,900 MWh of electricity produced per year and associated emissions reduction of 4,700 $MTCO_2$ /year.

Water Conservation

The extraction, delivery, and treatment of water consume large amounts of energy. By conserving water, energy consumption is also reduced. Within the City of Santa Ana, large volumes of water are conserved annually through the Water$mart and other programs. For the calculation of this measure, water conserved was converted to energy consumption using the same values for water use intensity as were used in the baseline inventory[4].

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[1] California Energy Commission. Options for Energy Efficiency in Existing Buildings. CEC-400-2005-039-CMF. Table B-11.

[2] ibid

[3] Calculated from Table AE-2.1.CAPCOA, Quantifying Greenhouse Gas Mitigation Measures. August 2010. http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

[4] CEC. 2006. Refining Estimates of Water-Related Energy Use in California prepared by Navigant Consulting, Inc.

Table 6.Water Conservation Programs Energy Savings

Water $mart Program	Water Conserved MG/Year	Indoor/Outdoor Use	Energy Intensity (kWh/MG)	Total Energy Conserved (kWh)	Emissions Reduced (MTCO2e)/Year
Clothes Washers	8.3	Indoor	13,021	108,362	31
Irrigation Controllers	6.2	Outdoor	11,110	68,454	20
Synthetic Turf	0.2	Outdoor	11,110	2,005	0.6
ULF Toilets	17.8	Indoor	13,021	232,359	67
Save A Buck rebates	462.9	Indoor	13,021	6,026,936	1,734

Total annual emissions reductions from water conservation programs in Santa Ana are 1,853 $MTCO_2$/year.

Reclaimed Water

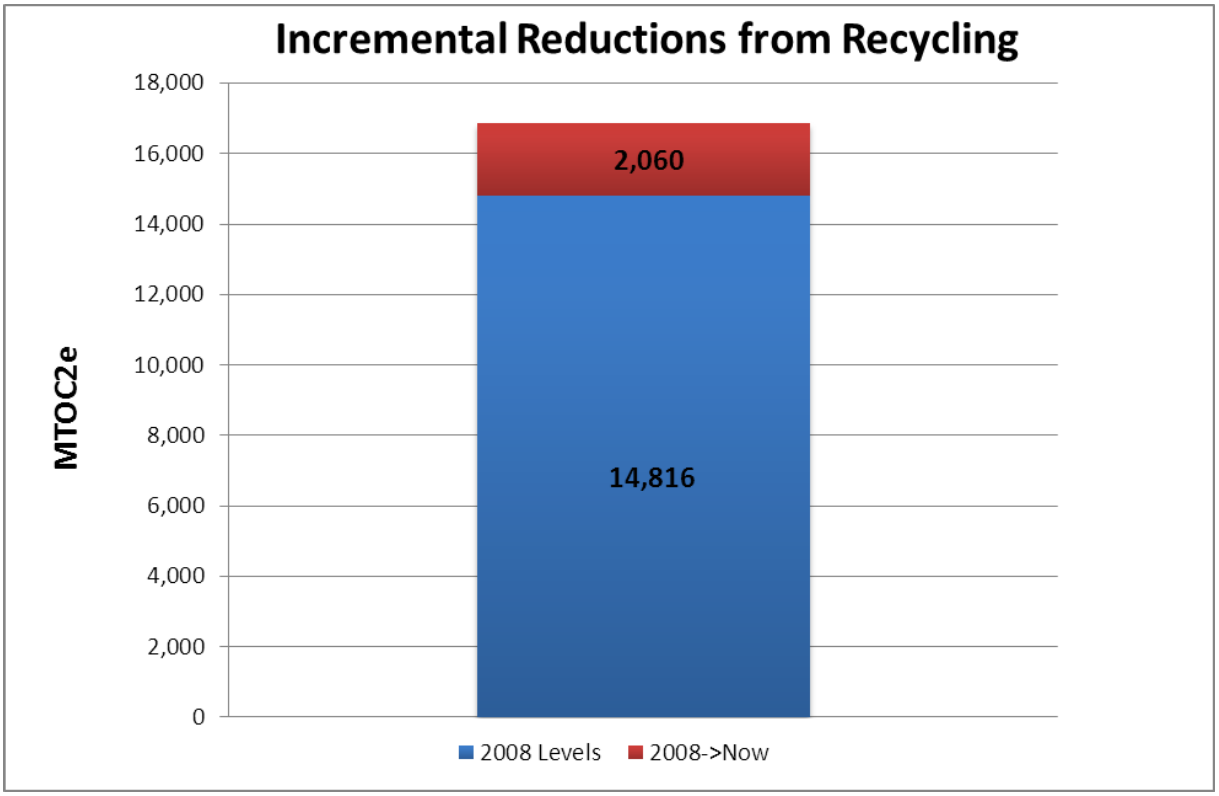
Since 2008, Santa Ana has progressively increased the volume of reclaimed water used in non-potable applications by 53.4 million gallons, from 62.3 to 115.7 million gallons. Each gallon of reclaimed water saves energy because it did not need to be pumped over long distances like much of the extracted potable water is. Also because it will be used for non-potable applications, less energy intensive treatment is needed. The estimated energy intensity to supply recycled water in the Los Angeles area is 1,841 kWh/million gallon[5]. Compared with the value of 11,110 kWh/million gallon for potable water used in outdoor applications, significant savings are achieved by utilizing reclaimed water. Total annual energy savings are estimated to be 494,928 kWh, resulting in emissions reductions of 142 $MTCO_2$/year.

Recycling and Waste Diversion

The City of Santa Ana has an exemplary recycling program with an overall diversion rate of 67%. For this calculation, diversion rates from both 2008 and 2011 were compared. Assuming the same waste characterization and total generation reported in 2008, the incremental reduction that has been achieved was calculated to be 2,060 $MTCO_2e$/year. The most significant portion of the total reductions achieved in this section is from diversion of green waste from the landfill, as these produce a high proportion of landfill emissions.

[5] Navigant Consulting. 2008. The Role of Recycled Water in Energy Efficiency and Greenhouse Gas Reduction. Table 4-13

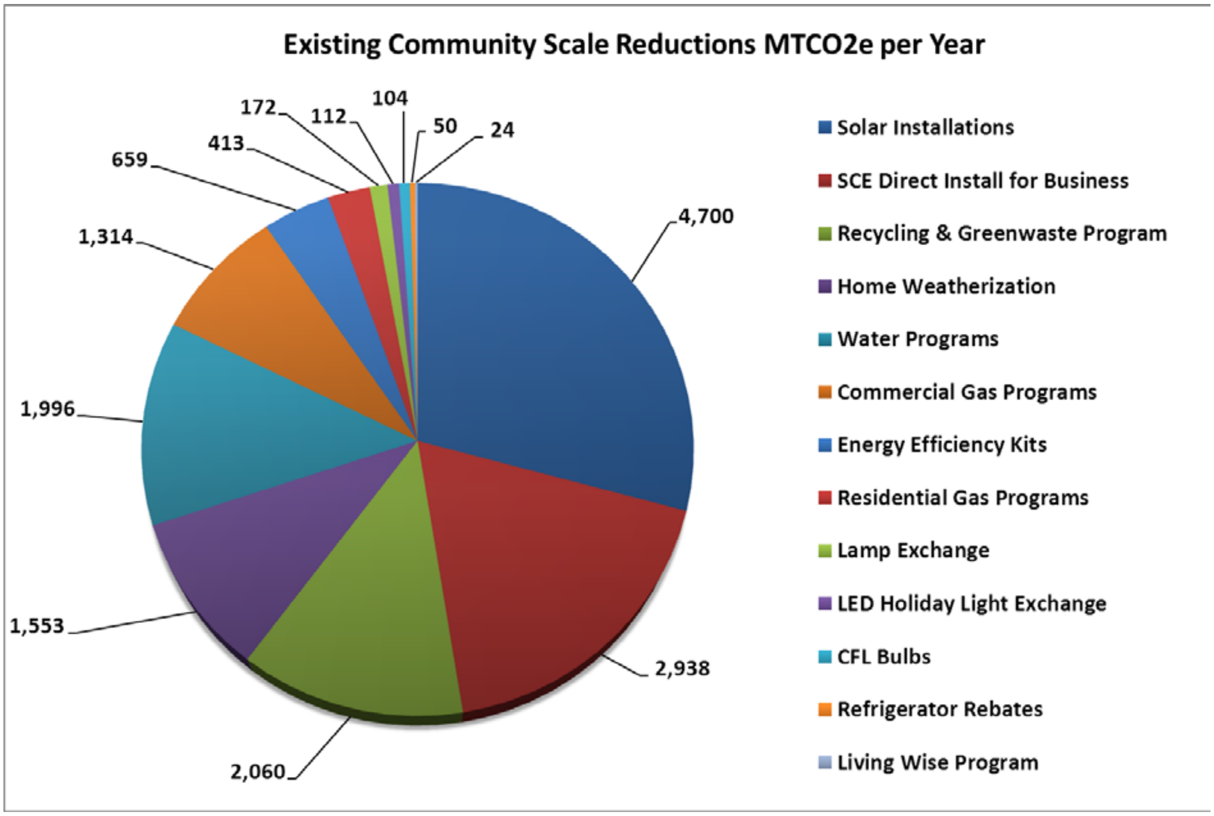
Figure 2.



Community Summary

Existing actions at the community level rely primarily on rebates and other programs administered through Southern California Edison and Southern California Gas Company. Figure 3 illustrates the relative contribution of measures that have been implemented to date. Additional measures should consider the City's ability to influence the built environment in ways that will create significantly more efficient buildings. The total reduction amount from existing measures is 16,094 $MTCO_2$/year.

Figure 3.



In total, the reductions that have been set in motion since the 2008 baseline will have a noticeable effect on overall emissions levels through 2035.

Transportation Plans

Within the transportation sector, several planned measures seek to reduce GHG emissions, but have yet to be implemented. These actions are being considered under this existing measures analysis due to the fact that they are already planned to occur, even though their impact will take some time to be realized. The projected vehicles miles travelled (VMT) reduction for these actions were modeled by Fehr & Peers and are presented in terms of a percent reduction in VMT as a result of each measure. The total amount of reduced VMT was then translated to emissions reductions by dividing by fuel economy to obtain a volume of fuel consumed, which was then translated to emissions with standard emissions factors.

Because these planned measures will take time to implement, and because transportation measures take time to reach their full potential, the total emissions impact of the transportation initiatives was calculated for three benchmark years: 2020, 2025, and 2030. While VMT is progressively reduced over time, average fuel economy is expected to increase, resulting in slightly diminished emissions reductions for these actions in the outlying years. Also, these measures will act primarily on personal vehicles. Thus, emissions reductions were calculated using solely gasoline powered passenger vehicles and not heavy trucks or diesel fuel vehicles. Table 6 illustrates the impact that these measures will have in future years.

Table 7. Existing Community Transportation Measures

Transportation Initiative	2020% Impact Realized	2025% Impact Realized	2030% Impact Realized
SARTC Improvements	50%	100%	100%
Alternative Transportation Improvements	50%	100%	100%
Transit Vision Plans	25%	50%	100%
Average Fuel Economy	24.1	26.3	28.8
Emissions Reduction $MTCO_2$/year	27,125	49,620	48,412

Statewide Reductions

Existing measures implemented or envisioned by Santa Ana demonstrate that Santa Ana is a proactive community with regard to climate and energy; however, more must be done to achieve the legislative goals for 2020 and beyond. The City must also consider the likely impact of other actions undertaken by the State of California on local emissions. Actions such as the Renewable Portfolio Standard and the Pavley regulations will have far-reaching impacts on emissions generation and will position Santa Ana to achieve additional reductions along with the measures generated in the CAP.

The State Renewable Portfolio Standard (RPS) will reduce the emissions generated from every kWh of electricity consumed. In order to calculate the impact of this action, future year emissions factors that have been developed assuming full implementation of the RPS[6]. These factors were applied to projected business-as-usual electricity consumption in future years to calculate projected emissions with the standard in place. A second calculation was made holding the emissions factors constant. The difference between the two sets is the emissions reduction from this measure. Total emissions reductions from the RPS are presented in Table 7 for several benchmark years.

Table 8. Santa Ana Emissions Reductions from the State RPS

Year	2020	2025	2030	2035
Reduced Emissions (MT CO_2e/Year)	182,020	182,391	182,762	183,135

In addition to systematic changes in the electricity grid, large scale changes in the emissions impact of VMT are underway as a result of increasing fuel economy of passenger vehicles from the Pavley I regulations. The Pavley I regulations are projected to have approximately the same impact on calendar-year fuel economies as national Corporate Average Fuel Economy (CAFE) standards, resulting in an increase in on-road fuel economy for passenger vehicles at an average rate of 2.2% per year until 2020,

[6] E3, GHG Calculator version 3c, worksheet tab "CO2 Allocations," http://ethree.com/public_projects/cpuc2.php

1.8% per year from 2020-2030, and 0.43% per year 2030-2035[7]. For this measure, emissions from projected business-as-usual VMT were calculated with projected fuel economies that will result from implementation of Pavley I, holding fuel economy at current levels. The difference between the resulting values is the emissions reduction associated with this measure. Total emissions reduction from Pavley I is presented in Table 9 for several benchmark years.

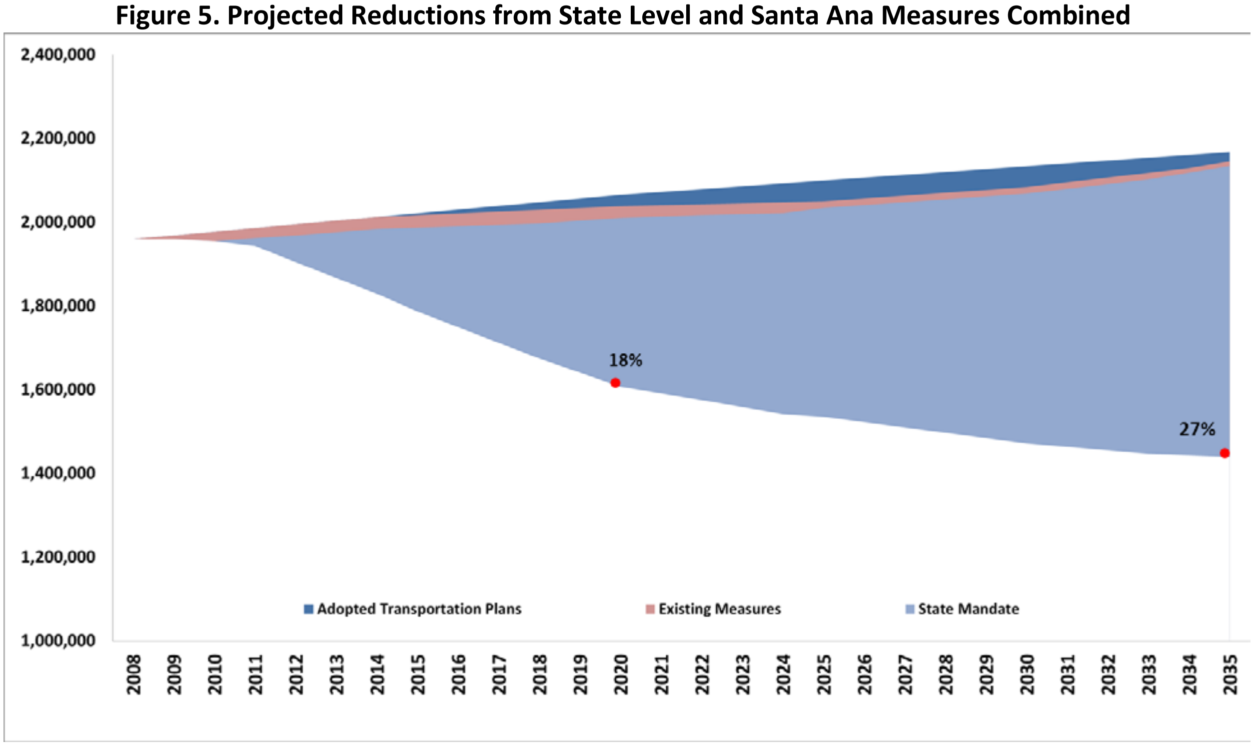
Table 9. Santa Ana Emissions Reductions from the Pavley I Standard

Year	2020	2025	2030	2035
Reduced Emissions (MTCO2e/Year)	221,440	316,422	414,034	442,431

Combined Impact of Existing Measures

The combined impact of all the measures discussed above will result in substantial reductions in emissions in Santa Ana. The total reduction from these measures in addition to the reduction from the other existing measures discussed previously in this document is presented in Figure 5. The dots on the chart indicate that the results of these measures will achieve an 18% reduction below 2008 by 2020 and a 27% reduction by 2035. The combined impact of these measures places Santa Ana on a solid path to meeting and exceeding State level goals with the additional measures developed through the Climate Action Plan and future efforts.

Figure 5. Projected Reductions from State Level and Santa Ana Measures Combined



[7] SEEC Forecasting Assistant Documentation, Table 3. http://californiaseec.org/documents/forecasting-tools/seec-forecast-assistant-documentation

Table 10 displays the total reduction potential in terms of % reduction below the 2008 baseline. It is important to note that this part of the analysis assumes both the RPS and Pavley I standards will be fully implemented as planned. It is also important to bear in mind that these actions will also influence the efficacy of other measures to reduce emissions in future years. These interactions will be accounted for in the calculations for measures later in the CAP.

Table 10. Projected Emissions Reductions from all Existing Measures

Year	**2020**	**2025**	**2030**	**2035**
BAU Forecast	2,065,263	2,099,425	2,133,588	2,167,750
Adjusted Forecast	1,597,001	1,523,270	1,459,460	1,427,357
% below 2008	18%	22%	26%	27%

While this analysis supports the idea that Santa Ana's local emissions reductions will be in line with California State targets, it is by no means an indication that additional action is not needed. If Santa Ana is to continue to meet its goals over the long term, sustained action is needed and the earlier it is taken will increase the feasibility of meeting long term reduction targets.