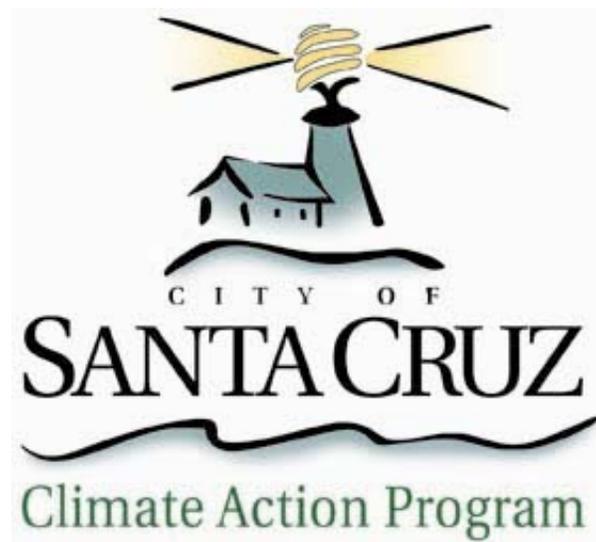


**City of Santa Cruz  
Greenhouse Gas Emissions Inventory  
2005 Municipal and Community Emissions**



**Ross Clark & Charlie Lewis  
Climate Action Program**

**August 2008**

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<u>Data Sources</u>	<u>Years Available</u>	<u>Source Contact</u>
Utility Manager Software	(2002 to present)	Mary Arman
HP billing database	(1993 - 2002)	Mary Arman
Wastewater Treatment Facility Cogeneration report	(1999 to present)	Mike Sanders
City Landfill LFG Cogeneration Report	(2004-2007)	Mary Arman
Countywide PGE Records	(1990 to present)	Kurt J. Kammerer (CEC)
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Citations

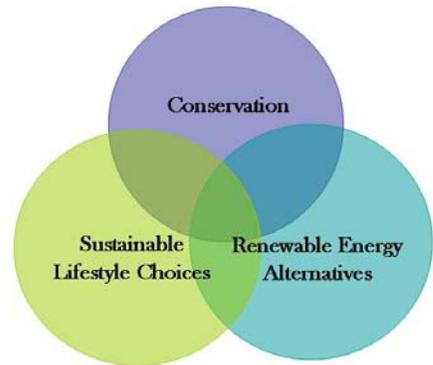
- Preliminary Draft - City of Santa Cruz Local Action Plan, 2001
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- Supply and Demand Side Water-Energy Efficiency Opportunities Final Report, Green Building Studio, 2007

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# 1 Climate Change and the City of Santa Cruz

For over two decades, the City of Santa Cruz has taken steps to reduce and respond to Global Warming. In June 2007, the city council adopted a set of General Plan goals and policies on climate change; including reducing community-wide greenhouse gas emissions thirty percent by 2020, reducing eighty percent by 2050 (compared to 1990 levels), and for all new buildings to be emissions neutral by 2030.

To meet the City's greenhouse gas reduction goals, incentives must be developed to provide low or carbon neutral alternatives for those living, working and visiting Santa Cruz. Options for reducing carbon emissions from daily living include conservation and energy efficiency, reduction through sustainable lifestyle choices, and selection of renewable energy sources. Together these three strategies will reduce waste, decrease use of resources and increase the percentage of renewable energy that is used and generated in Santa Cruz.



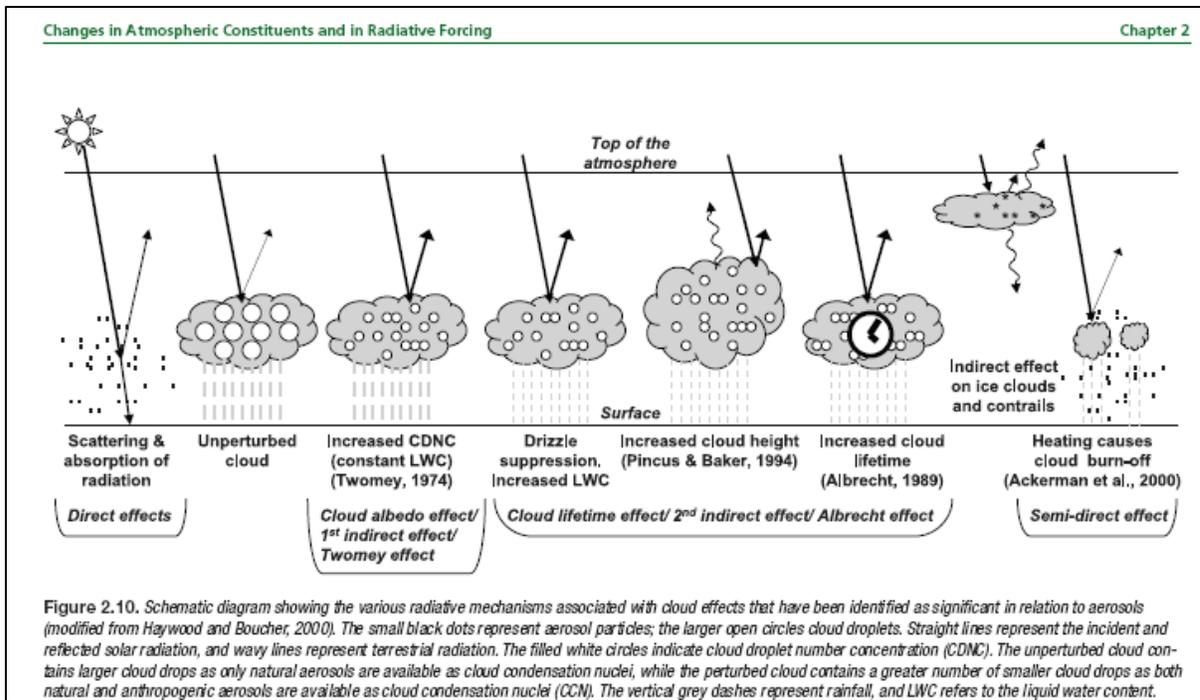
This Greenhouse Gas Emissions Inventory provides information regarding municipal and community wide emissions. This document provides the data and guidance to city staff and council to direct future program implementation. Specifically, 2005 emissions levels have been quantified for each community sector (business, residential, municipal, and transportation) and by fuel source (natural gas, electricity, petroleum, other). Benchmark emissions for 1990 have been estimated to prioritize reduction opportunities. This inventory also establishes a standard reporting procedure that can be replicated periodically to meet State requirements and demonstrate the feasibility and effectiveness of the various city programs. This inventory does not, however, replace facility specific (wastewater and landfill) reporting requirements mandated by the State Air Resources Board.

## 1.1 Global Climate Change

Global climate change is a subject that is gaining statewide, national and international attention. Human activities such as fossil fuel combustion, deforestation and other land use changes are resulting in the accumulation of greenhouse gases (GHGs) in the atmosphere, the most prevalent of which is carbon dioxide (CO<sub>2</sub>). Further GHG emissions will result in an increase in the earth's average surface temperature, commonly referred to as global warming,

which is expected to affect weather patterns, average sea level, ocean acidification, and precipitation rates. Recent reports released by the State of California indicate that climate change could have profound impacts on California's water supply. A report prepared by the California Climate Change Center, concludes global warming is a very serious issue requiring changes in the management of natural resources, water supply, and public health<sup>1</sup>. In the fourth assessment report released by the UN's intergovernmental Panel on Climate Change (IPCC), it was stated that "Warming of the climate system is unequivocal" and that climate change will cause "abrupt and irreversible changes."<sup>2</sup>

The natural process through which heat is retained in the troposphere (lower 10 km of atmosphere) is called the "greenhouse effect." The greenhouse effect traps heat through a three fold process as follows: shortwave radiation emitted by the Sun is absorbed by the Earth; the Earth emits a portion of this energy in the form of long-wave radiation (heat); and greenhouse gases in the upper atmosphere absorb this long-wave radiation and emit this long-wave radiation both into space and back toward Earth (Fig 2.10). This "trapping" of the long-wave (thermal) radiation emitted back toward the Earth is the underlying process of the greenhouse effect. The most abundant greenhouse gases are water vapor and carbon dioxide. While many other trace gases have greater ability to absorb and re-radiate long-wave radiation, these gases are not



Source: Climate Change 2007, Synthesis Report, Intergovernmental Panel on Climate Change

1 "Our Changing Climate: Assessing the Risks to California" (2006)

2 Climate Change 2007, Synthesis Report, Intergovernmental Panel on Climate Change

as plentiful in the atmosphere. For this reason, and to gauge the potency of greenhouse gases, scientists have established a **Global Warming Potential** for each greenhouse gas based on its ability to absorb and re-radiate long-wave radiation. The Global Warming Potential is determined using carbon dioxide as the reference gas with a Global Warming Potential of 1. All emissions quantified within the Santa Cruz GHG Emissions Inventory have been calculated as CO<sub>2</sub> equivalents (CO<sub>2</sub>e) and reported in metric tons.

California is a substantial contributor of global greenhouse gases, emitting over 400 million metric tons of carbon dioxide (CO<sub>2</sub>) a year<sup>3</sup>. Because primary greenhouse gases have a long lifetime in the atmosphere, accumulate over time, and are generally well mixed, their impact on the atmosphere is mostly independent of the point of emission. Although GHG emissions are not currently addressed in federal regulations, the State of California recently passed the Global Warming Solutions Act of 2006 (AB32) which seeks to reduce GHG emission generated by California. AB 32 (which is further described below) states:

Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.

## ***1.2 State Mandates regarding Greenhouse Gases***

**Executive Order S-3-05.** In June 2005, Governor Schwarzenegger established California's greenhouse gas emissions reduction targets in Executive Order S-3-05. The Executive Order established the following goals:

- ❑ Greenhouse gas emissions should be reduced to 2000 levels by 2010;
- ❑ Greenhouse gas emissions should be reduced to 1990 levels by 2020; and
- ❑ Greenhouse gas emissions should be reduced to 80 percent below 1990 levels by 2050.

The Secretary of the California Environmental Protection Agency is required to coordinate efforts of various agencies in order to collectively and efficiently reduce greenhouse gases.

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<sup>3</sup> Air Resources Board 1990 to 2004 State Inventory (November 2007)

**Assembly Bill 32 (Nuñez)** The State’s Legislature enacted Assembly Bill 32, the California Global Warming Solutions Act of 2006, which Governor Schwarzenegger signed on September 27, 2006 to further the goals of Executive Order S-3-05. Assembly Bill 32 represents the first enforceable statewide program to limit greenhouse gas emissions from all major industries with penalties for noncompliance. The foremost objective of California Air Resources Board (CARB), tasked with implementing AB32, is to adopt regulations that require the reporting and verification of statewide greenhouse gas emissions. The initial State goal is to limit greenhouse gas emissions to 1990 levels by 2020. Assembly Bill 32 allows CARB to adopt market based compliance mechanisms to meet the specified requirements. CARB is ultimately responsible for monitoring compliance and enforcing any rule, regulation, order, emission limitation, emission reduction measure, or market based compliance mechanism adopted. In January 2008, the first deadline for Assembly Bill 32, a statewide cap for 2020 emissions based on 1990 levels was adopted. By January 2009, CARB must adopt mandatory reporting rules for significant sources of greenhouse gases and also draft a plan indicating how reductions in significant greenhouse gas sources would be achieved through regulations, market mechanisms, and other actions. In June, 2008, CARB produced a Draft Local government Operations Protocol, outlining the procedures necessary for reporting community level GHG emissions. This emissions inventory has addressed the procedures outlined in that document.

### ***1.3 City of Santa Cruz aligned with State policies***

The City is currently preparing a General Plan update through 2025. Key additions to the General Plan include the City Council’s Global Warming Reduction Goals (2006), specifically:

- a. Reduce community-wide greenhouse gas emissions 30 percent by 2020 and 80 percent by 2050 (compared to 1990 levels).
- b. By 2030, require that all new development be carbon neutral.
- c. Support initiatives, legislation, and actions for reducing and responding to climate change.
- d. Encourage community involvement and public-private partnerships to reduce and respond to global warming.
- e. Minimize impacts of future sea level rise.
- f. Take early action on significant and probable global warming land use and development issues, including those that might arise after 2025.

### ***1.4 City of Santa Cruz Climate Action Program***

In November 2007, the City of Santa Cruz hired a Climate Action Coordinator to help facilitate the multitude of actions and programs related to climate change currently underway as well as provide a point of contact for local interest and regional partnerships. Responsibilities for the position include:

- Researching municipal best practices in reducing greenhouse gas emissions and responding to climate change impacts
- Coordinating volunteer and consultant resources
- Coordinating city participation in regional global warming initiatives
- Supporting internal City staff efforts to reduce and respond to global warming
- Drafting and evaluating proposed General Plan Action Programs
- Communicating the City's global warming efforts and initiatives

The Coordinator is also responsible for completion of this document, assisted by the Climate Action Program technical intern.

#### **Climate Action Compact**

In October 2007, the County of Santa Cruz, the City of Santa Cruz and the University of California Santa Cruz partnered to create a *Climate Action Compact* (CAC). The compact signatories realized that while climate change is a global issue, the causes and effects of those changes must be addressed locally.

The goal of the CAC is to achieve meaningful and measurable progress towards lowering our local greenhouse gas emissions through the implementation of cooperative programs. To that end, the CAC partners initiated a process to develop actions necessary to accomplish the goals outlined in the compact. Two of the most important goals are to develop partnerships with other local jurisdictions and to design a portfolio of potential cooperative projects to significantly lower GHG emissions and climate change impacts in our region. Thus far, the CAC has succeeded in obtaining agreement on three cooperative projects/initiatives that are now being implemented or for which funding is being sought. In July 2008, the Committee approved four more project ideas and referred each to the CAC partners for consideration by their internal technical advisory committees.

#### **City Climate Action Workgroup**

City staff has formed an interdepartmental workgroup tasked with providing guidance to Climate Action staff and helping develop programs to reduce municipal energy use and reduce emissions throughout the city. Municipal emissions reduction strategies must encompass actions and ideas from all of the City services and departments. The workgroup has helped expand city

programs including the Green Building Program, Green Business Program, Climate Action Teams, municipal efficiency efforts and green purchasing. The Climate Action Workgroup is also responsible for review of Climate Action Compact recommendations as well as this inventory and the resulting Climate Action Plan.

### ***1.5 Municipal Activities to date:***

The City of Santa Cruz Climate Reduction Strategy is based on three key activities; expansion of energy efficiency and conservation efforts, identification and selection of more sustainable products and services, and increases investment in local renewable energy. The combined contributions of these three activities will be the primary strategy for meeting our 2020 GHG reduction objectives. Current city programs include:

#### **Conservation**

##### *Efficiency Programs – Municipal Buildings*

- **Buy Efficiency Resolution.** In 1998 the City Council passed a Buy Efficiency Resolution directing staff to purchase energy efficient equipment.
- **Energy efficient building lighting.** Energy efficient lighting and room occupancy light sensors have been installed in many city buildings.
- **Sleep mode on computers** reduces waste when computers are not in use.
- **Heating/Air conditioning retrofit.** Several City building HVAC systems have been upgraded to improve climate control efficiency.
- **LED traffic signal retrofits.** LEDs (light-emitting diodes), which use 80-90% less energy and require less maintenance, have been installed on 95% of traffic signals.

##### *Efficiency upgrades - Wastewater Treatment*

- **Cogeneration system.** A system was installed which uses methane gas generated during the treatment process to produce energy and waste heat and reduces methane emissions to the atmosphere.
- **Efficient motors for pumps.** Pumps were replaced with energy efficient motors in 1991 and again in 1998.
- **Process tank insulation.** Process tanks were insulated to minimize heat loss.
- **Reuse.** The plant reuses its own treated effluent for wash-down .
- **UV Disinfection System.** The Ultraviolet Disinfection system bulbs have had their intensity turned down, saving energy, while still meeting discharge requirements.
- **Comprehensive lighting measures.** More efficient lighting was installed and lighting at night was reduced, timers and dimmers were installed, and unneeded lights removed.

- **Digester gas mixing compressor reduced use.** Gas mixing compressors installed on digesters have reduced equipment use from 24 hours per day to two hours per day from 24 hours per day to 12 hours per day.

## Sustainability

### Green Purchasing programs

- **Buy recycled.** The city has policies to purchase products with recycled content.
- **Zero Waste Task Force.** A Zero Waste Task Force has been established and is mandated with developing a long range plan to increase waste reduction and recycling.

### Waste Reduction and Recycling Programs

- **Zero Waste Goal and Landfill Diversion.** The City Council adopted Zero Waste as a long-term City goal in October 2000. As of 2006, the City had achieved a 62% diversion rate below the 1991 landfill base year tonnage. The state mandates a 50% diversion rate.
- **Ban on Styrofoam and nonrecyclable, nonbiodegradable disposable food service packaging.** Effective August 12, 2008, it is illegal to serve food to the public on disposable food service ware that is made from polystyrene foam, or that is not biodegradable, compostable or recyclable.
- **“Pay-as-You-Throw” Refuse Rates.** City refuse rates increase with the volume of refuse collected, encouraging customers to reduce and recycle. Carts and containers for curbside recycling and greenwaste collection are provided to all refuse customers at no additional cost.
- **Single-stream recycling service.** Customers may combine paper, containers and bagged plastic bags in their recycling carts. This convenience increases recycling rates.
- **Home compost/worm bin program.** Residential refuse customers are provided a \$40 discount on home compost or worm bins.
- **Construction and Demolition (C&D) Materials Diversion Program.** The City offers roll-off boxes at reduced collection rates and reduced tonnage fees at the Resource Recovery Facility for customers who separate construction materials so that they can be recycled.
- **School Waste Reduction and Recycling Program.** City staff assists schools to set up recycling programs, and provides tours of the Resource Recovery Facility, classroom presentations, resource materials, and school assemblies to all local schools about waste reduction and recycling.
- **Collection Fleet Modernization and Collection Efficiencies.** City staff changed collection vehicle configurations and worked on routing and collection efficiencies resulting in a reduction of the collection fleet from 35 vehicles to 27.

- **Collection Fleet Emission Reductions.** City staff completed emission upgrades to the collection fleet ahead of the legislated schedule and changed the entire City fleet fuel to Ultra Low Sulfur Diesel and 20% Biodiesel.
- **Change to Same Day Collection Service.** City staff rerouted refuse, recycling and green collection from twice a week collection to once weekly. This change resulted in a reduction of approximately 45,000 route miles per year as well as the accompanying emission reductions.

#### General Plan Update 2030

- **Climate Action Plan.** The Climate Action Plan will be a part of the General Plan update process
- **City Infill Policies.** The city has established growth boundaries and is emphasizing infill development that supports a livable and workable community.
- **Green Building Ordinance.** The City has adopted a mandatory Green building ordinance that requires energy efficient design.
- **Bike Plan.** The city is updating the Bike Plan tasked with providing safe bike transport throughout the city.

### **Renewable Energy**

#### Expanded use of renewable energy for City Buildings

- **Solar Photovoltaic Power.** A 14 kilowatt solar system has been installed on the roof of the City Hall Annex Building. A 55 kilowatt system was installed on the Corporation Yard building and a 50.7 kilowatt system was installed at the Regional Wastewater Treatment Facility. Two new systems are planned by the Water Dept. in 2008.
- **Waste Cogeneration Power System -** Gas is a byproduct of the treatment process. The City captures the gas and uses it on-site to generate 3.4 megawatt hours/year electricity. The cogeneration system reduces our dependence on commercially generated electrical power and reduces emissions of climate-changing greenhouse gasses.
- **Landfill methane gas recovery systems.** A system has been installed that captures 75% of methane emitted from the landfill and burns it to create 4.8 megawatt hours/year of energy.

## **1.6 Climate Reduction Strategy**

The City of Santa Cruz has been a member of the International Council for Local Environmental Initiatives (ICLEI) since 1996, and is one of over 400 U.S. members of the Cities for Climate Protection (CCP) campaign. The CCP campaign provides a framework for local communities to identify and reduce GHG emissions. This framework consists of five steps:

1. Conduct an inventory of local greenhouse gas emissions (*this document*).
2. Set GHG reduction targets (*set in 2006*).
3. Complete a Climate Action Plan defining programs and actions that will achieve those targets (*in draft for the General Plan update*).
4. Implement the Climate Action Plan, modify as needed.
5. Monitor and report on progress.

As stated above, the City has established GHG reduction targets of 30 percent by 2020 and 80 percent by 2050 (compared to 1990 levels), and this document represents the third emissions inventory for the residents, businesses and municipal operations of Santa Cruz.

## **2 Greenhouse Gas Emissions Inventory Procedures**

### ***2.1 Introduction***

The first step in establishing a Climate Action Plan is to quantify the current greenhouse gas emissions from both the municipality and from the various community sources (transportation, residential homes, business and industry). This information will help identify key emissions sectors, help focus reduction strategies and set initial levels from which to track program success. A comprehensive greenhouse gas inventory involves completing two assessments; a community wide assessment and a separate inventory for municipal sources. The municipal inventory represents the subset of the community wide emissions over which city government has direct control. Once completed, these inventories provide the basis for forecasting future emissions trajectories.

### ***2.2 Inventory Methods***

Emissions data for this inventory came from numerous sources including PG&E, the City's Utility Manager software, City billing records, California Energy Commission, CalTrans, and departmental record keeping. A full disclosure of data sources and conversion factors is available in Appendix X.

### ***2.3 CACP Software***

Towards supporting community efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package. The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. Greenhouse gas emissions are aggregated and reported in terms of equivalent carbon dioxide units, or CO<sub>2</sub>e. The emissions coefficients and quantification method employed by the CACP software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change. ICLEI has

participated in the development of the California Local Government Operations Protocol, which will ensure that the Santa Cruz inventory meets future state requirements. Although the software provides Santa Cruz with a sophisticated and useful tool, calculating emissions from energy use with precision remains difficult. The software depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation of reality, rather than an exact value.

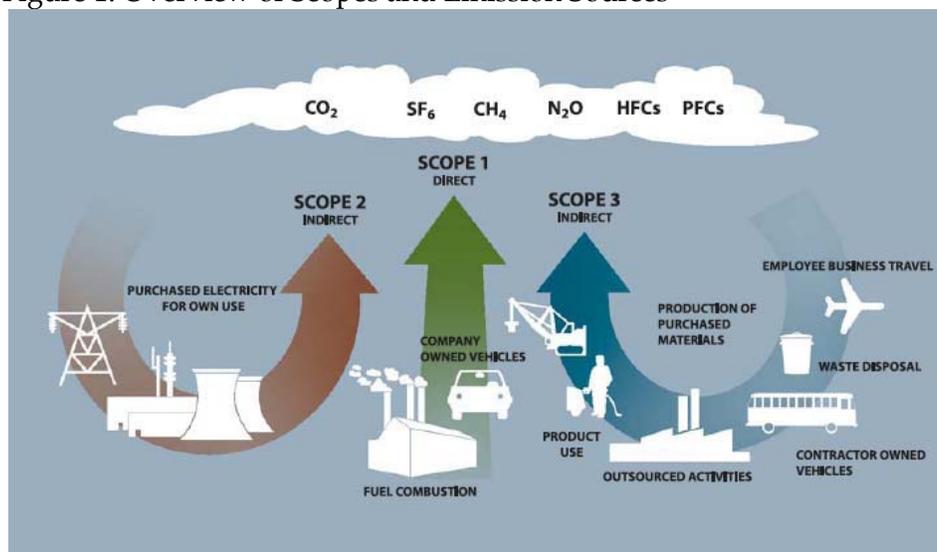
## 2.4 Draft Local Governments Operations Protocol

The Draft Local Governments Operations Protocol was developed in partnership by the California Air Resources Board (CARB), California Climate Action Registry (CCAR), and ICLEI - Local Governments for Sustainability (ICLEI), in collaboration with The Climate Registry and dozens of stakeholders. The Local Government Operations Protocol (Protocol) is designed to provide a standardized set of guidelines to assist local governments in quantifying and reporting greenhouse gas (GHG) emissions associated with their government operations. The Protocol facilitates the standardized and rigorous inventorying of GHG emissions, which can help track emissions reduction progress over time and in comparison to GHG reduction targets.

## 2.5 Scope of Emission Sources

As defined by State Protocol (2008 Draft), local governments are responsible for quantifying and reporting all sources of GHG emissions within their operations.

Figure 1. Overview of Scopes and Emission Sources



Source: WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition), Chapter 4.

The Santa Cruz Emission Inventory follows the state draft protocol in categorizing direct and indirect emissions into “scopes” as follows:

**Scope 1:** All direct GHG emissions (with the exception of direct CO<sub>2</sub> emissions from biomass combustion).

**Scope 2:** Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.

**Scope 3:** All other indirect emissions not covered in Scope 2, such as upstream and downstream emissions, emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, etc.

Together the three scopes provide a comprehensive accounting framework for managing and reducing direct and indirect emissions. The City has adopted the Operational Control method (all facilities for which the city has full operational control) for determining in which sector certain emissions are reported (e.g. Wastewater natural gas cogeneration emissions).

### **3 2005 Greenhouse Gas Emissions Inventory**

#### **3.1 Introduction**

Creating an emissions inventory requires compiling energy use data and reporting emissions from various emissions sectors. The municipal inventory quantifies all the energy and direct emissions that the City emitted while providing services such as light and heat for city buildings, public safety, parks, water and wastewater services. Primary energy sources include electricity and natural gas from PG&E, natural gas from secondary vendors, and gasoline and diesel for City fleets. The year 2005 was selected for this inventory because complete data are not available for more recent years. It is also of benefit to be consistent with other municipalities; eighteen of which are currently working on emissions inventories within the Southern San Francisco Bay and Monterey Bay areas for the year 2005.

#### **Local Government Sectors**

Under the state draft protocol, emissions are categorized into the following local government sectors:

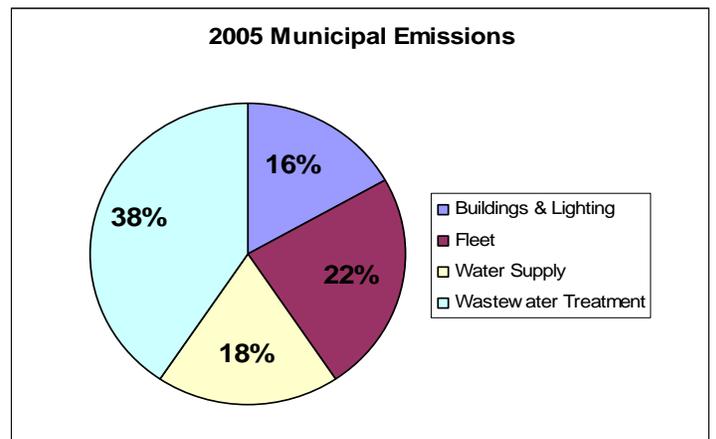
- Buildings and other facilities
- Streetlights and traffic signals
- Water supply facilities
- Vehicle fleet

- Power generation facilities
- Solid waste facilities
- Wastewater facilities
- Other process and fugitive emissions

The local government sectors are meant to create a framework that is based on internationally recognized GHG accounting terms (i.e., Scope 1, Scope 2, stationary combustion, mobile combustion, etc.), relevant to local governments. By categorizing Santa Cruz GHG emissions according to these sectors, we will be able to more easily communicate the inventory results to the public, and identify opportunities for reductions.

### 3.2 Municipal Emissions

The City of Santa Cruz municipal operations emitted the equivalent of 12,017 metric tons of CO<sub>2</sub> in 2005 to provide the services required by its residents, businesses and visitors (Table 1). The lighting and heating of municipal buildings led to 16% of municipal emissions (Fig 2). The City fleet of heavy equipment, emergency response, and staff vehicles were responsible for 22% of emissions. The transport and treatment of municipal water supplies resulted in 18% and wastewater treatment resulted in 38% of emissions. Methane emitted from the landfill (leakage not captured for electricity generation) equated to an additional 12,455 tons (comparable to emissions from all other city services, not presented in Fig 2).



**Figure 2.** 2005 Municipal Emissions by Sector

An estimated 75% of the methane produced at the landfill and 100% from the wastewater treatment plant was captured and used to generate 10.5 million kWh of electricity, avoiding methane emissions equivalent to 70,554 additional metric tons of CO<sub>2</sub>.

In 2005, water and wastewater treatment resulted in over half of the municipal energy use and emissions. These numbers are not surprising since 20% of California's state wide emissions come from the treatment and movement of water. A 2005 report outlined the energy and emissions from several San Francisco Bay area water service providers and Santa Cruz Water Department was one of the least energy intensive systems analyzed (Green Building Studio, 2007).

**Table 1.** Energy Use and Greenhouse Gas Emissions Totals for Santa Cruz Municipal Operations

**2005 Municipal Energy Use**

Sector	Emissions							
	Sector	kWh	Therms	Gallons	Million BTUs	Tonnes CO2e	Tonnes Avoided	Cost
<b>Buildings</b>	<b>1&amp;2</b>	3,922,060	112,443	-	24,373	<b>1,893</b>	-	\$678,098
<b>B - Solar</b>	<b>1</b>	<i>90,000</i>	-	-	307	-	<b>29</b>	
<b>Fleet</b>	<b>1</b>	-		<b>282,302</b>	34,212	<b>2,684</b>	-	<b>\$544,709</b>
<b>Streetlights</b>	<b>2</b>	2,588,491	-	-	8,832	<b>833</b>	-	\$405,348
<b>Water</b>	<b>1&amp;2</b>	6,414,031	9,790	3550 mill	22,860	<b>2,119</b>	-	\$784,587
<b>Wastewater</b>	<b>1&amp;2</b>	2,051,092	12,104	3696 mill	8,209	<b>728</b>	-	\$303,958
<b>Cogen (NG)</b>	<b>1</b>	<i>4,991,034</i>	678,089	-	67,809	<b>3,760</b>	-	\$16,520
<b>Methane Cogen</b>	BE	<i>5,658,384</i>	<i>840,058</i>	-	84,005	-	<b>24,876</b>	
<b>WW - Solar</b>	<b>1</b>	<i>70,000</i>	-	-	239	-	<b>23</b>	
<b>Waste</b>	<b>1</b>	-	-	-	-	<b>12,455</b>	-	
<b>W-CH4 Capture</b>	BE	<i>4,800,000</i>	-	-	16,378	-	<b>45,668</b>	
<b>Total</b>		<b>25,785,092</b>	<b>1,652,484</b>	<b>282,302</b>	<b>250,846</b>	<b>24,472</b>	<b>70,596</b>	<b>\$2,733,220</b>

Italicized values are energy generated from city resources (methane & solar). BE indicates Biogenic Emissions not contributing to net GHG emissions

Based on guidance from the State Air Resources Control Board, water and wastewater emissions estimates in this inventory include all city facility emissions regardless of end user location. This is an important consideration as the City Water Department provides water service to a 30 square mile area, including the entire City of Santa Cruz, adjoining unincorporated areas of Santa Cruz County, a small part of the City of Capitola, and coastal agricultural lands north of the city, with a total service population of 90,000 (1.6 times the city population). The City wastewater treatment facility provides service to more than 130,000 people including many residents of the unincorporated county including Rio Del Mar and Aptos as well as the City of Capitola.

### **Waste**

Emissions from the municipal landfill are quantified and reported separately from other municipal emissions sectors. Unavoidable emissions from landfill methane generation totaled 12,455 tons of CO<sub>2</sub>e while the captured methane from the gas recovery system reduced potential emissions by the equivalent of 45,668 tons. The captured methane was used to generate 4.9 million kWh of electricity. Annual emissions from the municipal landfill have dropped more than two fold since 1993 totaling 16,868 fewer tons of CO<sub>2</sub>e annually. This significant reduction is the result of the shared efforts of city services (expanded recycling and diversion programs) and city residents (increased efforts to recycle waste).

### **Methane Capture**

Through methane capture at the city landfill and wastewater treatment plant, the municipality has eliminated emissions by the equivalent of 70,544 metric tons of CO<sub>2</sub> annually. The reduction equates to 21% of total community wide emissions and is six times the emissions from all municipal sources. These calculations demonstrate the extreme importance of methane capture as an initial greenhouse gas reduction strategy. Since methane is 21 times as potent a greenhouse gas as CO<sub>2</sub>, capture and use of these emissions have been an effective reduction strategy. Capture of methane also generated 5.7 million kWh of electricity eliminating 600 tons of CO<sub>2</sub> from being emitted by conventional electrical generation.

### **Other Scope 3 Emissions**

Currently, reporting of "Scope 3" emissions is not required for AB32 compliance. However, the draft State Protocol recommends that these emissions be recorded for future planning and reporting needs. Such emissions include those from staff commutes to work, air travel and third party emissions during municipal contract work. Presently, there are no standard tracking mechanisms to collect this information. Staff will work to identify and implement appropriate

reporting mechanisms to collect the appropriate data and establish reduction goals.

### 3.3 Community Emissions

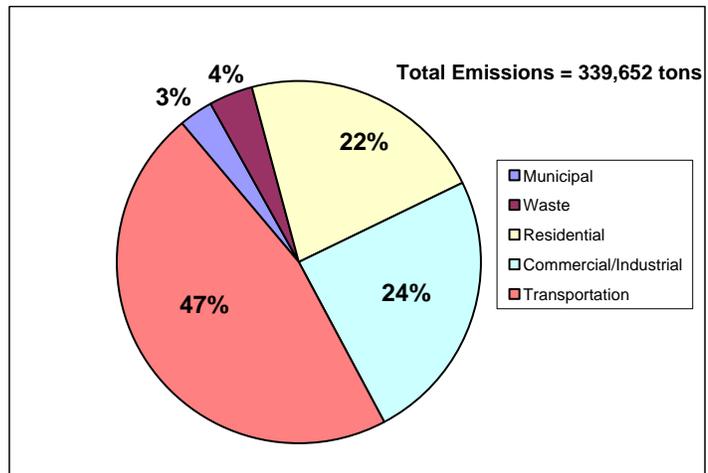
Community emissions include all energy and fuel used within the City of Santa Cruz by residents, visitors and businesses as well as those of the municipality reported above. Primary fuels used in Santa Cruz include electricity, natural gas, gasoline, diesel and methane. In total, Santa Cruz released the equivalent of 339,652 metric tons of CO<sub>2</sub> community wide in 2005. The residents, businesses and municipal operations emitted a combined total of 182,053 metric tons of CO<sub>2</sub>, and an additional 157,559 metric tons were emitted by vehicles (Table 3). The residential and business sectors emitted relatively similar percentages of the total (Figure 3).

**Table 3.0 2005 Community Energy Use / Metric Tons CO<sub>2</sub>e Emissions**

2005 Community Wide Energy Use							
Sector	kWh	Therms	Gallons	Million BTUs	Tonnes CO <sub>2</sub> e	Tonnes Avoided	Cost
<b>Municipal</b>	25,785,092	1,652,484	282,302	250,846	12,017	24,928	\$2,716,700
<b>Residential</b>	103,653,246	8,448,830		1,198,648	74,769		
<b>Commercial/Industry</b>	127,575,975	8,823,893		1,317,802	82,812		
<b>Transportation</b>	-	-	18,248,305		157,599		
<b>Waste</b>	-	-	-	-	12,455	45,668	
<b>Total</b>	<b>257,014,313</b>	<b>18,925,207</b>	<b>282,302</b>	<b>2,767,296</b>	<b>339,652</b>	<b>70,596</b>	<b>2,716,700</b>

#### Transportation

The Transportation emissions sector is one that has continued to increase since 1990 and currently comprises 47% of the community-wide GHG emissions. A recent City survey of residents estimated that 10,000 automobiles commute over the Santa Cruz Mountains every day for work, emitting 71,448 tons of CO<sub>2</sub> annually. Community wide mobile emission estimates (Transportation) for 2005 were calculated based on a 2.4% increase in vehicle miles traveled between 2000 and 2005 within Santa Cruz County (CalTrans 2005 VMT report). Values were extrapolated from the 2000 municipal inventory because city specific VMT estimates are not currently available. Mechanisms to gain these data for future inventories will be sought.



**Figure 3.** Community-wide Emission by Sector

## **Residential**

Residential emissions were estimated to be 74,769 metric tons in 2005, equaling 3.5 tons per residence. This number is below previous estimates of 4.19 metric tons per household in 2000 and 4.6 metric tons in 1996. While these numbers are estimates, the data suggests increased efficiency and conservation in Santa Cruz homes. County data suggests similar trends in enhanced efficiency, specifically between 2000 and 2003, immediately after the “energy crisis” of 2000 and 2001 (County PG&E Records). While trends are once again increasing (1% annually) the significant reductions between 2000 and 2005 demonstrate the potential opportunities if energy conservation and efficiency continue to be considerations in the home.

## **Business and Industry**

Business and Industry emissions estimates were 82,812 tons in 2005 down from previous estimates of 90,522 tons in 2000 and 167,689 tons in 1996. Most of the reductions since 1996 are from a 50% decline in electricity use between 1996 and 2000, most likely due to the change in industry from manufacturing (closing of large industry including Lipton, Wrigley, and Salz Tannery) to high-tech (Mary Arman, Pers. Com.). Efficiency upgrades since 2000 by local Santa Cruz businesses has resulted in considerable GHG reductions (9%) and energy cost savings.

# **4 1990 Baseline Emissions for Santa Cruz**

## ***4.1 Introduction***

The year 1990 was set as a worldwide baseline for greenhouse gas emissions and codified in policy by the Kyoto Protocol of 1997. The State of California also set reduction goals based on 1990 levels (AB32) and has quantified state wide emissions for 1990 at 427 million metric tons of CO<sub>2</sub>e. Santa Cruz has supported these historic worldwide declarations by adopting the Kyoto GHG reduction levels and setting goals based on reductions below 1990 emission levels.

There are significant problems associated with creating a reliable emissions inventory for 1990. Much of the data have not been stored in comparable formats which makes generating emissions values problematic. Other municipalities, as well as the international nonprofit ICLEI (who helped develop the software program that is being used by the city to generate emissions numbers), are working on strategies to address this issue. The City of Berkeley has completed an inventory for 2000 and 2005 and has used state wide energy use numbers to extrapolate back to 1990. To ease their future planning, Berkeley then modified their reduction goals (33% by 2020) to be based on more reliable 2000 emissions numbers.

Fortunately, Santa Cruz has reliable municipal energy use numbers for 1993 and has used these numbers to set a benchmark from which to plan reductions. For residential and business emissions numbers, Santa Cruz has adopted a similar approach to Berkeley and has extrapolated back to 1990 using previous emissions estimates completed in 1996 and 2000.

## 4.2 *Municipal Baseline Emissions Values*

Calculating emissions for multiple years (1996, 2000 & 2005) has led to a greater understanding of how historic changes in population, business and municipal operations has led to increases and declines in emissions from various sources.

Municipal energy use and GHG emissions have risen an average of 2.4% annually (Table 4), with emissions 15% higher in 2005 than 1993. This estimate integrates energy use increases from water services and reductions from energy efficiency improvements in buildings and fleet. Conservation and efficiency upgrades in buildings, fleet vehicles, and street lights have resulted in a 31% reduction in emissions for those sectors since 1993. Energy use in municipal buildings is similar to 1993 values despite the increases in city services, infrastructure and staff. Significant increases in emissions from the wastewater sector are the direct result of improvements in treatment (from primary to advanced secondary).

**Table 4.** City greenhouse gas emissions for multiple years by sector.

Sector	1993 CO2e	1996 CO2e	2000 CO2e	2005 CO2e
Buildings	1,850	2,049	1,591	1,893
Fleet	4,562	4,562	2,272	2,684
Streetlights	1,383	921	1,483	833
Water	1,606	1,571	2,400	2,119
Wastewater	771	1,496	3,307	4,488
<b>Energy Emissions</b>	<b>10,172</b>	<b>10,599</b>	<b>11,053</b>	<b>12,017</b>
Waste	29,323	25,277	17,866	12,455
<b>Total</b>	<b>38,626</b>	<b>35,876</b>	<b>28,919</b>	<b>24,472</b>

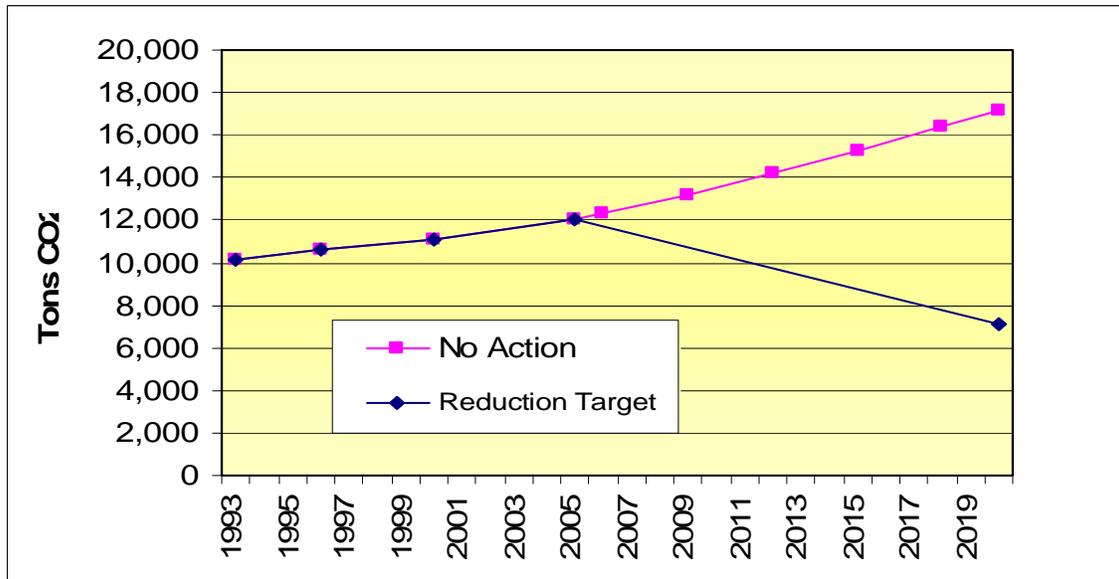
## 4.3 *GHG Reduction Benchmarks*

The City of Santa Cruz has selected the year 1993 as its municipal benchmark from which to set reduction goals and evaluate program success. The 1993 year was chosen as a surrogate for 1990 not only because data are limited prior to 1993 but also because 1990 values are not representative of normal emissions for that period due to the unprecedented city and community impacts from the 1989 Loma Prieta earthquake. The estimated municipal GHG emissions for 1993, totaling 10,172 tons CO2e, will be used as the historic benchmark from which to set future reduction goals.

**To meet City Climate Reduction Goals, acceptable GHG emissions levels for the municipality are set at 7,120 metric tons for 2020 (down from 12,017 tons) and 2,034 metric tons for 2050.**

Reaching this target represents a 40% reduction from 2005 emissions values by 2020 and will require significant actions from all sectors (Fig. 4). While the energy emissions have risen overtime, several sectors of energy use have remained steady or been reduced, even with growth in staff and services. Other sectors have risen significantly. If the reductions from landfill fugitive emissions are included in the total municipal benchmark, due to increased recycling efforts, the overall 2005 municipal emissions are 37% below 1993 levels. While this is an important consideration, the City of Santa Cruz Climate Action Program staff has interpreted the City Climate Reduction Goals to represent emissions reductions from energy used by the City, and not to take advantage of methane decline and capture as the primary reduction strategy for the city. Relying on landfill program success will not prepare the city to meet it’s 2050 reduction goals nor take full advantage of conservation and efficiency opportunities.

**Figure 4.** Santa Cruz Municipal CO<sub>2</sub> Emissions Trajectory



#### **4.4 Community Emissions Baseline**

Having historic data on community wide energy use has helped to establish reduction goals as well as understand how previous conservation efforts have performed. Available data on city wide energy use by sector suggests that GHG emissions have been reduced significantly since 1996. Available data suggest that residential emissions have declined 24% since 1996 and commercial/industrial emissions have been reduced 9% since 2000 and 44%

since 1996. The reduction in industry emissions between 1996 and 2000 is most likely due to the closure of several large manufacturing facilities in the late 1990s. Since loss of industry is not a prudent climate reduction strategy, industry benchmarks have been set at year 2000 values, intent to focus on the current industry composition.

**Table 5. Community Wide GHG Emissions (Metric Tons)**

Community Sector	1996	2000	2005	% change from 1996	2020 Emissions Objective
<b>Municipal</b>	10172*	11,755	12,017	<b>29%</b>	7,120
<b>Residential</b>	98,705	80,719	74,769	<b>-24%</b>	69,094
<b>Commercial/Industrial</b>	167,689	90,522	82,812	<b>-9%</b>	63,365
<b>Transportation</b>	148,506	153,755	157,599	<b>6%</b>	103,954
<b>Waste</b>	32,931	17,866	12,455	<b>-62%</b>	12455 <sup>#</sup>
<b>Total</b>	<b>447,831</b>	<b>354,617</b>	<b>339,652</b>	<b>-11%</b>	<b>266,585</b>

\* municipal emissions values are from 1993

<sup>#</sup> 2020 waste emissions objectives are equal to 2005. Other sectors can take advantage of the large reductions from this sector if unable to meet their specific 2020 objective.

Total community wide emissions have declined 11% since 1996 (since year 2000 for industry), bringing us one third of the way towards our 2020 reduction goals. Since 1996, some community sectors emissions have increased (municipal and transportation) and others have been reduced (residential, commercial and waste).

The community wide reduction goals have been set at 266,585 tons of CO<sub>2</sub>e. Therefore, annual emissions from the Santa Cruz community need to be reduced an additional 73,068 tons by 2020. State reduction goals, defined by AB32, are set at 1990 levels. Available yearly county wide emissions suggest that between 1990 and 1996 average emissions grew by 3%. Extrapolating back to 1990 using this growth rate sets the AB32 reduction goal for the Community of Santa Cruz to be 434,396 tons annually by 2020.

Future reduction success will most likely be variable, depending on economics, technology and interest. For instance, emissions from transportation have increased 6% since 1996, now totaling 47% of community-wide emissions. Reductions in this sector, however, are difficult without significant lifestyle changes, large capital investments or both. Until very recently, economics and technology have not supported reductions in transportation. Specifically, low fuel prices have allowed for waste and inefficiency. Significant increases in auto efficiency have only recently been available and encouraged through high gas prices. Some sectors, like transportation, may require longer initial start up time to implement. In those cases, initial efforts should be to identify infrastructure needs and test ideas at a pilot scale. Other sector actions can be taken immediately. Emissions reductions will need to be spread among community

sectors wisely, relying on technical and economic opportunities, and will be facilitated where appropriate by city programs and services.

## 5 Necessary Emissions Reductions Through 2020

### 5.1 Introduction – Climate Action Plan

Achieving a comprehensive 30% reduction in GHG emissions cannot happen immediately without causing significant impacts to the local economy, residents’ lifestyles and the availability of City services. Santa Cruz’s proposed strategy is to start immediately and continue a sustained effort over the next 12 years to meet the reduction goals. Success to date has positioned Santa Cruz for success. Next steps are to empower residents and businesses to continue current reductions and begin new actions. The City has initiated a Climate Action Pledge that advocates for everyone in the community to develop a strategy to reduce their GHG emissions 10% during the current year and then make small additional reductions each year there after. This will promote immediate conservation and efficiency measures and, over time, establish additional small changes by all within the community.

The prioritization of which actions should be implemented first and which actions have the greatest potential for success will be addressed within the Santa Cruz Climate Action Plan. The Climate Action Plan will investigate feasible opportunities and innovative options to meet the 2020 goals. Emission reductions must be made within all sectors (Fig 6a) but may not be accomplished equitably. Many opportunities are already available and have been implemented with success within this and other communities. Figure 6b depicts some plausible reductions through expansion of current programs. Unfortunately, all of the reduction opportunities are not readily apparent. An investment in new technologies or acceleration of current programs is necessary to meet our goals.

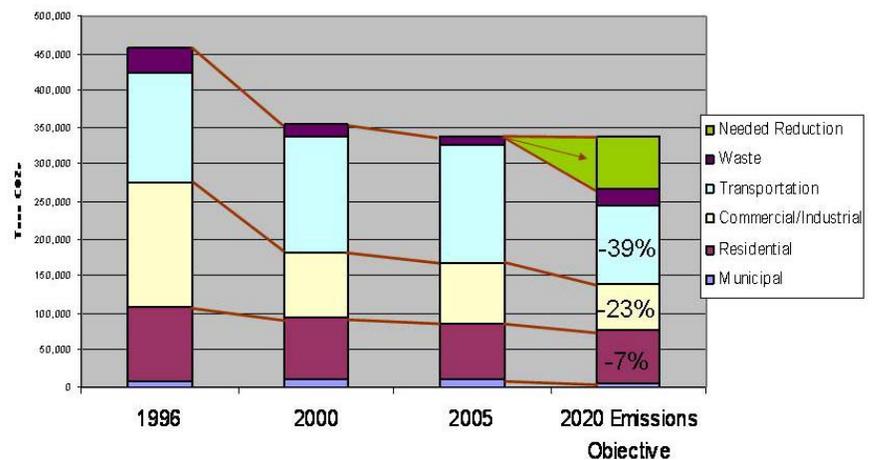


Figure 6a. Emissions and future reduction needs.

**Residential**

Efficiency upgrades in homes, businesses and municipal services have been shown effective. With energy costs continuing to increase, cost incentives to invest in new equipment will make such changes more enticing. Energy use and emissions from city residents have already been reduced by 24% since 1996. Continued emphasis on efficiency upgrades, insulation and conservation can easily provide the needed 8% additional reduction, and more. Green Building requirements, continued financial incentives for appliance and lighting upgrades, and the newly formed Climate Action Team program can help residents to reduce emissions further. The Green Building Program represents the future of residential efficiency and will help reduce future increases in emissions due to development and population growth.

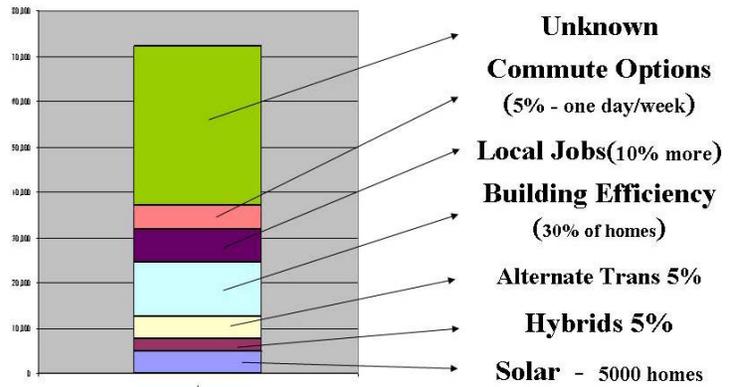


Figure 6b. Possible allocation of reductions among sectors and programs

**Municipal**

While overall municipal emissions have increased 15%, buildings, fleet and lighting have seen significant reductions. Recent investments in energy efficiency equipment, HVAC upgrades and fuel efficient fleet vehicles have resulted in approximately 14% reduction in potential emissions. Past investments in Solar PV for buildings and wastewater have resulted in 2-4% reductions in potential emissions for those sectors.

**Phase II efficiency upgrades**

Since 2005, the city has invested in several new solar installations and is currently investigating future opportunities. Municipal conservation and efficiency programs (see section 1.5) have led to an estimated reduction in emissions of 16% over what would have been emitted without these programs (a.k.a. “business as usual”) (Fig 5). Fortunately in Santa Cruz efficiency and conservation is standard procedure and

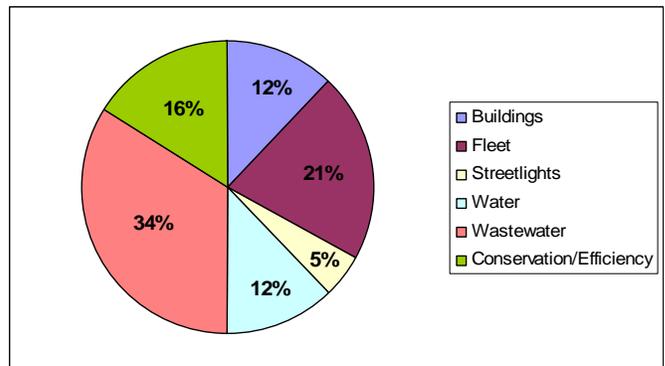


Figure 5. 2005 municipal emissions not emitted due to conservation and efficiency (designated in green) in relation to other sector totals.

has equipped us to meet and exceed the City's 2020 GHG reduction goals.

The Wastewater Treatment facility, which is the largest municipal energy user, has identified several additional opportunities to reduce energy use through equipment replacements. Additional solar PV and solar thermal may also have potential.

### **Waste**

Recycling and reductions in waste generation within Santa Cruz has led to the greatest GHG reductions. Unavoidable methane emissions from the land fill have been reduced by 62% due to reductions in disposal tonnage. Additional residential and business actions (wise purchasing, home composting and buy-local campaigns) will continue to help reduce waste, as will potential additions of food waste recycling programs.

### **Business and Industry**

City businesses and industry have reduced emissions by 9% since 2000. Future reduction opportunities for smaller businesses (Green Business Program, Right Lights) will most likely help reduce emissions and increase profitability. Additional opportunities for city/business collaboration to improve energy efficiency and adoption of renewable energy will be sought.

### **Transportation**

With emissions from transportation totaling 47% in Santa Cruz, a significant effort is needed to meet this sector's reduction goal over the next 12 years. Hybrid vehicles can increase individual fuel efficiency by as much as 50%. State incentives for people to replace aging vehicles with more efficient hybrids or possible plug-in hybrids should continue. Political support to return or expand hybrid purchase incentives should be a priority for meeting 2020 transportation goals.

While local residents have purchased a large number of hybrid and fuel efficient cars, the reduction of an additional 54,000 tons of CO<sub>2</sub> by 2020 through investments in vehicle efficiency alone will be difficult and expensive. A combination of improved overall vehicle efficiency, reductions in vehicle miles traveled and an increase in alternative/efficient transportation will be needed to meet these goals. Transportation oriented community planning and improved transit options will need to expand dramatically if 2050 transportation goals are to be met.

### **Solar Santa Cruz**

Based on current city growth estimates and the GHG emission trajectory, it is apparent that in order to meet 2020 GHG reduction objectives, conservation and

efficiency alone may not be sufficient. This conclusion dictates that reductions must also include the switch from fossil fuels to renewable energy sources. Climate Action Program staff has met with residents and the solar industry to define renewable energy goals and outline a strategy to meet those goals. A portion of the Climate Action Plan will define mechanisms to implement these strategies.

### **Goals**

- Make the switch from fossil fuel electric generation to renewable generation
- Make the initial switch cost effective or cost neutral
- Make the switch an investment against long term energy cost increases
- Provide long-term cost savings that can be redirected to city services
- Make the switch an investment in local infrastructure and the local renewable energy economy

Solar electric generation requires large initial investment and extensive areas for installation. However, the technology is proven; residential systems require limited permit and environmental review and are available now. Operation and maintenance costs are low, therefore, long term costs to manage a system are minimal. Until other options (wind, tides, geothermal) have been studied, designed, planned and have passed environmental scrutiny, the renewable energy strategy to meet the 2020 reduction goals is primarily solar.

### **Greening the Grid**

A key factor in reducing municipal and residential CO<sub>2</sub> emissions is the increased generation of electricity from non-carbon sources. PG&E and others have invested in renewable energy generation (wind, solar, geothermal) which has ultimately reduced the amount of CO<sub>2</sub> emitted with each kWh of electricity generated in California. Currently, California electricity generation emits half the carbon footprint of other areas of the nation. The State of California has set aggressive goals for expanding renewable energy generation, increasing the overall amount of renewable energy generation from 13% to 33%. If California meets the AB32 goal of 33% renewable generation by 2030, city and community reductions goals will benefit.

Investments by home owners in residential size solar systems has also helped “green the grid” by reducing their energy use and supplying renewable energy to the grid during peak use times when state-wide natural gas powered generation is greatest. The residents then use grid-supplied electricity during off-peak times when generation has the lowest carbon component. Continued political support for expanded electric generation from renewable sources

including both residential and large scale solar and wind generation, is crucial if California and Santa Cruz are to meet their Climate Change Reduction Goals.

## 6 Conclusions - Creating a Sustainable Santa Cruz

With energy prices expected to continue to increase, conservation and efficiency upgrades are wise investments and have already led to significant emissions reductions throughout the community. In 2005, the City of Santa Cruz saved \$750,000 on energy costs compared with 2003. Businesses and residents have also seen savings through reductions in energy use. Investments made to achieve these reductions are investments in local infrastructure that will continue to save money and reduce emissions for years to come.



The community of Santa Cruz has been a leader in addressing Climate Change both through words and actions. Continued support of these partnerships is necessary and efforts must be made to reach out to others to do more. The 2005 Emissions inventory provides the necessary data on city emissions to complete a City of Santa Cruz Climate Action Plan which will prioritize options, provide specific information on possible methods to meet the City goals and will take advantage of local opportunities and public interest. The Climate Action Plan will document how Santa Cruz can make a significant contribution to how the world responds to this environmental threat, and in doing so, build a better, more sustainable community.