

2011 Municipal Climate Action Plan

An Initiative to Reduce Municipal Greenhouse Gas Emissions



City of Antioch

200 H Street | Antioch, CA 94531

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Developing this plan was made possible with the input and assistance of many city staff. Without their assistance, opinions and data provided the emissions inventory and this plan would not have been created. Ultimately all city staff and officials will be involved in our climate success.

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City of Antioch Municipal Climate Action Plan

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Background: Antioch's Climate Change Initiative

Antioch's commitment to mitigating climate change began in September 2007 when the City Council of Antioch unanimously approved Resolution 2007/69 authorizing the City of Antioch to join ICLEI's (Local Governments for Sustainability) Cities for Climate Protection Campaign (CCP). Antioch is one of over 500 cities around the world to participate in the (CCP) campaign, sponsored by ICLEI and as part of the campaign, member cities have committed to: Inventory their emissions of Greenhouse gasses (GHG's); Set reduction targets; Develop comprehensive strategies to meet these targets; Implement these emissions reduction actions; and Measure the results.

Antioch's baseline community wide GHG emissions inventory was completed as part of a grant with ICLEI in February 2008. Staff has recently completed the baseline municipal emissions inventory for the year 2005. Further, on June 23, 2009, the City Council of Antioch unanimously approved Resolution 2009/57 adopting GHG reduction targets by reducing overall carbon emissions by 25% by 2020 and 80% by 2050.

About the City of Antioch, California

Antioch is one of the oldest cities in California, having been founded in 1850. Circa 1859, coal was discovered in several places in the hills south of Antioch and formed the first substantial industry aside from farming and dairying. This new industry resulted in the founding of the towns of Nortonville, Somersville, Stewartville, and Black Diamond (now Pittsburg), and added greatly to the prosperity of Antioch. Today, Antioch is mainly a "bedroom" community, with most adults working in larger cities toward Oakland and San Francisco. Antioch has seen an enormous amount of growth in the last 30 years, as the population of the Bay Area continues to grow, and relatively lower real estate prices have allowed families to move towards the eastern portions of the Bay Area.

The City of Antioch is within the metropolitan region of the San Francisco Bay Area. The 2005 census estimates the City's population at approximately 100,000. Like other metropolitan areas, residents of Antioch as well as residents of other cities within Contra Costa County contribute to the problem of global climate change, while also holding immense potential to contribute to the solution. The energy consumed and the waste produced within Antioch's boundaries result in thousands of tons of heat-trapping greenhouse gas emissions every year. But, as is evidenced by the widespread municipal involvement in Antioch through its Climate Protection Initiative, Antioch is firmly committed to building on existing efforts to reduce its emissions that cause global climate change.

Regional governments and nations across the world can only manage what they measure. Below is a chart of global greenhouse gas emissions, which includes the amount of metric tons of carbon dioxide equivalent (MTCO₂e) that is generated worldwide, within the United States, the State of California, and in Antioch. For context, California alone is the 16th largest emitter of MTCO₂e in the world- second only to Texas in the US. However, Californians per capita are among the lowest emitters of MTCO₂e in the US.

Table 1- World Greenhouse Gas Emissions Scenarios

Locations	GHG – Metric tons of CO ₂ e per year	Percent of World GHG Emissions	Percent of U.S.A Emissions	Percent of California Emissions
World (2000)	30,583,828,421	100.0%		
United States (2000)	6,233,901,378	20.4%	100%	
California (2004)	491,861,051	1.6%	7.9%	100.0%
Contra Costa County (2005)	12,335,904		0.002%	.025%
City of Antioch (2005)	308,954			0.0006%

Source: (2000) World and United States emissions from World Resources Institute – Climate Analysis Indicators tool (<http://cait.wri.org/>). (2004) California emissions from California Energy Commission (<http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF>). Figures exclude land use related emissions.

Note: All units in this report are reported in metric tons.

Fast Facts

2000 Worldwide per capita GHG emissions MTCO₂e **4.5** metric tons CO₂e
 2004 US per capita GHG emissions MTCO₂e **21** metric tons CO₂e
 2004 California per capita GHG emissions MTCO₂e **15** metric tons CO₂e

Additional source: 2004, U.S.A. GHG Emissions from EPA
<http://www.epa.gov/climatechange/emissions/downloads06/06ES.pdf>

City of Antioch Municipality Fast Facts (2005)

Number of Employees.....333 (full-time only)
 Employees to Population Ratio1/310
 Number of City owned Facilities.....13
 Electricity costs.....\$1,421,230
 Natural gas costs.....\$135,190
 Number of City owned vehicles.....161
 Gas/Diesel consumption.....94,222 (gallons)
 Total landfilled waste.....544 (metric tons)
 Landfilled waste per employee.....1.6 (metric tons)
 Waste diversion rate.....50%

About ICLEI and the Cities for Climate Protection Campaign

ICLEI's mission is to improve the global environment through local action. The Cities for Climate Protection (CCP) campaign is ICLEI's flagship campaign designed to educate and empower local governments worldwide to take action on climate change. ICLEI provides resources, tools, and technical assistance to help local governments measure and reduce greenhouse gas emissions in their communities and their internal municipal operations.

ICLEI's CCP campaign was launched in 1993 when municipal leaders, invited by ICLEI, met at the United Nations in New York and adopted a declaration that called for the establishment of a worldwide movement of local governments to reduce greenhouse gas emissions, improve air quality, and enhance urban sustainability. The CCP campaign achieves these results by linking climate change mitigation with actions that improve local air quality, reduce local government operating costs, and improve quality of life by addressing other local concerns. The CCP campaign seeks to achieve significant reductions in U.S. greenhouse gas emissions by assisting local governments in taking action to reduce emissions and realize multiple benefits for their communities.

ICLEI uses the performance-oriented framework and methodology of the CCP campaign's 5-Milestones to assist U.S. local governments in developing and implementing harmonized local approaches for reducing global warming and air pollution emissions, with the additional benefit of improving community livability. The milestone process consists of:

- Milestone 1: Conduct a baseline emissions inventory and forecast
- Milestone 2: Adopt an emissions reduction target
- Milestone 3: Develop a Climate Action Plan for reducing emissions
- Milestone 4: Implement policies and measures
- Milestone 5: Monitor and verify results

Figure 1: ICLEI's 5 Milestones



Executive Summary

The debate is over. The overwhelming scientific consensus is that human-induced climate change is among the most pressing environmental and social problems facing this generation and those to come.

The time to act is now. Never in the past 1000 years has the planet warmed at a faster rate than during the 20th century, and the most recent decade has been the warmest ever on record. Allowing this trend to continue could result in decreased agricultural output, increased catastrophic weather events such as forest fires, drought and floods and displacement of entire populations due to rising sea levels.

Antioch must do its part. Although the United States accounts for a mere 4% of the world's population, it produces 20.4% as illustrated in Table 1 on page 6 of the world's greenhouse gases. As a community, Antioch released 308,954 MTCO₂e in 2005 and, if steps are not taken to achieve reductions, is projected to emit 75,000 more MTCO₂e in 2020. Antioch's total community-wide GHG emissions in 2005 are equivalent to the emissions generated by 60,000 passenger vehicles.

On September 25, 2007, Antioch pledged to take action against this destructive trend by passing a resolution to join more than 230 U.S. local governments and 770 local governments worldwide in ICLEI's CCP campaign. In so doing, Antioch committed to ICLEI's 5-Milestone methodology for combating global warming. The City of Antioch is committed to reducing community-wide GHG emissions by 25% below our baseline year (2005), by the year 2020 and 80% by 2050.

Antioch's Municipal Climate Action Plan (MCAP)

It is important to note that this initiative to reduce carbon emissions within Antioch's jurisdiction should be seen as a road map of potential strategies which seek to accomplish the City's goals over the next 40 years. This document is a malleable non-binding resolution which details policies and programs that can be implemented to help reduce the City's GHG emissions should funds and or the political will to do so become available. The City of Antioch's MCAP:

- Provides background on the science and impacts of climate change
- Presents Antioch's baseline GHG emissions inventory and emissions reduction target
- Outlines the policies and measures in energy efficiency and renewable energy, transportation, water, and solid waste management sectors that Antioch may implement and/or is already implementing to achieve its target
- Presents next steps required to implement the plan

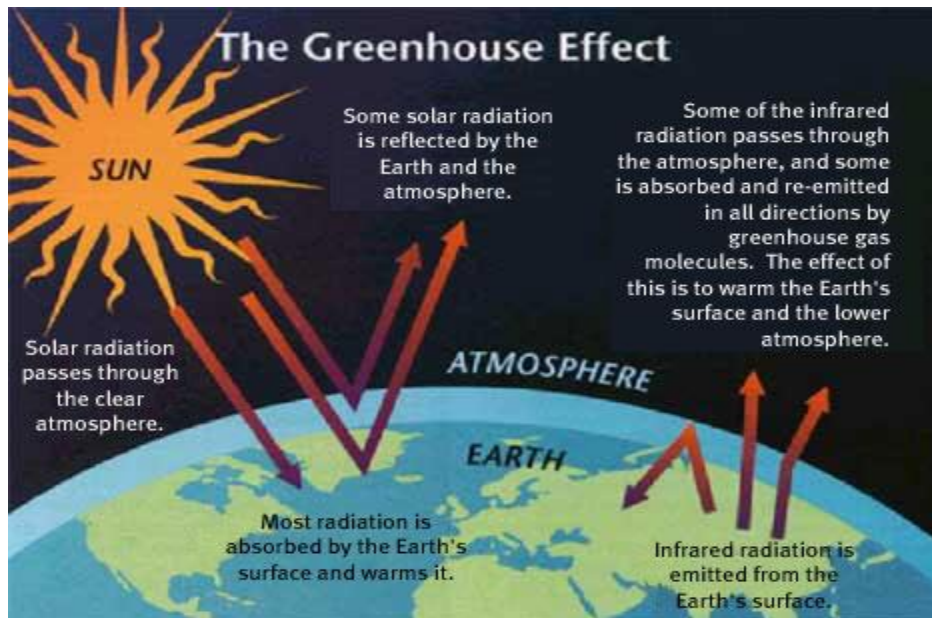
If all the measures in the MCAP were implemented and the projected emissions reductions realized, we would be very close to our goal of an 80% reduction by 2050. With just the existing/planned measures, we should reach our goal to decrease emissions 25% below the 2005 baseline set for 2020. Moving forward, emissions inventories are planned for every 5 years to track the actual reductions in emissions. The next inventory will be completed in fiscal year 2011/12 for calendar year 2010 emissions.

1. Introduction

1.1. Introduction to Climate Change Science

The Earth's atmosphere is naturally composed of a number of gases that act like the glass panes of a greenhouse, retaining heat to keep the temperature of the Earth stable and hospitable for life at an average temperature of 58°F. Carbon dioxide (CO₂) is the most prolific of these gases. Other contributing gases include methane (CH₄), nitrous oxide (NO₂), ozone (O₃) and halocarbons. Without the natural warming effect of these gases the average surface temperature of the Earth would be around 14°F.

Figure 2



Source: US Environmental Protection Agency

However, recently elevated concentrations of these gases in the atmosphere have had a destabilizing effect on the global climate, fueling the phenomenon commonly referred to as global climate change. The global average surface temperature has increased during the 19th and 20th century by about 2°F. According to NASA scientists, the 1990s were the warmest decade of the century, and the first decade of the 21st century is well on track to be another record-breaker. The years 2002, 2003, 2004 and 2005, along with 1998, were the warmest five years since the 1890s, with 2005 being the warmest year in over a century.

Scientific Facts and Projections¹:

- The atmospheric concentration of carbon dioxide (CO₂) during the last two decades has increased at the rate of 0.4% every year.
- Current CO₂ concentrations are higher than they have been in the last 420,000 years and according to some research, the last 20 million years.
- About three-quarters of the CO₂ emissions produced by human activity during the past 20 years are due to the burning of fossil fuels.

¹ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

The climate and the atmosphere do not react in a linear fashion to increased greenhouse gases. That is to say that you cannot simply predict the specific degree of warming that each ton of carbon dioxide emitted from a power plant or a vehicle's tailpipe will cause.

The Earth's climate has a number of feedback loops and tipping points that scientists fear will accelerate global climate change beyond the rate at which it is currently occurring. For example, as CO₂ emissions have increased in recent human history, the oceans have been absorbing a significant portion of these gases, but as the oceans become more permeated with CO₂, scientists anticipate they will reach a saturation point, after which each ton of anthropogenically emitted CO₂ (human induced) will have a more substantial impact.²

Another example of this compounding can be found in the polar ice caps. Ice is highly reflective and acts effectively like a giant mirror, reflecting the sun's rays back into space. As the planet warms and some of this ice melts away, a darker land or ocean surface is revealed. This darker surface tends to absorb more heat, accelerating the speed at which the planet warms with each ton of greenhouse gas emitted. As these examples illustrate, the stakes are high, and there is no time to lose in the fight against global climate change.

1.2. Effects & Impacts of Climate Change

Global Impacts

In addition to causing an increase in average global surface temperature, rising levels of GHG's have a destabilizing effect on a number of different micro-climates, conditions and systems. According to the Intergovernmental Panel on Climate Change (IPCC), surface temperatures are on course to increase anywhere from 2.5 to 10.5°F by the year 2100, with regions in the northern parts of North America and Asia heating by 40% above the mean increase.³ The increase in the temperature of the oceans is projected to accelerate the water cycle, thereby increasing the severity and rate of both storms and drought, which, along with decreased snow pack, could disrupt ecosystems, agricultural systems and most importantly for us water supplies.

Snow cover world-wide has decreased by 10% in the last forty years. Average sea levels have raised between 1/3 and 2/3 of a foot over the course of the 20th century and are projected to rise by at least another 1/3 of a foot and up to almost three feet by the year 2100. These coastal infringements on such a large scale could lead to not only significant environmental and ecosystem disturbances, but also major population displacement and economic upheaval.⁴

Local Impacts:

While climate change is a global problem influenced by an array of interrelated factors, climate change is also a local problem with serious impacts foreseen for California, the Bay Area and Antioch.

Sea level rise: According to the Union of Concerned Scientists, the sea level in the State of California is expected to rise up to 12 inches throughout the next 100 years. The Pew Center on

² Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

³ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

⁴ Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report: "Climate Change 2001: The Scientific Basis."

Climate Change has reported that this would result in the erosion of beaches, bay shores and river deltas, marshes and wetlands and increased salinity of estuaries, marshes, rivers and aquifers.⁵ This increased salinity has the potential to damage or destroy crops in low-lying farmlands. Infrastructure at or near sea level, such as harbors, bridges, roads and even the San Francisco International and Oakland International Airports are at risk of damage and destruction.

The City of Antioch will not experience much if any land loss due to sea level rise according to future models of the Bay. However, an increase in sea level combined with an increase in salinity throughout the Bay will threaten Antioch's ability to receive and provide fresh potable water to all of its customers. If the City's ability to provide fresh potable water to its customers is threatened, that would result in the City having to purchase more of its water from Contra Costa Water District, these costs however unknown in an uncertain future with a failing Delta are assumed to be extremely high.

The San Francisco Bay Conservation and Development Commission have modeled the impact of a sea level rise of 3 feet (approx 1 meter) on the San Francisco Bay Area. As shown in Figure 3, areas such as the Oakland Airport would be under water as well parts of Alameda, San Leandro, Hayward, Union City, Fremont and Newark, including sections of Interstate 880.

Natural disasters: Climate models predict a 4°F temperature increase in the next 20 to 40 years, with an increase in the number of long dry spells, as well as a 20-30% increase in precipitation in the spring and fall. More frequent and heavier precipitation causes flooding and mudslides, which would incur considerable costs in damages to property, infrastructure and even human life. Heavy rains during the winter of 2005 offered a glimpse of the potential costly and disruptive effects of such precipitation.

In addition, the increase of wildfires due to continued dry periods and high temperatures is another expected impact of continued climate change. In these conditions, fires burn hotter and spread faster. During 2008, according to Cal Fire, there were over 2,780 individual fires at the height of the fire season. The fires broke out after three years of below-normal rainfall and above-normal temperatures. Spring 2008 for California was the driest on record for many locations and in summer 2008, California saw record temperatures for the month of July. According to the National Weather Service inland locations such as, the Central Valley saw

Figure 3- Bay Area impacts of a 1 meter sea level



Source: SF Bay Conservation Development

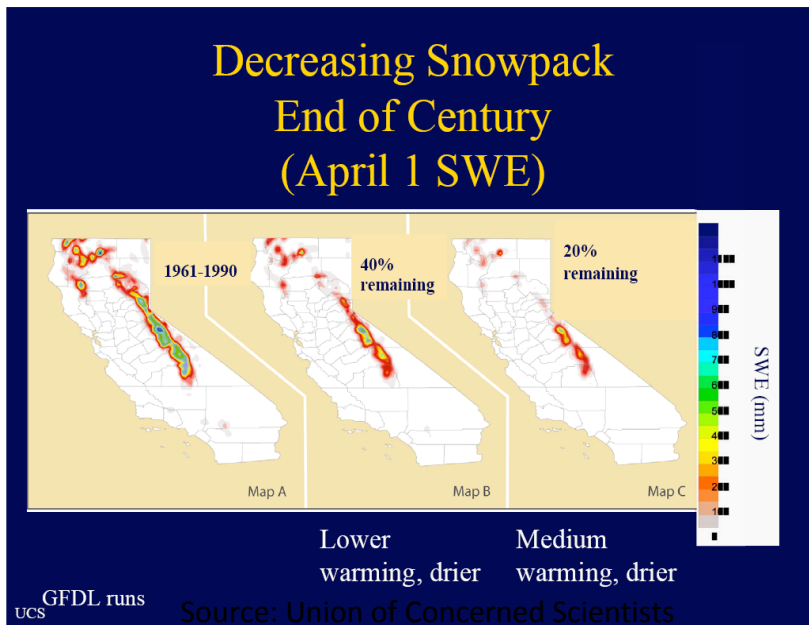
⁵ Neumann, James E. for the Pew Center on Global Climate Change. "Sea Level Rise & Global Climate Change: A Review of Impacts to the US Coasts." February 2000.

temperatures reach 115°F, while Lake Berryessa experienced record high temperatures reaching 126°F.

Impacts on water: Water quality and quantity are also at risk as a result of changing temperatures. With warmer average temperatures, more winter precipitation will fall in the form of rain instead of snow, shortening the winter snowfall season and accelerating the rate at which the snowpack melts in the spring. Not only does such snow melt increase the threat for spring flooding, it will decrease the Sierras' capacity as a natural water tower, resulting in decreased water availability for agricultural irrigation, hydro-electric generation and the general needs of a growing population.

The decrease in snow-pack is particularly relevant in the State of California and the Bay Area, as the Sierra snow-pack provides approximately 80% of California's annual water supply, and it is the origin of the Tuolumne River, the primary source of water for the San Francisco regional

Figure 4- Decreasing Snowpack in California



water system. Figure 4 was provided by the Union of Concerned Scientists for the California Climate Action Team Report (2006).

Impacts on plants and vegetation: Native plants and animals are also at risk as temperatures rise. Scientists are reporting more species moving to higher elevations or more northerly latitudes in response. Increased temperatures also provide a foothold for

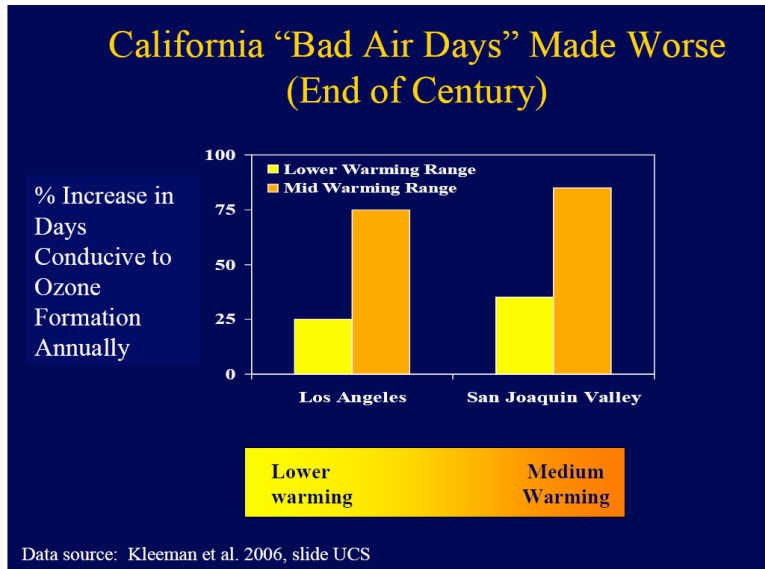
invasive species of weeds, insects and other threats to native species. The increased flow and salinity of water resources could also seriously affect the food web and mating conditions for fish that are of both of economic and recreational interest to Californians. In addition, the natural cycle of plant's flowering and pollination, as well as the temperature conditions necessary for a thriving locally adapted agriculture could be affected, with perennial crops such as grapes taking years to recover. In California, the impacts of climate change on agriculture are estimated to be \$30 billion by the Farm Bureau, mostly due to changes in chill hours required per year for cash crops.

Public health impact: Warming temperatures and increased precipitation can also encourage mosquito-breeding, thus engendering diseases that come with mosquitoes, such as the West Nile Virus, a disease of growing concern in our region. This problem is only being made worse with the soaring foreclosure rates in East Contra Costa County and throughout the rest of California resulting in unattended pools providing ample conditions for mosquitoes to breed. Heat waves are also expected to have a major impact on public health and be a determinant

factor of mortality. According to the IPCC (2004), the summer mortality rates will double by half by 2050 due to hot weather episodes.

Increased temperatures also pose a risk to human health when coupled with high concentrations of ground-level ozone and other air pollutants, which may lead to increased rates of asthma and other pulmonary diseases. Furthermore, anticipated increases in the number and severity of hot days place significant portions of the population, particularly the elderly, young, those already sick, and people who work outdoors, and those at risk for heat-stroke.

Figure 5- California Bad Air days



Source: Union of Concerned Scientists

The incidence of bad air days in California's urban areas has increased, mostly in hot summer days. On long, hot, stagnant days, ground level ozone can build up to levels that violate federal and state health-based standards. In the summer of 2008, the Bay Area Air Quality Management District (BAAQMD) registered 12 Spare the Air days and exceeded the California 8-hour standard for ozone (set at 75 ppb) 20 times.

Given that climate change has local repercussions and effects on weather, water resources, ecosystems, public health, infrastructural stability and economic vitality, local governments including Antioch have a vested interest in mitigating the amount of GHG's being produced by their communities.

1.3. Action Being Taken on Climate Change

International Action

As evidence of climate change has mounted, groups at the international, federal, state and local level have responded with ways to confront the impending threat. The United Nations Framework Convention on Climate Change (UNFCCC) leads international efforts to investigate and combat climate change. Recognizing the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk associated with

human-induced climate change, its potential impacts and options for adaptation and mitigation, releasing its most recent assessment in 2007.⁶

In 1997, 10,000 international delegates, observers and journalists gathered in Kyoto, Japan to participate in the drafting and adoption of the Kyoto Protocol, requiring industrialized nations to reduce their collective greenhouse gas emissions 5.2% below 1990 levels. As of January 2007, 162 countries have ratified the Protocol, with the United States and Australia most notably absent from the list. Additionally, since 1995 the annual Conference of the Parties (COP) has met to discuss action and implementation to combat climate change, with the most recent COP, COP-12, being held in Nairobi in 2006.

In 2009, nearly 100 world leaders accepted UN Secretary-General Ban Ki-Moon's invitation to participate in an historic Summit on Climate Change in New York on September 22 to mobilize political will and strengthen momentum for a, "fair, effective, and ambitious climate deal" in Copenhagen this December of 2009. The Summit marked the first UN visit for the Presidents of China and the United States as well as the newly elected Prime Minister of Japan.

Between December 7 and December 18, 2009, the United Nations Climate Change Conference will take place in Copenhagen, Denmark. Over 184 countries are expected to attend and participate in this conference including the United States and China, who combined contribute to 40% of the world's GHG emissions. It is expected that this conference will produce a framework for climate change mitigation beyond 2012.

State and Federal Action

Though adequate attention and action related to combating climate change has been lacking at the federal level, California has taken significant steps at the state level. California has been leading the charge on combating climate change through legislation:

Senate Bill 1771 Sher, 2000 – Requires the California Energy Commission (CEC) to prepare an inventory of the state's GHG emissions, to study data on global climate change, and to provide government agencies and businesses with information on the costs and methods for reducing GHG's. It also established the California Climate Action Registry to serve as a certifying agency for companies and local governments to quantify and register their GHG emissions for possible future trading systems.

Senate Bill 1078 Sher, 2002 – Established renewable portfolio standards requiring electricity providers to increase purchases of renewable energy resources by 1% per year until they have attained a portfolio of 20% renewable resources.

Assembly Bill 1493 Pavley, 2002 – Requires the State California Air Resources Board (CARB) to develop and adopt regulations that achieve the maximum feasible reduction of GHG's from vehicles primarily used for non-commercial transportation by January 2005.

Executive Order #S-3-05 - Signed by Governor Schwarzenegger on June 1, 2005 establishing a GHG reduction target of reducing emissions to 2000 levels by 2010, to 1990 levels by 2020 and 80 percent below 1990 levels by 2050. In April 2006, the California Climate Action Team

⁶ Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report: "Climate Change 2007"

released its Report to Governor Schwarzenegger and the State Legislature, outlining recommendations and strategies to achieve those reductions.

Assembly Bill 32 Núñez & Pavley, 2006 – Institutes a mandatory limit on GHG emissions; reducing emissions in California to 1990 levels by the year 2020, or 25% below forecasted levels. The bill also directs CARB to establish a mandatory reporting system to track and monitor emission levels and requires CARB to develop various compliance options and enforcement mechanisms.

Senate Bill 375 Steinberg, 2008 – Builds on the existing regional transportation planning process (which is overseen by local elected officials with land use responsibilities) to connect the reduction of GHG emissions from cars and light trucks to land use and transportation policy. According to CARB, transportation accounts for some 40% of GHG emissions, with cars and light trucks accounting for almost three-quarters of those emissions (30% overall).

Local Climate Protection Efforts by the City of Antioch

While the goals of many of the existing actions listed below (e.g., reducing local air pollution, reducing traffic congestion, improving public health, increasing energy efficiency and conservation, and improving solid waste management) is not necessarily to reduce GHG emissions, they do serve that function. Ultimately, the goal of Antioch’s Municipal Climate Action Plan (MCAP) is to build on existing planning and implementation efforts and integrate them into the broader task of reducing Antioch’s impact on climate change.

LED Traffic Signal Retrofit Project-Beginning in 2000 and extending into 2001 the City of Antioch underwent an LED traffic signal retrofit project. At the time the City owned and operated over 80 traffic signal lights in the City. From 2001 to 2005 the City increased the amount of traffic signal lights from 80 to around 100; all new traffic signals had LED lights installed for the green and red signals. Estimated GHG emissions reduction of 41 MTCO₂e annually

Grass-cycling Project- Prior to 1999 the City of Antioch implemented a grass-cycling program for all of its parks and recreation areas. Grass-cycling is the process where the cut grass clippings are left on the area that was mowed versus trapping the clippings in bags for the purposes of off-site disposal. This process results in the City diverting over 3200 tons of yard waste from the landfill annually and reducing GHG emissions by 462 MTCO₂e annually.

C&D recycling ordinance-In 2004 the City of Antioch adopted a construction and demolition debris (C&D) recycling ordinance. This C&D recycling ordinance requires the redirection from the waste stream of at least 50% of the total construction and demolition debris generated by a project via reuse or recycling. This ordinance also requires a Waste Management Plan (WMP) to be completed and approved by the City of Antioch for the purposes of complying with this ordinance. A completed WMP contains actual weight or volume of the material disposed or recycled.

Local Governments for Sustainability (ICLEI)-In 2007 the City of Antioch joined Local Governments for Sustainability or ICLEI, a group consisting of over 500 cities whose goals are to

adopt long-term GHG reduction targets and develop a Climate Action Plan to meet those targets, and monitor and reevaluate those efforts.

Magnificent Green Machine (MGM) Task Force- In 2008 the City of Antioch formed a green task force made up of representatives from several departments. The group is made up of representatives from management, finance, capital improvements, community development, information systems, recreation, public works as well as human resources. The groups' goal is to help make policy changes and develop resource conservation programs within their respective departments and/or divisions. The group held its first meeting on August 11, 2008 and meet quarterly until staffing reductions necessitated putting meetings on hold. MGM will be invaluable in implementing this plan.

GHG Reduction Targets-On June 9, 2009 the City Council of Antioch unanimously adopted GHG reduction targets of 25% below baseline year by the year 2020, and 80% reductions by 2050. These targets adopted by Antioch are in accordance with California State Law AB 32 *Global Warming Solutions Act (2006)*.

2. Emissions Inventory

2.1. Reasoning, Methodology & Model

The City of Antioch's municipal inventory was completed by city staff while the community inventory was completed in partnership with ICLEI. The purpose of the baseline emissions inventory is to determine the levels of GHG emissions that Antioch emitted in its base year, (2005).

ICLEI's CCP inventory methodology allowed Antioch to systematically estimate and track greenhouse gas emissions from energy and waste related activities at the community-wide scale and those resulting directly from municipal operations. The municipal operations inventory is a subset of the community-scale inventory.

Once completed, these inventories provide the basis for creating an emissions forecast and reduction target, and enable the quantification of emissions reductions associated with implemented and proposed measures.

2.2. ICLEI's Emissions Analysis Software

To help facilitate local governments identify and reduce GHG emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package with Torrie Smith Associates. This software estimates emissions derived from energy consumption and waste generation within a community. The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. Emissions are aggregated and reported in terms of MTCO₂e. Converting all emissions to carbon dioxide equivalent units allows for the consideration of different GHG's in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide in its capacity to trap heat, so the model converts one ton of methane emissions to 21 tons of CO₂e.

The emissions coefficients and methodology employed by the software are consistent with national and international inventory standards established by the IPCC (1996 Revised IPCC Guidelines for the Preparation of National GHG Emissions Inventories), the U.S. Voluntary GHG Reporting Guidelines (EIA form 1605), and, for emissions generated from solid waste, the U.S. EPA's Waste Reduction Model (WARM).

The CACP software has been and continues to be used by over 250 U.S. local governments to reduce their GHG emissions. However, it is worth noting that, although the software provides Antioch with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. The model 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 rather than an exact value.

2.3. Inventory Data Sources and Collection Process

An inventory of GHG emissions requires the collection of information from a variety of sectors and sources. For electricity and natural gas data, ICLEI consulted Pacific Gas & Electric Company (PG&E). The Metropolitan Transportation Commission (MTC), Bay Area Air Quality Management District (BAAQMD), and Bay Area Rapid Transit (BART) served as sources of transportation data. Solid waste data was gathered from California Integrated Waste Management Board (CIWMB), Allied Waste, and Contra Costa County. *City* staff, including: Jeff Glover, Willy Frasier, Nicholas Tagas, Julie Haas-Wajdowicz, Chris Alvarez, and Mike Bechtholdt were instrumental in providing data for municipal operations.

The collection of this data was entered into the software to create a community and a municipal emissions inventory. The community inventory represents all the energy used, vehicle miles traveled and waste produced within Antioch and its contribution to GHG emissions. The municipal inventory is a subset of the community inventory, and includes emissions derived from internal government operations only.

There are two main reasons for completing separate emissions inventories for community and municipal operations. First, the City of Antioch is committed to action on climate change, and has a higher degree of control to achieve reductions in its own municipal emissions than those created by the community at large. Second, by proactively reducing emissions generated by its own activities, the City of Antioch takes a visible leadership role in the effort to address climate change. This is important for inspiring local action in Antioch, as well as for inspiring other communities within the greater Bay Area.

Data for both inventories reflect calendar year 2005, which is the baseline year used by most participating cities in the Contra Costa County Climate Leaders group. 2005 is recent enough for data to still be maintained and accessible, and often available in electronic formats. At the same time, 2005 allows trend analyses to show the GHG reduction impacts of conservation actions taken in recent years.

When calculating Antioch's emissions inventory, all energy consumed in Antioch was included. This means that, even though the electricity used by Antioch residents is produced elsewhere, this energy and emissions associated with it appears in Antioch's inventory. The decision to calculate emissions in this manner reflects the general philosophy that a community should

take full ownership of the impacts associated with its energy consumption, regardless of whether the generation occurs within the geographical limits of the community. This is also the reasoning behind local power plant emissions not being included in our inventories.

2.4. Inventory Results

City of Antioch Results

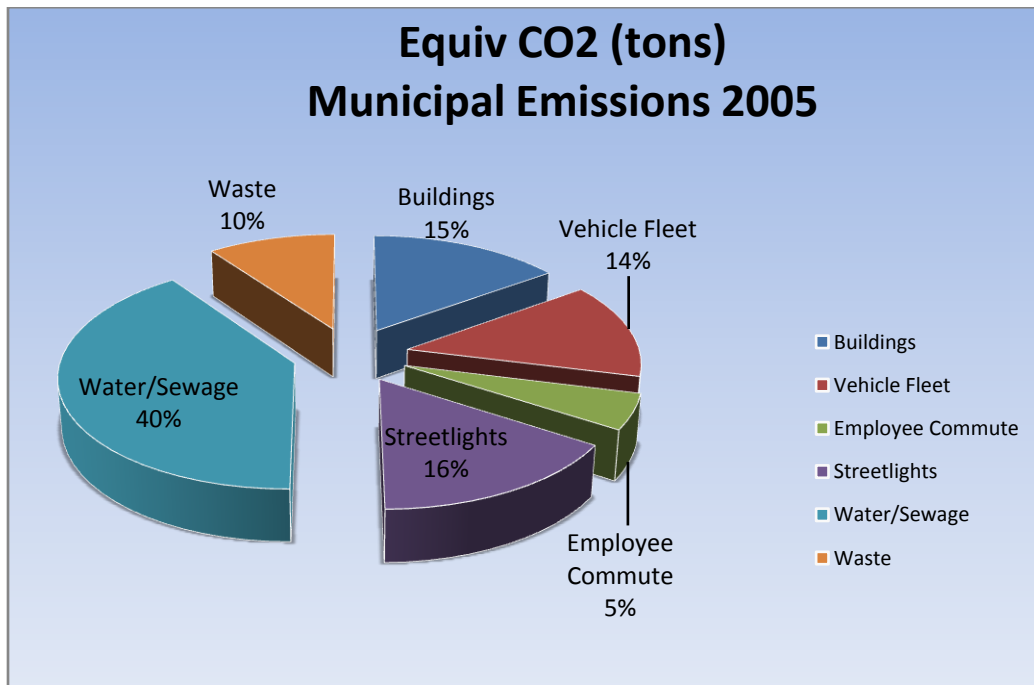
The results below represent Antioch’s completion of the first milestone of ICLEI’s CCP campaign. The City of Antioch’s municipal GHG emissions inventory for baseline year 2005 are shown in the following Table 2 and Figure 6:

Table 2- GHG Emissions Inventory Results for City of Antioch

GHG Emissions Municipal Inventory City of Antioch, CA	Total CO2e metric tons/year
Facilities/operations	Baseline Year 2005
Buildings	1,173
Vehicle Fleet	1,073
Employee Commute	402
Streetlights	1,230
Water/Sewage	3,120
Waste	777
Total	7,775

Source: CACP 2003 output

Figure 6- GHG Emissions Inventory Results for Antioch



Source: CACP 2003 output

The City of Antioch emitted approximately 7,775 MTCO₂e from all sectors of operations and facilities in 2005. The treating and transportation of water in Antioch represents the largest source of GHG emissions followed by streetlights, energy used for buildings and facilities, and lastly the burning of fossil fuels for the vehicle fleet.

3. Forecast for Greenhouse Gas Emissions

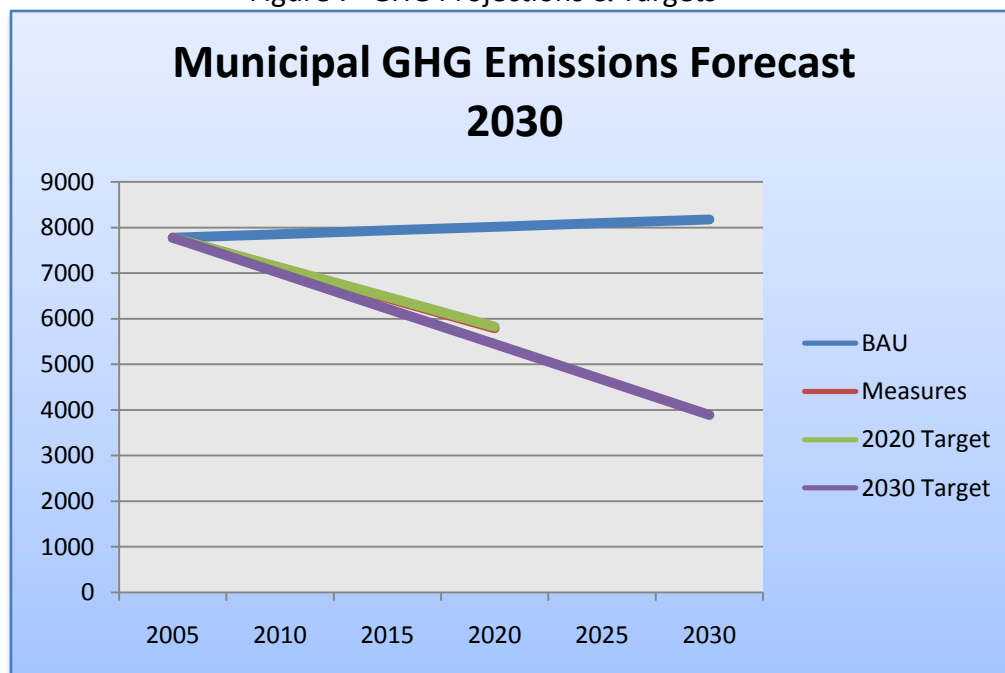
The first step in reducing emissions toward targeted levels is to determine the City's baseline emissions level, or the emissions level before anything had been done to reduce the City of Antioch's 2005 emissions. This baseline is used to determine business-as-usual (BAU) forecast projections and target emissions levels for the target years. Even though a baseline has been established, the City must also anticipate annual growth rates which will affect the amount of MTCO₂e emitted. With a BAU calculation the City can more accurately predict how much emissions will increase over the next 40 years and at what amounts of MTCO₂e will be needed to be reduced in order to meet specified goals.

This baseline is used to calculate BAU projections and target emissions levels. BAU projections account for future growth and are based on an average annual employment growth since year 2005 of 0.2% per year.

2005 baseline Municipal emissions level = 7,775 MTCO₂e
2020 projected emissions level (BAU) = 8,015 MTCO₂e

Based upon these BAU projections the City has made several recommendations to reduce GHG's in line with AB 32. The goal of establishing a BAU projection allows the City to more accurately develop programs and policies that will reduce GHG emissions at levels that meet or exceed reductions set by AB 32. With a BAU forecast established, the City can now determine how much emissions are projected to increase, and how much the City needs to reduce.

Figure 7- GHG Projections & Targets



Source: CACP 2003 output

4. Greenhouse Gas Emissions Reduction Target

A reduction target provides a tangible goal for Antioch’s emissions reduction efforts. Our emissions reduction target represents a percentage by which the municipality aims to decrease emissions 25% below the 2005 baseline, by the year 2020.

Many factors were considered when selecting Antioch’s reduction target. Staff strove to choose a target that was both aggressive and achievable given local circumstances. On June 23, 2009 the City Council of the City of Antioch unanimously approved reduction targets in line with California State Law AB 32 which set reduction targets of 25% by 2020 and 80% reductions by 2050.

Under AB 32 the California Air Resources Board (CARB) shall enforce these state-wide mandates and shall be the enforcing agency monitoring counties and municipalities if reductions become mandatory at the local level. While there are currently no requirements for local governments, the City should anticipate potential future regulation and analyze its ability to meet this target for its **municipal** operations.

CARB, in its proposed AB 32 Scoping Plan, recommends the establishment of reduction targets for years 2020, 2030, and 2050. This reasoning is based on the assumption of future changes to technologies, programs, and projects aimed at reducing emissions. With robust reduction schedules in place for 2020 and 2030 it allows entities to more closely evaluate their progress before the 2050 deadline for conformance. Therefore a reduction target of **50% below baseline levels by 2030** for City municipal operations would keep the City on track toward the long-term target of 80% by 2050.

Local factors considered in selecting the target reduction percentages included:

- Estimation of a .2% annual growth rate for government
- Estimation of the effects of implemented and planned programs and policies,
- An approximate assessment of future opportunities to reduce emissions,
- Targets adopted by peer communities, and
- Emissions reductions expected to be achieved by state-level climate policy.

The city of Antioch can meet its target of 80% reductions below *2005 levels* by the year 2050 if it reduces its emissions from its operations and facilities by only **178 metric tons annually**.

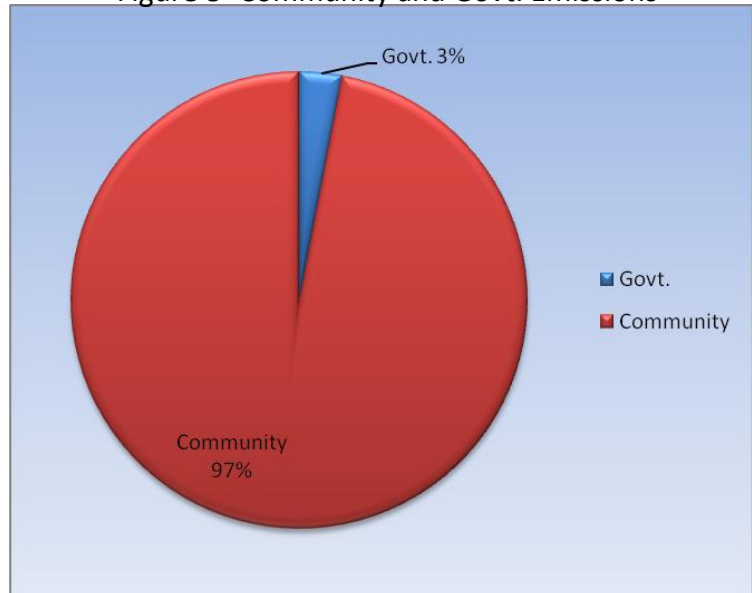
Table 3- Baseline, Projection, and Target

Baseline and Projected Years	MTCO ₂ e
2005 Emissions Level	7,775
2020 BAU Projected Emissions	8,015
2020 Target Level	5,831
Total Reduction Needed by 2020	2,184
2030 BAU Projected Emissions	8,160
2030 Target Level	3,888
Total Reduction Needed by 2030	4,273
2050 BAU Projected Emissions	8,494
2050 Target Level	1,555
Total Reduction Needed by 2050	6,939

5. Existing/Planned Emissions Reduction Measures & Policies

The emissions that result from municipal facilities and operations account for only 3 percent of Antioch’s community-wide emissions. That being said, measures taken to reduce municipal emissions show that the city’s elected officials and staff are committed to taking action on climate change and to inspiring action in both our community and neighboring communities. Antioch is proud of the emissions reduction efforts implemented or planned to date and is committed to building on those efforts by increasing fleet fuel efficiency, reducing solid waste and water consumption, and increasing energy efficiency and conservation in municipal facilities and operations.

Figure 8- Community and Govt. Emissions



Source: CACP 2003 output

The City of Antioch can achieve its targets by evaluating existing and planned GHG reduction measures as well as additional measures for implementation. As time progresses, the City may exhaust the most cost-effective measures, but opportunities will develop as technologies improve, mass transit systems expand, and growing demand for environmentally friendly products lowers costs.

The City of Antioch has already begun implementing measures to reduce its municipal GHG emissions. This report will analyze the GHG reductions achieved by these measures as well as those that could be achieved with the implementation of additional measures. The GHG reductions from these measures are explained in detail below.

Table 4- Summary of Planned Emissions Reductions

Planned/Existing Measures	Target Year (2020)
Reduction Target	2,184 MTCO ₂ e
Reductions Achieved	2,015 MTCO ₂ e
Additional Reduction Needed by 2020	169 MTCO₂e

For the purposes of this report, *planned measures* are those that have already been identified and approved and thus will be implemented in the near future without further consideration. The table to the right highlights that these planned measures alone will almost get us to our

2020 goal. There are a couple of measures where the resulting GHG reduction is currently unknown. Staff plans to conduct inventories every five years to monitor our progress and calculate actual results from implemented programs.

5.1. Planned/Existing Municipal Operations Measures

Table 5- Summary of Existing or Planned Projects

Planned/Existing	Project Name	MTCO ₂ e Reduction
	Alternative Work Schedules	86
	Analyze City of Antioch vehicle fleet	unknown
	Energy Audits	unknown
	DDC upgrade to HVAC	81
	LED Exit signs	23
	Streetlight/City Facilities lighting retrofit	1825
	Total Reduction	2015

Alternative employee work schedules- (86 MTCO₂e) It is up to each Department to determine how to implement these schedules, as long as public service is not compromised. GHG emissions are reduced when employees work more hours per day but fewer days per week, thereby eliminating commute trips. The City has temporarily moved to a 4/9 schedule for all non-sworn employees where they work four

days a week consisting of nine hour work days and having most City facilities and services closed every Friday.

Analyze City of Antioch vehicle fleet- (unknown) The City continuously examines the number, size, fuel type, and usage profiles of its municipal vehicles. Also, when acquiring new vehicles, the City examines with scrutiny the size/payload of the new vehicles to ensure that it is appropriately sized. Quite often, municipal fleets have “too much bang for the buck”, these audits help make sure that is not the case for Antioch.

Conduct energy audit of city facilities and implement retrofits- (unknown) In 2007 the City conducted an energy audit of seven city facilities. In cooperation with ABAG’s Energy Watch Program, they provided Antioch an Energy Assessment Report to help Antioch obtain a comprehensive view of the energy use for these seven facilities. This audit yielded many areas where the City could invest in energy efficiency retrofits and identified energy savings rebates. An audit walkthrough of this nature should be repeated every five years so that the City may reevaluate its energy consumption and determine what available technologies and programs are available that would help reduce municipal energy usage.

Direct digital control for HVAC systems for all city facilities- (81 MTCO₂e) Direct digital control (DDC) on HVAC systems provides precise control over heating and cooling systems, which optimizes operation and reduces simultaneous heating and cooling while maintaining comfort. This project will be funded through the Federal Governments Department of Energy (DOE) Energy Efficiency and Conservation Block Grant (EECBG) of 2009.

Replace exit signs in all city facilities with LED lights- (23 MTCO₂e) In each public entry to City buildings, municipal and state regulations require illuminated exit signs. Quite often, these are overlooked as measures to consider, even though these devices are illuminated 24 hours a day. A standard exit sign, with two 20-watt incandescent bulbs, uses 316 kWh per year, and costs approximately \$35 per year to operate. The City owns and operates 126 exit signs. Over the past three years the City has been replacing outdated incandescent Exit signs with LED’s reducing the City’s energy usage by 56,816 kWh annually with a realized cost savings of over \$6,818 annually.

Street light and City Facilities retrofit project- (1,825 MTCO₂e) The project will consist of retrofitting over 8,725 street and park lights with induction lighting and retrofitting eight (8) City facilities with high efficiency fluorescent lighting. This would result in an estimated annual energy savings of \$342,700 (\$259,555 from street lights, \$24,363 from parks and decorative lighting, and \$58,782 from city facilities). This project was partially funded through the DOE EECBG of 2009 as well as borrowing private capital.

6. Potential Emission Reduction Measures & Policies

Table 6-Possible Reductions

Antioch Emissions Summary	MTCO₂e Reduction
Sum of Planned Measures	2015
Sum of Potential Measures	2999
Total Reductions Possible	5014
Additional Reduction Needed by 2020	169
Additional Reduction Needed by 2030	-742
Additional Reduction Needed by 2050	1,925

Table 6 includes the reductions projected from the planned and existing measures above and the potential measures highlighted in this section. The goal of this section is to identify

measures that the City may implement.

However, the measures detailed in this section are not set in stone. This section should in no way be perceived as an unfunded mandate for the city of Antioch. Rather this list of reduction measures should be seen as a menu of options which the City may or may not voluntarily choose to undertake. As we move forward, it is possible that alternative measures will be selected and implemented.

At this point, there are no set timelines for implementation of any potential measure; as outlined below, several measures can be implemented as replacement policies, or as funding becomes available. The ultimate goal of this MCAP is to get the City of Antioch on a path that reduces its GHG emissions by 25% by 2020 and by 50% by 2030 and 80% by 2050. As you can see by Table 6 above, these measures will get Antioch to the 2030 goal. As with the planned and existing measures, there are measures where the potential emissions reductions are not yet known and staff will be monitoring the actual results as programs are implemented as well as conducting emissions inventories every 5 years.

Based on careful consideration of the emissions reductions needed to achieve our stated targets, the distribution of emissions revealed in our emissions inventory, existing priorities and resources, and the potential costs and benefits of various potential emissions reduction projects, Antioch has identified a set of emissions reduction measures that should be set into motion where feasible. Below are five areas of operations, programs and policies which address climate change. Each of the five areas addresses specific functions of municipal operations and facilities which can be adapted to: increase energy efficiency, reduce operating costs, and reduce GHG emissions.

6.1. Energy Efficiency and Renewable Energy

Table 7- Potential Energy Measures

Energy	Project Name	MTCO ₂ e Reduction
	Purchase Renewable Energy	1540
	Duplex Printing	1
	Energy Awareness	60
	Solar Panels	625
	Cool Roofs	15
	Window Film	145
	Vending Misers	8
	Remove Light bulbs from Vending Machines	6
	Lights out at Night	82
	Energy Efficient Computers	12
	LEED for Municipal Facilities	*****
	Planning/Zoning Incentives	*****
	Planning/Zoning Mandates	*****
	Total Reduction	2494

Purchase Renewable Energy via the Grid-(1540 MTCO₂e)

Green energy purchases allow utility customers to use energy from renewable sources such as solar, wind and geothermal without having to generate that energy themselves. PG&E offers their Climate Smart program to give customers the chance to purchase more renewable energy than PG&E's standard grid mix. There is a slightly higher cost for this option, but as a municipal customer, PG&E often offers grant funds to offset the costs and provide additional funding for other climate and energy efficiency work if the City was enrolled in Climate Smart. The project emissions reduction is

based on purchasing 20% of our electricity from renewable sources.

Adopt GreenPrint software, draft paper and duplex printing practices- (1 MTCO₂e) GreenPrint is a software product that automatically detects pages which may not be necessary, such as a last page with only a URL or an online banner advertisement. The software gives the user the option of eliminating these wasteful pages from the print job. Another feature of the software is the ability to print only text or images, rather than both, using the print preview option. The software can also be used as a PDF writer, to save documents rather than printing. Reports can be generated daily, weekly, monthly, or yearly illustrating paper and ink saved, as well as an estimated cost-savings.

In addition to installing GreenPrint software, City Information Systems should work with department heads to ensure double-sided printing is the default on all printers and computers which have that capability. When it is time to replace printers and copiers, new equipment must have duplexing and be Energy Star rated.

Create an employee energy awareness program to promote energy conservation and efficient use of city facilities- (60 MTCO₂e) As part of its Federal Energy Management Program, the US Department of Energy offers a handbook on the design and implementation of a facility energy awareness program—including instructions on creation of staff surveys, formation of focus groups, identification of desired behaviors, identification of motivations, and development of messaging. It provides examples of desired behaviors, communication channels, and specific messaging strategies. This measure requires only a small cost for staff labor, materials, and administrative costs. With a goal of reducing energy consumption in the workplace by 5%, the

city could reduce its GHG emissions by 60 MTCO₂e and save the City nearly \$2,000 per year in energy costs. This handbook is available at http://www1.eere.energy.gov/femp/pdfs/step2_hndbk.pdf.

Install solar panel systems at city facilities- (625 MTCO₂e) Solar installations are expensive with paybacks in the 15-year time frame even when including incentives. Rebates from the “California Solar Initiative” are offered in varying amounts that are dependent on the expected performance of the system. More information is available on the Go Solar California website. This program can also be funded by a Power Purchase Agreement (PPA) with no upfront cost to the City.

A PPA is a lease from a private company that installs and owns the system, and there are many companies currently offering PPA’s. The City pays for electricity generated by the system to a leaser and, after the lease term, the company removes the system or the City acquires ownership of the system. The City has already conducted a feasibility study to install a solar farm at the Water Treatment Facility and the Prewett Water Park. While the results of that study determined that at this time it was not feasible, staff is still searching for grants and other funding sources that could make this a more attractive decision based on financial a reason.

Use cool roofing systems for city facilities, goal of 50,000ft²- (15 MTCO₂e) On average, cool roofing systems reduce building air conditioning electricity use by 10 to 30 percent, or total building electricity use by 3 to 10 percent. Energy Star certified reflective roof products can lower roof temperature by up to 100°F.

Install thermally resistant window films on city facilities- (145 MTCO₂e) Thermally resistant window films reduce heat gain and balance HVAC, thereby reducing energy use and increasing comfort for occupants. Thermally resistant window films reduce total building energy use by 10 to 15-percent. This program is more effective for existing buildings that do not have other built-in mechanisms for efficiency.

Convert vending machines to Energy Star options as machines are replaced- (8 MTCO₂e) The average beverage vending machine uses nearly 3,500 kWh per year. The City of Antioch has 14 vending machines which use approximately 49,000 kWh per year combined with a cost of \$4,488 in electricity rates. Vending Misers are devices that can be installed on beverage vending machines. Vending machines run very inefficiently. Energy Star new or refurbished machines use half the electricity of non-Energy Star models.

Remove light bulbs from all vending machines- (6 MTCO₂e) Typical vending machine lighting consists of two T-12 fluorescent lamps that use up to 180 watts of electricity. Continuous operation could use 1,580 kilowatt hours at a cost of \$126 annually. Coordinate with the soft drink vendor(s) to remove lights from the drink machines. If the vendor objects, please do not request bulb replacement at failure. This is a measure that can be implemented immediately while we await the proper time to replace machines with Energy-Start in the measure above.

Implement Lights out at Night Policy- (82 MTCO₂e) Lighting is typically the largest electricity user in commercial buildings. The City has already done much to improve lighting efficiency with occupancy sensors in many areas and the lighting retrofits that were completed in 2009. Currently many lights are left on at night and over the weekend when the buildings are

unoccupied. A policy of turning lights off at the end of the work day can result in a 35% savings in lighting electricity.

Energy Efficient Computers- (12 MTCO₂e) EPA Energy Star certified computers, monitors, copiers and printers often cost the same or nominally more than non-Energy Star counterparts. By adopting a purchasing policy to purchase Energy Star certified products at time of replacement, the city can save money in electricity cost with a pay back period of a less than one month in most cases.

Require LEED construction standards for all new municipal facilities- (unknown) The LEED system aims to provide achievable building performance results that create energy, water, and resource efficient buildings that are economically viable and healthy for those living and working in them. LEED certified buildings ultimately depend less on city infrastructure because they use fewer utilities.

There are four possible levels of LEED certification: Certified, Silver, Gold, and Platinum. Achieving a certain level of LEED certification means that a green building project has achieved not only the prerequisite required for certification, but also a variety of optional credits in the areas of sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design. Projects are encouraged to pursue LEED credits that are most applicable to their building type and project goals.

Support planning and zoning incentives- (unknown) While the City has yet to incorporate green building incentives or requirements into its planning ordinances, the potential of each of the following incentives should be explored:

- A density zoning incentive for rooftop gardens on buildings in non-residential districts, a height or density bonus to commercial or residential projects that provide affordable housing and achieve at least LEED Silver, or a height and density bonus to multi-family residential and non-residential projects that comprise of a green roof.
- Permit incentives, to expedite the permitting process for projects aiming for LEED certification, as well as a reduction in permit fees based on carbon footprint and LEED certification level.
- Create property tax abatements for LEED Gold buildings for the first five years, incrementally increased by 20% per year through year ten.
- Provide financial assistance for new LEED residential or rehabilitated low-income or mixed-income structures and homes with the creation of an Energy Efficiency and Conservation Fund.
- Expedite water and electrical connections for buildings meeting LEED Silver.
- Offer publicity to builders incorporating green building practices in new single-family homes.

Support planning and zoning mandates- (unknown) In addition to incentives, the City should explore the option of the following sustainability mandates for public and/or private projects. Potential planning or zoning mandates the City of Antioch may consider include:

- Develop a green building code- other Bay Area cities have already adopted such codes. A green building code could help incentivize developers to build more energy efficient structures and also promote economic growth in a new and vibrant economy.
- Unless they are LEED certified, building projects over 5,000-square-feet shall establish a building-specific sustainable education program or contribute to a general sustainability program fund for the City.
- Any new building construction or renovation projects receiving public financing of any kind shall achieve LEED commercial certification or Green Rating residential certification.
- Private-sector buildings over 10,000-square-feet that receive 10% of their project costs or \$200,000 from public agencies shall achieve LEED Silver certification.
- Private commercial/industrial projects over 10,000- square-feet and residential/mixed use projects of 50 or more housing units shall pursue LEED certification.
- Private-sector, non-residential buildings 10,000- square-feet or larger shall pursue LEED certification.
- Public projects larger than 5,000-square-feet shall be LEED certified.
- All public projects (new construction or major renovations) greater than 10,000-square-feet shall have a green roof if there is a horizontal roof surface.
- All new government buildings shall achieve LEED certification.

6.2. Vehicle Fleet

Table 7- Potential Fleet Measures

Vehicle Fleet	Project Name	MTCO ₂ e Reduction
	B20 Biodiesel	84
	No Idling Policy	17
	CNG Vehicles	29
	Hybrid Vehicles	43
	Total Possible Reduction	173

Change to B20 biodiesel fuel for diesel fleet- (84 MTCO₂e) The use of B20 displaces petroleum fuel consumption by 20-percent versus standard diesel.

Draft a No Idling Ordinance for Municipal Fleet- (17 MTCO₂e) Idling refers to the practice of operating a motor vehicle engine when the vehicle is not moving. While necessary at

times, idling often produces little or no discernable benefit. However, idling vehicles consume fuel and produce VOC and NOx emissions, which contribute to smog formation. Reducing idling can be a straightforward approach to achieving lower fuel consumption and improved air quality. A municipal idling reduction program can also enhance community image and improve community health. The no idling policy could start with a goal of reducing idling time on average of 10 minutes daily per vehicle. This would save the city roughly \$5,000 in avoided fuel costs.

Replace 20 vehicles for Compressed Natural Gas (CNG) vehicles for city fleet- (29 MTCO₂e) CNG vehicle resale values are currently very high due to low CNG prices, various incentive programs, and tax credit programs. Increased resale values may continue to at least partially offset the majority of the additional procurement cost upon resale. Additionally, CNG fuel is cheaper than gasoline per gallon equivalent and the CNG sedan has better fuel efficiency than a standard gasoline sedan. This reflects a fuel cost savings of about \$7,700 annually.

Replace 10 vehicles for electric vehicles in city fleet- (43 MTCO₂e) Vehicle use applications that are compatible with the capabilities of plug in electric vehicles should be identified, and assigned where appropriate. The vehicles could be purchased incrementally as equipment is replaced and also as additional vehicle requests where new vehicles are added to the fleet are made. In 2005, based on a 5 day work week, the average miles per day traveled ranged from 20-50 miles per day depending on the vehicle class. With most batteries lasting around roughly 100 miles, most of the vehicles could easily be replaced with electric with no change to daily usage. There is funding available with Contra Costa 511 to install charging stations. With fuel prices at record highs, fuel savings now will rapidly offset the additional procurement costs very early in the equipment lifecycle.

Replace 15 vehicles for hybrid vehicles for city fleet- (57MTCO₂e) Vehicle use applications that are compatible with the capabilities of hybrid vehicles should be identified, and hybrids assigned as appropriate. The hybrid vehicles could be purchased incrementally as equipment is replaced and also as additional vehicle requests where new vehicles are added to the fleet are made. With fuel prices at record highs, fuel savings now will rapidly offset the additional procurement costs very early in the equipment lifecycle.

6.3. Employee Commute

Table 8- Potential Commuter Measures

Employee Commute	Project Name	MTCO ₂ e Reduction
	Pre-Tax for mass transit	46
	Telecommuting	14
	Carpool Program	69
	Bike Racks	23
	Total Possible Reduction	152

Allow City employees to use pre-tax dollars to pay for mass transit or car-pool expenses (10% employee participation)- (46 MTCO₂e) the concept of allowing employees to use pre-tax dollars to pay for commute expenses is similar to the Health Care Spending Accounts currently offered by other cities for their employees. The program could be

administered by the Human Resources Department or a hired contractor to administer the program; employers who provide the benefit for commute expenses call these programs Commuter Spending Accounts (CSAs).

CSAs take advantage of tax savings available through Section 125 of the Internal Revenue code, which is the same provision enabling the establishment of the Health Care Spending Account benefit. The money an employee allocates to the CSA is not subject to federal, state, or Social Security or Medicare (FICA) taxes. Eligible expenses include costs for transit fare, vanpool fees, and parking charges.

Create a telecommuting program by identifying opportunities for employee participate in if applicable- (14 MTCO₂e) The City could institute an employee telecommute program allow

employees that are eligible to telecommute from home. This assumes that potentially 20 employees would be able to telecommute on day per week. The City should identify the barrier to increased telecommuting through discussions with staff. If the barrier is at the manager level, the City should consider sponsoring training for these managers to address their concerns about telecommuting. The City should also send a message to all staff to make sure that employees are aware of opportunities to utilize the telecommuting program.

Employee carpool and vanpool program (15% employee participation)- (69 MTCO₂e) The City of Antioch could implement an employee carpool program to get employees to carpool to work with their vehicle or with a City issued vehicle. This could also involve requiring employees that take a city vehicle home to carpool with coworkers that live near his/her route to work. A feasibility study should be conducted on such a ride-share/ employee commute program.

Install bike racks and or lockers at all city facilities and create a bike program for city employees (5% participation)- (23 MTCO₂e) A non-motorized commute reduces greenhouse gas emissions by about 20 pounds of CO₂e for every gallon of gasoline avoided. As part of the GHG inventory process, an employee commute survey was completed. Of the 72 surveys submitted, two indicated that they occasionally bike to work. Until recently the City has not formally encouraged its employees to bike to work, nor does it provide adequate bike storage. Currently we have 4 bike lockers at Maintenance Services, but at no other city locations.

To encourage employees to use bicycles for part or all of their commute, the City should provide safe, sheltered areas to store bicycles, either at secure bike racks or in an indoor storage area. As well, showers and lockers should be provided at facilities including City Hall. Other incentives include “bike pooling” programs, and rewards such as cash rewards, assistance purchasing bikes, reimbursement for bicycle repairs or bicycle/bicycle accessory purchase, free breakfast or snacks, and recognition in internal memos or publications.

6.4. Waste Reduction and Recycling

Table 9- Potential Waste Related Measures

Waste	Project Name	MTCO ₂ e Reduction
	EPP Program	*****
	Recycling Program	163
	Composting	17
	Total Possible Reduction	180

Environmentally Preferred Products (EPP) procurement program- (unknown) The City currently has a Recycled Content Purchasing Policy that gives a 10% price preference for recycled content products this should be expanded to incorporate other environmental impacts into purchasing decisions. Much of the current purchasing

of supplies is done by each department, or individual. The department or division is responsible for buying what they need, as long as they order from a contracted vendor. The deciding factor is usually cost. Since most office supplies are purchased by individual departments, outreach and education needs to be done to all departments on this issue. Some simple changes can be ordering refills versus new pens, recycled content in post its and other paper products, citywide surplus swapping for durable goods and purchasing more durable goods versus single use items

Purchasing environmentally friendly products can not only reduce the City’s carbon footprint, but often it can save money on energy costs. For example, a large laser printer typically uses

2.4 kWh per day, or a total of 867 kWh per year. Using this figure, replacing a large laser printer with an Energy Star model could save approximately 217 kWh per year. In addition to saving money on electricity costs, this change would result in an emissions reduction of one-fourth ton of CO₂e.

Similarly, replacing a refrigerator manufactured in 2001 with a new Energy Star model reduces electricity usage between 15 to 40%. Energy Star models of refrigerators and microwaves should be purchased when lunchroom appliances are replaced. In addition to using energy efficient office equipment, the City could further reduce its carbon footprint through the use of post-consumer recycled goods.

Broaden City employee recycling program- (163 MTCO₂e) In 2005 the total amount of landfilled waste by all city employees, (approximately 333 full-time) produced was 544 metric tons. That equates to almost 2 metric tons of waste per employee per year. While all city facilities have recycling bins available, the program could be improved and expanded to encourage greater participation by employees. Simply adding more recycling bins will not ensure more people recycle. Rather, a change in office culture as part of the overall greening of city facilities is essential. The City could create a 20% reduction goal based on 2005 landfilled waste totals.

Divert organic waste from parks and city maintained landscaping to on-site composting-(17 MTCO₂e) The City’s green waste could be composted using simple and inexpensive technology, specifically a turned-windrow composting process. This would require about 2,000 to 3,000 square feet of vacant land and a small chipper/grinder and small turner. At this scale of facility, even the smallest capacity processing equipment would still have processing capacity much greater than 170 tons per year. The final compost product could even be sold as a means for revenue generation for further composting and other energy efficient strategies.

6.5. Water and Waste Water

Table 10- Potential Water Related Measures

Water/Waste Water	Project Name	MTCO ₂ e Reduction
	Improve Energy Efficiency	156
	Low Maintenance Landscaping	9
	Water Conservation	*****
	Total Reduction	165

Improved energy efficiency in water treatment and distribution-

(156 MTCO₂e) Forty percent of Antioch’s municipal emissions are the attributed to the pumping, treating and distribution of water and the conveyance of waste water to Delta Diablo Sanitation District. A 5% reduction in energy

consumption due to efficiency upgrades would result in an annual emissions reduction of 156 MTCO₂e. In 2007, PG&E conducted a survey of the distribution system and made recommendations on pumps that could be upgraded; staff is implementing those suggestions as replacements occur.

Convert 10 acres to Low Maintenance Landscaping- (9 MTCO₂e) Once established, landscaping with native plants is less expensive to maintain, uses less water and provides a habitat for local wildlife and more visual diversity and enjoyment in our parks and open spaces. Converting areas that are currently unused turf, such as slopes and spots too small for playing will also

serve as demonstration areas for homeowners to look to on what can be done in their own yards.

Water conservation as an emission reduction tool- (unknown) As our customers reduce their water consumption, emissions are reduced because, less electricity is needed to pump and treat less water and less natural gas is needed by customers to heat their water. Since this is primarily a demand management measure, the goal and emissions reductions will be captured in the Community Climate Action Plan.

6.6. Summary of Emissions Reduction Measures

Based on the emissions reductions estimated through the proposed measures and the contribution of the existing measures, Antioch could achieve our emissions reduction target on

Table 11- Antioch Emissions Summary

Antioch Emissions Summary	MTCO₂e Reduction
Sum of Planned Measures	2015
Sum of Potential Measures	2999
Total Reductions Possible	5014
Additional Reduction Needed by 2020	169
Additional Reduction Needed by 2030	-742
Additional Reduction Needed by 2050	1,925

municipal operations of 50% by 2030. As illustrated in Table 11, we would still be 1,925 MTCO₂e short of our 2050 goal of an 80% reduction. However, 2050 is still 40 years into the future and we will have seven more emissions inventories (for calendar years ending in 5 and 0) and a new MCAP in after 2020 inventory to address achieving our 2050 goal.

7. Measures Implemented External to Antioch

In addition to emissions reduction measures implemented, planned, and proposed for our municipality, the effects of measures recently implemented at the state level also deserve consideration in the context of our greenhouse gas emissions inventory. These measures have not been integrated into the estimated emissions reductions for Antioch above because they are imposed from outside of the community and their creation and enforcement is beyond our control. Antioch is committed to meeting our emissions reduction target without relying on externally imposed policies. However, we feel it is appropriate to have a sense for how emissions reductions achieved due to external policies may compare with the work we are engaging in within our municipality and community.

In California, numerous policies have been adopted by the state legislature or governor that either are currently or are projected to significantly reduce GHG emissions. In 1989, AB 939 established the current organization, structure and mission of the CALRecycle. The purpose was to direct attention to the increasing waste stream and decreasing landfill capacity, and to mandate a reduction of waste being disposed. Jurisdictions were required to meet diversion goals of 25% by 1995 and 50% by the year 2000. A disposal reporting system was established with CIWMB oversight, facility and program planning was required, and cities and counties began to address their waste problems. Along the same lines, in 2009 Keller Canyon Landfill built a 3.9 megawatt landfill gas-to-energy plant. Two-thirds of Antioch’s garbage is landfilled

there annually. The project is outside of the city's jurisdiction, but our 2010 emissions inventory will reflect the benefits of the methane capture that is happening there.

In 2002, the California Senate passed SB1078 requiring public utilities to gradually increase the percentage of their energy supply generated from renewable sources, reaching 20 percent renewable content by 2017. This means that, over time, a larger and larger share of the energy electrifying homes and businesses in Antioch will be generated with clean power.

Executive Order S-20-04 was signed July 27, 2004 and directs the state to commit to aggressive actions to reduce state building electricity usage by implementing cost-effective energy efficiency and green building strategies. To this end, the Order directs all facilities owned, funded or leased by the state (and encourages cities, counties and schools as well) to take measures to reduce grid-based energy purchases for state-owned buildings by 20% by 2015. This is to be done through cost-effective efficiency measures and distributed generation technologies. These measures include designing, constructing and operating all new and renovated state-owned facilities paid for with state funds as "LEED Silver" or higher certified buildings, seeking out office space leases in buildings with a U.S. EPA ENERGY STAR rating, and purchasing or operating ENERGY STAR electrical equipment whenever cost-effective.

In 2006, Governor Schwarzenegger signed AB 32 – the Global Warming Solutions Act – into law. AB 32 institutes a mandatory limit on greenhouse gas emissions. The limit will be set to achieve the target of reducing statewide emissions to 1990 levels by the year 2020. The bill directs the CARB to establish a mandatory emissions reporting system to track and monitor emissions levels and to develop a wide range of compliance options and enforcement mechanisms.

In 2008 the California State Senate passed Senate Bill SB 375. SB 375 requires CARB to set regional targets for the purpose of reducing GHG emissions from passenger vehicles, for 2020 and 2035. If regions develop integrated land use, housing and transportation plans that meet the SB 375 targets, new projects in these regions can be relieved of certain review requirements of the California Environmental Quality Act (CEQA). The targets apply to the regions in the State covered by the 18 metropolitan planning organizations (MPOs).

8. Guide for Future Steps

8.1. Administration and Staffing

The MCAP is only the beginning of the City's climate protection process. The City's next steps include the implementation of the MCAP and the approval and implementation of a *community-wide* climate action plan (CAP) to include measures that would reduce citywide emissions.

The City should consider establishing an internal **staff workgroup** that would meet on a regular basis and assist in the implementation of projects in their respective departments. This workgroup could promote the implementation of the municipal measures in this report and identify additional measures, track progress in reducing municipal GHG emissions, identify necessary changes in policies to more effectively reduce emissions, and implement educational trainings, campaigns, and competitions for City staff. The employee committee that is currently on hold, the Magnificent Green Machine, could be renewed for this task.

Ultimately, a **dedicated staff person** would be necessary to provide the leadership needed to help the City meet its targeted goals in a strategic and comprehensive manner. This staff person would lead efforts to coordinate project implementation, work with appropriate staff to develop policies and design strategies and programs to reduce emissions, monitor progress toward the GHG reduction targets adopted by the City Council, and track state and federal policy and its implications for local government. This staff-time could be funded initially by a grant, but ultimately should be permanent and internally-funded.

8.2. Financing and Budgeting

The City should consider establishing a **revolving fund** for climate protection activities. As many GHG reduction projects will eventually lead to financial savings, these savings should be placed in a revolving fund to pay for implementation of measures or climate staff-time for further research and planning. The City is currently putting a portion of the PG&E Rebate funds from the streetlight retrofit project into a fund for this purpose. Additional funding will be needed in the future.

Existing staff will also continue to apply for grant funding to implement the programs in this plan and in the Community Climate Action Plan. Programs will only be implemented as funding and staffing are available with priority given to measures that have a short return on investment and/or save the city money.

8.3. Developing a Timeline

A schedule for implementing this MCAP should be established to enable Antioch to achieve its emissions reduction targets by the target year (2050). It should be practical, taking into account the administrative, political, technical, and other issues Antioch will face in getting programs up and running. It must allow time for stakeholder involvement in each phase as appropriate; yet it should also contain significant near-term steps, pushing Antioch to build from the momentum created by releasing this plan. Emphasis should focus on projects considered to be “low-hanging fruit” first, allowing time to lay the groundwork for more complicated projects.

8.4. Public Involvement in the Implementation Process

Through Federal Funding with the Energy Efficiency and Conservation Block Grant of 2009, the City of Antioch hired a team of University students to work directly with the community on developing a Community Climate Action Plan. This process involved workshops with the community and many of those who participated could be invited to assist with the implementation efforts or as a Sustainability Advisory Panel.

The City should also identify a formal structure for **collaboration with other local cities** on countywide climate protection efforts. Collaboration with cities could include the sharing of ideas and resources, partnership on grant applications, or a countywide outreach and education campaign.

8.5. Re-inventory/ Monitoring

Because of the difficulty associated with modeling potential emissions reductions with precision, it is especially important to monitor and report actual reductions over time, as well as other indicators, as part of the implementation process. A number of tools and practices exist that can enable the City and its community partners to track and report progress toward achieving the goals outlined in this plan.

Steps the City and its partners should take to ensure transparent, sustained evaluation and continuous improvement of GHG reduction strategies include providing reports to City Council on progress made on specific indicators and metrics to be used for tracking the implementation of actions in the plan, including:

- Estimated GHG reductions
- Implementation costs
- Costs savings and payback for given strategies
- Other co-benefits of implementation
- Ongoing barriers of implementation

The City of Antioch should establish a system for monitoring the implementation of the MCAP and adjust the plan as opportunities arise. The City should also conduct **interim inventories** of municipal GHG emissions to monitor progress toward the reduction targets, possibly every 5 years in accordance with the 2050 target milestone. The first re-inventory will be of 2010 emissions and is expected to be completed in fiscal year 2011-12.

The City should also adjust energy and waste savings numbers from proposed measures in the emissions tracking software CACP as projects are implemented and actual savings are documented. The City could also incorporate GHG emissions reduction progress into other reports Antioch is already producing.

Appendix A:

Background on Antioch's GHG emissions: Sources and Calculations

The City of Antioch GHG emissions inventory for 2005 is divided into sources from the community (commercial, industrial, and residential power consumption; transportation, and waste), and sources from the municipal government (power consumption and transportation). GHG emissions are expressed in carbon dioxide equivalence (CO₂e). GHG emissions included in the inventory are associated with electricity generation; direct burning of fossil fuels, including natural gas, diesel, and gasoline; and solid waste, which produces methane gas when disposed in a landfill. The following explanations are provided to show how GHG emissions are calculated from different forms of energy and waste.

Electricity

A *watt-hour* (W-h) is a unit of energy commonly used to measure electricity. It describes the amount of electrical energy supplied to a one-watt load drawing power for one hour. The commonly used form *kilowatt-hour* (kW-h) is equivalent to 1,000 W-h. Ten 100 watt bulbs burning for 1 hour consume 1 kW-h of electricity. A *megawatt-hour* (MW-h) is equivalent to 1,000,000 W-h or 1,000 kWh. A kW-h of electricity for the City of Antioch is estimated to produce 0.88 pounds of CO₂e emissions. The average household in California uses about 8,000 kWh per year, which produces about 3.5 tons of CO₂e.

Natural Gas

A *therm* is a unit of energy commonly used to measure heat, such as the heat produced by burning natural gas. Although partially dependent on the average concentration of methane, propane, or butane, and the presence of impurities such as carbon dioxide or nitrogen found in the natural gas source, a therm is approximately equal to 29.3 kW-h of electrical energy. A therm of heat energy for the City of Antioch is estimated to produce 11.73 pounds of CO₂e emissions. Antioch businesses and residents emit more GHG from use of natural gas than from use of electricity.

Transportation - Gasoline and Diesel

GHG emissions resulting from the combustion of diesel or gasoline are determined from the volume of fuel consumed, or estimated based on average fuel economy and the number of miles driven. Diesel fuel has an emission factor of 22.38 pounds of CO₂ per gallon consumed. Gasoline has an emission factor of 19.42 pounds of CO₂ per gallon consumed. Both types of fuel also produce a small amount of methane and nitrous oxide, both of which are potent GHG's. If the volume of fuel consumed is unknown, then the number of vehicle miles traveled can be used to estimate the number of gallons of fuel consumed. According to the U.S. EPA, the average fuel economy of the entire US 2004 model year fleet (cars and light duty trucks and SUVs) was 24.7 mpg.

Solid Waste

When organic materials decompose in a landfill, they do so mostly in the absence of oxygen. In these anaerobic conditions, methanogenic (methane-producing) bacteria produce methane as the material decomposes. Methane is 21 times more potent than carbon dioxide in its effects on the climate, over a 100-year timeframe.

The GHG inventory used municipal waste disposal figures and waste characterization studies to determine the amount of organic putrescible waste produced annually within the City of Antioch. Waste-specific emission factors were used to determine the amount of methane produced. This figure was then reduced by the amount of methane captured by the landfill’s gas collection and flaring system: flaring converts methane to carbon dioxide, and so greatly reduces its effect on the climate.

"Rules of Thumb" to Estimate GHG Reductions

Avoided Energy Consumption	CO ₂ e (pounds)	CO ₂ e (metric tons)
1 MMBtu of Natural Gas	117	0.053
1 Gallon of Gasoline	20	0.009
1 kWh of CA-Grid Average Electricity	1	0.0004

Appendix B:

Existing/Planned GHG reduction Measures: Assumptions and Calculations

Alternative Employee Schedule

Data based on 2005 employee commuter survey

2005 total VMT = 941,400

$941,400 / 12 \text{ months} = 78,450 \text{ VMT per month}$

$941,400 / 52 \text{ weeks} = 18,104 \text{ VMT per week}$

$18,104 / 5 \text{ days} = 3,621 \text{ VMT per day}$

$3,621 \times 4 \text{ furlough days per month} = 14,484 \text{ VMT reduced per month}$

$14,484 \times 12 \text{ months} = 173,808 \text{ VMT reduced per year}$

$173,808 \times *.000492 = 86 \text{ MTCO}_2\text{e}$

Potential annual reduction of 86 MTCO₂e

Direct digital control for HVAC systems for all city facilities

City data estimates that this retrofit project will reduce total energy usage by 10-15% each year

Total energy consumed for buildings in 2005 = 2,073,433 kWh/ 108,172 therms

Total output of MTCO₂e in 2005 = 1,173 MTCO₂e

Total potential savings of 81 MTCO₂e

*energy savings and amount of MTCO₂e estimates provided by Public Works Department

Replace exit signs in all city facilities with LED lights

123 LED exit signs = \$6,818 in annual energy savings

$\$6,818 \times \$.012 \text{ (cost per kWh)} = 56,816 \text{ kWh saved per year}$

$1 \text{ kWh} = .0004 \text{ MTCO}_2\text{e}$

$56,816 \text{ kWh} \times .0004 = 22.72 \text{ MTCO}_2\text{e}$

Total potential savings of 23 MTCO₂e

*This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Street light and City Facilities retrofit project

Data provided by Honeywell, as well as all assumptions and calculations for energy savings and MTCO₂e reductions.

Total potential savings of 1,825 MTCO₂e

Appendix B:

Proposed GHG Emission Reduction Measures: Assumptions and Calculations

Energy Efficiency and Renewable Energy

Adopt GreenPrint software and duplex printing practices

Set a goal of saving at least 500,000 sheets of paper (1000 reams) in a year. For every 1,000,000 sheets of paper saved per year Antioch could reduce the associated emissions, (upstream energy consumption and decomposition in landfill) by approximately 1.9 tons CO₂e.

More information is available on the company's website, at www.printgreener.com.

Total potential savings of 1 MTCO₂e

Create an employee energy awareness program to promote energy conservation and efficient use of City facilities.

Assume that this program could reduce building energy use by five percent.

** Five percent of GHG emissions from building energy use*

Potential annual reduction of 60 MTCO₂e

Install solar panel systems at 2 city facilities (Prewett Water Park and Water Treatment Plant)

Assumes between two sites that total 1250 Kwh of panels installed. Emissions reduction projections calculated using ICLEI's CAPP software. 615 MTCO₂e

Possible array size data provided by BEW ENGINEERING prepared for City of Antioch Solar Feasibility Study

Install thermally resistant window films on 13 City facilities.

Thermally resistant window films reduce total building energy use by 10 to 15% (Piper 2004).

** 12% of total building energy use*

The total energy usage of the affected buildings (based on a building list for 13 City Facilities) in 2005 was 2,073,433 kWh and 108,172 therms. Assuming a 12-percent reduction in energy use, this yields an annual reduction of 282,741 kWh and 12,980 therms of energy use (see calculations below).

Current kWh represents the current electricity use for the affected buildings with window films
Baseline kWh represents the electricity use for the same buildings before window films

A 12% reduction means that current kWh = 88% of baseline kWh

2,073,433 kWh = 0.88X where X is baseline kWh

$X = 2,073,433 / 0.88 = 2,356,174$ kWh

Annual reduction = baseline kWh – current kWh

Annual reduction = 2,356,174 – 2,073,433 = 282,741 kWh

Total annual reduction of 66 MTCO₂e

Current therms represent the current natural gas use for the affected buildings
 Baseline therms represent the natural gas use for the same buildings before window films

A 12% reduction means that current therms = 88% of baseline therms
 $108,172 \text{ therms} = 0.88X$ where X is baseline therms
 $X = 108,172 / 0.88 = 122,923 \text{ therms}$
 Annual reduction = baseline therms – current therms
 Annual reduction = $122,923 - 108,172 = 14,751 \text{ therms}$
 Total annual reduction of 79 MTCO₂e

Total potential reduction of 145 MTCO₂e

Use cool roofing systems for City buildings

Assumes 50,000 ft² of reflective roofing material installed on city facilities for an annual Electricity savings of 42,100 kWh. Emissions reduction calculation done using ICLEI’s CAPP software.

Total annual reduction of 15 MTCO₂e

Convert to Energy Start vending machines

From ICLEI’s CAPP Software:

\$ 0.0988	Price of Electricity (\$ per kWh)						
1,659	Annual Energy Savings of one ENERGY STAR Vending Machine (kWh)						
\$0	Incremental Cost to Purchase an ENERGY STAR Vending Machine (\$)						
23,226	Total Annual Energy Savings (kWh)						
\$2,295	Annual Cost Savings						
0.0	Simple Payback (years)						

Total annual reduction of 8 MTCO₂e

Remove light bulbs from all vending machines

Typical vending machine lighting consists of two T-12 fluorescent lamps that use up to 180 watts of electricity. Continuous operation could use 1580 kilowatt hours at a cost of \$126 annually. City data shows a typical vending machine uses 3,500 kWh per year.

$3,500 \text{ kWh per machine} \times 9 \text{ machines} = 31,500 \text{ kWh annually w/ T-12 fluorescent lamps}$
 $31,500 \text{ kWh} \times .0004 = 13 \text{ MTCO}_2\text{e}$

$1,580 \text{ kWh} / 3,500 \text{ kWh} = \text{a } 45\% \text{ reduction}$
 Current kWh – Reduction Measure = Annual Consumption w/o T-12 fluorescent lamps
 $3,500 \text{ kWh} - 1,580 \text{ kWh} = 1,920 \text{ kWh}$
 $1,902 \text{ kWh} \times 9 \text{ machines} = 17,118 \text{ kWh annually}$
 $17,118 \text{ kWh} \times .0004 = 7 \text{ MTCO}_2\text{e}$

Total annual reduction of 6 MTCO₂e

*coefficient provided by PG&E for calculating kWh and their CO2 equivalents in metric tons

Lights out at Night Policy

From ICLEI's CAPPA Software (based on 100,000 ft² of facilities participating)

\$	
0.0988	Price of Electricity (\$ per kWh)
6.85	Annual Lighting Energy Use per Square Foot (kWh)
35	Percent Savings With Policy
\$0.06	Cost of Implementation (\$ per square foot)
239,750	Total Annual Electricity Savings (kWh)
\$23,687	Annual Cost Savings
0.2	Simple Payback (years)

Energy Star Computers, Monitors, Printers and Copiers

From ICLEI's CAPPA Software

Savings from 50 monitors replaced with Energy Star models

\$	
0.0988	Price of Electricity (\$ per kWh)
61	Annual Energy Savings of one ENERGY STAR Monitor (kWh)
\$0	Incremental Cost to Purchase an ENERGY STAR Monitor (\$)
3,050	Total Annual Energy Savings (kWh)
\$301	Annual Cost Savings
0.0	Simple Payback (years)

Savings from 20 printers replaced with Energy Star models

\$	
0.0988	Price of Electricity (\$ per kWh)
33	Percent of Printers < 10 ppm
34	Percent of Printers 10-30 ppm
33	Percent of Printers >30 ppm
229	Annual Energy Savings of one ENERGY STAR Printer <10 ppm (kWh)
316	Annual Energy Savings of one ENERGY STAR Printer 10-30 ppm (kWh)
569	Annual Energy Savings of one ENERGY STAR Printer >30 cpm (kWh)
\$10	Incremental Cost to Purchase an ENERGY STAR Printer (\$)
7,416	Total Annual Energy Savings (kWh)
\$733	Annual Cost Savings
0.3	Simple Payback (years)

Savings from 20 copiers with Energy Star models

\$	
0.0988	Price of Electricity (\$ per kWh)
33	Percent of Copiers <20 cpm
34	Percent of Copiers 20-40 cpm
33	Percent of Copiers >40 cpm
12	Annual Energy Savings of one ENERGY STAR Copier <20 cpm (kWh)
546	Annual Energy Savings of one ENERGY STAR Copier 20-40 cpm (kWh)
1,702	Annual Energy Savings of one ENERGY STAR Copier >40 cpm (kWh)
\$10	Incremental Cost to Purchase an ENERGY STAR Copier (\$)
15,025	Total Annual Energy Savings (kWh)
\$1,484	Annual Cost Savings
0.1	Simple Payback (years)

Savings from 50 computers replaced with Energy Star models

\$ 0.0988	Price of Electricity (\$ per kWh)				
201	Annual Energy Savings of one ENERGY STAR Computer (kWh)				
\$0	Incremental Cost to Purchase an ENERGY STAR Computer (\$)				
10,050	Total Annual Energy Savings (kWh)				
\$993	Annual Cost Savings				
0.0	Simple Payback (years)				

Vehicle Fleet

Change 21 City Vehicles to B20 biodiesel fuel from diesel fleet

From ICLEI’s CAPP Software based on 2005 data for 19 city owned diesel vehicles:

8.6	Average Fuel Economy of Vehicles switching to Biodiesel (mpg)
5,000	Average Annual Miles Driven by Vehicles switching to Biodiesel
11,047	Gallons of Fossil Diesel Reduced
11,147	Gallons of Biodiesel Purchased

Total annual savings of 84 MTCO₂e

No Idling Policy

From ICLEI’s CAPP Software, based on 142 fleet vehicles

\$2.64	Cost of Gasoline
10	Daily Minutes Vehicles Idled
0.0053	Gasoline Use per Minute of Idling (gallons)
240	Days of Operation per Year
1,806	Annual Gasoline Savings (gallons)
\$4,768	Annual Cost Savings

Potential annual savings of 17 MTCO₂e

Replace 20 vehicles for CNG vehicles for city fleet

Estimates of actual emissions will vary with engine design; these numbers reflect the potential reductions offered by compressed natural gas, relative to conventional gasoline. According to the Federal EPA CNG versus conventional gasoline yields the following reductions:

- Carbon monoxide.....90-97%
- Carbon Dioxide.....25%
- Nitrogen oxide.....35-60%
- Non methane hydrocarbon.....50-75%

From ICLEI’s CAPP Software based on 2005 data averages for all gasoline vehicles

\$2.64	Price of Gasoline (\$ per gallon)
\$ 1.86	Price of Natural Gas (\$ per gallon gasoline equivalent)
13.4	Miles per Gallon of Vehicle Replaced
7,628	Average Annual Miles per Vehicle
\$3,000	Incremental Cost of CNG Vehicle

11,385	Annual Gasoline Savings (gallons)
1,449,739	Increased Natural Gas Usage (Standard Cubic Feet)
7,766.0	Annual Fuel Cost Savings
7.7	Simple Payback Period (years)

Total annual savings of 29 MTCO₂e

Replace 10 vehicles for electric vehicles for city fleet

From ICLEI's CAPP Software based on 2005 data averages for all gasoline vehicles

\$2.64	Price of Gasoline (\$ per gallon)
\$ 0.0988	Price of Electricity (\$ per kWh)
13.4	Miles per Gallon of Vehicle Replaced
7,628	Average Annual Miles per Vehicle
\$10,000	Incremental Cost of Electric Vehicle
5,693	Annual Gasoline Savings (gallons)
30,543	Annual Electricity Use (kWh)
\$12,011	Annual Cost Savings
8.3	Simple Payback (years)

Total annual savings of 43 MTCO₂e

Replace 15 vehicles for hybrid vehicles for city fleet

From ICLEI's CAPP Software based on 2005 data averages for all gasoline vehicles

\$2.64	Price of Gasoline (\$ per gallon)
46	Hybrid Miles per Gallon
13.4	Miles per Gallon of Vehicle Replaced
7,628	Average Annual Miles per Vehicle
\$2,530	Incremental Cost of Hybrid
6,051	Annual Gasoline Savings (gallons)
\$15,976	Annual Cost Savings
2.4	Simple Payback (years)

Total annual savings of 57 MTCO₂e

Allow City employees to use pre-tax dollars to pay for mass transit or car-pool expenses 10% employee participation

Data based on 2005 employee commuter survey

2005 total Vehicle Miles Traveled= 941,400

941,400 x 10% for employee participation = 94,140

94,140 VMT x *.000492 = 46 MTCO₂e

Total annual savings of 46 MTCO₂e

*coefficient provided by ICLEI software (miles/tons of MTCO₂e) emissions factors

Create a telecommuting program by identifying opportunities for participation of 20 employees.

From ICLEI's CAPP Software

\$2.64	Price of Gasoline (\$ per gallon)
20	Percent of Employees Telecommuting each Workday
15.0	Average One-way Commute Length (mi)
19.7	Average Passenger Vehicle Fuel Economy
28,800	Annual Vehicle Mile Reduction
1,462	Annual Gasoline Savings (gallons)

\$3,859	Annual Cost Savings
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Total annual savings of 14 MTCO₂e

Employee carpool and vanpool program 15% employee participation

Data based on 2005 employee commuter survey

2005 VMT= 941,400

$941,400 \times 15\% = 141,210$ VMT reduced

$141,210 \times *.000492 = 69$ MTCO₂e

Total annual savings of 69 MTCO₂e

Install bike racks at all city facilities and create a bike program for city employees 5% participation

Data based on 2005 employee commuter survey

2005 VMT = 941,400

$941,400 \times 5\% = 47,070$ VMT reduced

$47,070 \times *.000492 = 23$ MTCO₂e reduced

Total annual savings of 23 MTCO₂e

Waste Reduction and Recycling

As the baseline GHG inventory only considers methane production from landfilled waste, for consistency, the reductions in the waste sector only include avoided methane. However, it should be noted that recycling and waste reduction also hold other reduction potentials, including the carbon sequestration of trees that are not consumed for paper production, the avoided energy use of new paper production, and the avoided transportation to landfill sites.

Broaden City employee recycling program

1 lb. organic waste in a landfill = 1.5lbs of CO₂e

*Estimates based on US EPA waste diversion calculations

2005 Solid Waste Totals = 1,200,000 lbs.

$1,200,000 \times 1.5$ lbs. = 1,800,000 lbs. of CO₂e

1,800,000 lbs. of CO₂e = 816 MTCO₂e

$816 \text{ MTCO}_2\text{e} \times .20 = 163$ MTCO₂e

Total potential savings of 163 MTCO₂e

Divert organic waste from parks and city maintained landscaping to on-site composting

Research conducted by CalRecovery, Inc. estimates that the generation of green waste from the grounds-keeping activities of GSD is approximately 170 tons per year. StopWaste.Org's 2007 Climate Action Plan Template, which was developed for Alameda County, estimates that this type of measure could avoid twelve 50-mile trips by heavy diesel trucks or 600 VMT annually.

Potential annual reduction of 16 MTCO₂e (avoided landfill) + 1 MTCO₂e (avoided VMT)

Total potential savings of 17 MTCO₂e

Water and Waste Water

Improved energy efficiency in water treatment and distribution

2005 Energy Usage for municipal water supply = 3,120 MTCO₂e

With a 5% reduction in energy usage from energy efficiency upgrades

$3,120 * .05 = 156 \text{ MTCO}_2\text{e}$

Total potential savings of 156 MTCO₂e

Low Maintenance Landscaping

From ICLEI's CAPP software, based on 10 acres of landscaping converted

38	Annual VOC per Acre (lbs)
8	Annual Gasoline Use per Acre (gal)
652,000	Annual Gallons of Water Used per Acre
0.0035	Energy Use per Gallon of Water (kWh)
6,520,000	Total Annual Water Savings (gallons)
22,820	Total Annual Electricity Savings (kWh)
80	Total Annual Gasoline Savings (gal)

Appendix C: List of Key Acronyms

BAAQMD- Bay Area Air Quality Management District
BART- Bay Area Rapid Transit
BAU- Business as usual
CACP- Clean Air and Climate Protection Software
CAP- Climate Action Plan
CARB- California Air Resources Board
CCP- Cities for Climate Protection
CEQA- California Environmental Quality Act
CIWMB- California Integrated Waste Management Board
CNG- Compressed Natural Gas
COP- Conference of Parties
CSA- Commuter Spending Accounts
DOE- Department of Energy
EECBG- Energy Efficiency and Conservation Block Grant
EPP- Environmentally Preferred Products
GHG- Greenhouse Gas
HVAC- Heating, Venting, and Air Conditioning
ICLEI- Local Governments for Sustainability
IPCC- Intergovernmental Panel on Climate Change
LED- Light Emitting Diode
LEED- Leadership in Energy and Environmental Design
MCAP- Municipal Climate Action Plan
MTC- Metropolitan Transportation Commission
MTCO_{2e}- Metric Tons of Carbon Dioxide Equivalents
MPO- Metropolitan Planning Organization
NASA- National Aeronautics and Space Administration
PG&E- Pacific Gas and Electric
PPA- Power Purchase Agreement
UNEP- United Nations Environment Programme
UNFCC- United Nations Framework Convention on Climate Change
USGBC- United States Green Building Council
US EPA- United States Environmental Protection Agency
WARM- Waste Reduction Model
WMU- World Meteorological Organization