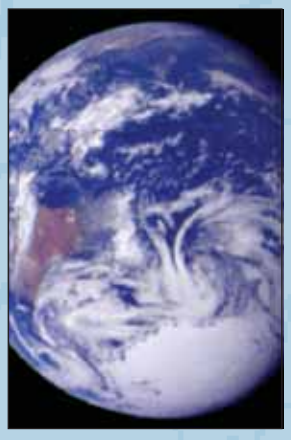
Climate Action Plan

For San Francisco

Local Actions to Reduce Greenhouse Gas Emissions



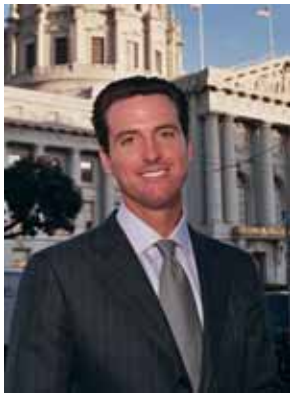




San Francisco Department of the Environment • San Francisco Public Utilities Commission

September 2004

From the Mayor



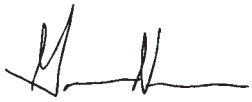
Climate change presents serious threats to the quality of life in San Francisco. The impacts of rising sea levels could be potentially devastating. Low lying areas such as San Francisco International Airport, Treasure Island, Mission Bay, SBC and Candlestick Parks, roads, railroad tracks, sewage treatment plants, and our marina and harbor facilities could be threatened. We must act now to significantly reduce greenhouse gas emissions or we will quickly reach a point at which global warming cannot be reversed.

That is why San Francisco holds itself accountable for its contributions to global warming, and is committed to dramatically reducing overall greenhouse gas emissions to 20% below 1990 levels by 2012. The *Climate Action Plan,* prepared by San Francisco's Department of Environment and Public Utilities Commission staff, quantifies the emissions we are responsible for and identifies actions required to achieve emissions rollbacks.

The good news is that we can reduce the pollution that causes global warming by using currently available technologies that also enhance economic development. We can promote energy efficiency, renewable energy, alternatives to automobile transportation, and recycling to help save money and create jobs that strengthen the local economy, and increase the livability of our neighborhoods.

Our actions can be an example to others. As cities across the nation make similar commitments we can work in concert to make an environmental u-turn. It is up to municipal governments to take ownership of this critical issue when there is scant leadership coming from Washington, D.C.

We need to act now if we are going to keep San Francisco and the Bay Area a viable place to live for future generations. It is our responsibility as citizens of the world.



Gavin Newsom

Acknowledgements

The *Climate Action Plan* is the result of the hard work and persistence of many people. These include staff at San Francisco's Department of Environment (SF Environment), San Francisco Public Utilities Commission (SFPUC), International Council for Local Environmental Initiatives (ICLEI), consultants and reviewers. They spent many hours researching, writing, crunching numbers, and reviewing the Plan. In particular, Randa Gahin, Kevin Drew, Cal Broomhead and Elizabeth Stubblefield of SF Environment were major contributors. Abby Young, director of ICLEI's Cities for Climate Protection campaign, and the rest of the ICLEI staff gave invaluable input, advice and technical support throughout the process. Special thanks to Shawn Rosenmoss for contributing her sharp editing skills and to Ashley Frey Rosemire for the fine design and layout. Thank you to Jared Blumenfeld, Director, SF Environment and to Ed Smeloff, Assistant General Manager for Power Policy, Planning, and Resource Development, SFPUC, for their leadership and support. Finally, thanks to John Deakin, former director of San Francisco's Bureau of Energy Conservation, for his vision in initiating this project.

Danielle Dowers, Project Manager

SF Environment staff:
Clark Aganon
Cal Broomhead
Kevin Drew
Randa Gahin
Alena Gilchrist
Ann Kelly
Jack Macy
Kate Meny
Peter O'Donnell
Ashley Frey Rosemire
Shawn Rosenmoss
Rick Ruvolo
Ina Shlez

Volunteers:
Luz Ruiz
Elizabeth Stubblefield

ICLEI staff:
Ryan Bell
Bill Drumheller
Matt Nichols
Susan Ode
Allison Quaid
Melissa Royael
Nancy Skinner
Abby Young

SFPUC staff:
Pam Husing
Doug Johnson
Oliver Kesting
Angie Lee
Gary Oto
Roger Picklum
Fred Schwartz

Reviewers:
Kevin Finney, *Union of Concerned Scientists*
Guido Franco, *California Energy Commission*
Charles Rivasplata, *San Francisco Planning Department*
Ed Vine, *Lawrence Berkeley National Laboratory*
Abby Young, *International Council for Local Environmental Initiatives*

Consultants:
Ann Guy, *Brown, Vence & Associates*
Leslie Kramer, *Brown, Vence & Associates*

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Executive Summary

Global Warming is real. The world's leading climate scientists agree that human behavior is accelerating global warming, and that the earth is already suffering the impacts of the resulting climate change.

Climate change will affect San Francisco. It is a global problem with local impacts. Rising temperatures, rising sea level, and more frequent El Niño storms could seriously threaten the City's infrastructure, economy, health, and ecosystems with impacts such as:

- Flooded roads, threats to the sewage system and Airport infrastructure
- Increased asthma and respiratory illness due to higher ozone levels
- Threatened Bay wetlands and marine life
- Fishing and tourism industry impacts, high insurance and mitigation costs

We have a responsibility to act. San Francisco is responsible for about 9.7 million tons of CO_2 emissions per year. In 2002, the San Francisco Board of Supervisors passed the *Greenhouse Gas Emissions Reduction Resolution*, committing the City and County of San Francisco to a greenhouse gas emissions reductions goal of 20% below 1990 levels by the year 2012. The resolution also states that the Mayor and Board of Supervisors actively support the Kyoto Protocol, and calls upon national leaders to do so as well. Federal inaction makes state and local action all the more important. The development of this *Climate Action Plan*, called for in the resolution, describes what San Francisco can do in order to achieve our greenhouse gas reduction goal.

San Francisco has joined with over 500 cities around the world to participate in the *Cities for Climate Protection* (CCP) campaign, sponsored by the International Council for Local Environmental Initiatives (ICLEI). As part of the campaign, member cities have committed to: inventory their emissions of greenhouse gases; set reduction targets; develop comprehensive strategies to meet these targets; implement these emissions reduction actions; and measure the results. The criteria set by the CCP campaign have been used to define the scope and presentation of this Plan.

The *Climate Action Plan*

- Provides background information on the causes of climate change and projections of its impacts on California and San Francisco from recent scientific reports;
- Presents estimates of San Francisco's baseline greenhouse gas emissions inventory and reduction target;
- Describes recommended emissions reduction actions in the key target sectors - transportation, energy efficiency, renewable energy, and solid waste management – to meet our 2012 goal; and
- Presents next steps required over the near term to implement the Plan.

Climate Change: Causes and Impacts

Climate change is both a global and local phenomenon. The Intergovernmental Panel on Climate Change (IPCC), reports that temperatures and sea level are rising at the fastest rate in history, and are projected to continue rising (2-10 degrees Fahrenheit temperature rise, 4-36 inches sea-level rise over the next 100 years). This trend, sometimes referred to as "global warming," is seriously impacting water resources, ecosystems, human health, and the economy.

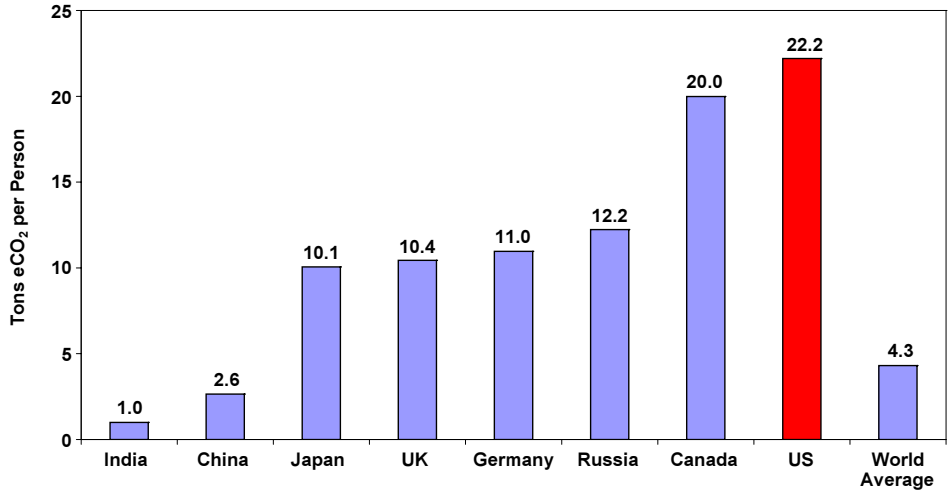
Human and Cultural Causes of Climate Change

Human behavior is accelerating climate change. The release into the atmosphere of carbon dioxide (CO_2) from the burning of fossil fuels in power plants, buildings and vehicles, the loss of carbon "sinks" due to deforestation, and methane emitting from landfills are the chief human causes of climate change. These emissions are referred to collectively as "greenhouse gases" (ghgs).

The United States has the highest per capita emissions of ghgs in the world–22 tons of CO_2 per person per year (see figure ES.1). With only five percent of the world's population, the United States is responsible for 24 percent of the world's CO_2 emissions.

California, despite its strong environmental regulations, is the second largest greenhouse-gas polluting state in the nation, and emits 2% of global human-generated emissions. Its largest contribution of CO_2 is from vehicle emissions. Clearly, more needs to be done. California has much to lose if climate change is not abated.

Figure ES.1 - Per Capita CO_2 Emissions 2001



Sources: Energy Information Administration: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1992-2001, U.S. Census Bureau: Countries Ranked by Population: 2001

Impacts on San Francisco

San Francisco, as a coastal city surrounded on three sides by water, is extremely vulnerable to climate change. It is further at risk because the City depends on the Sierra snow pack for its water supply and for hydroelectric power. According to a joint study by the Union of Concerned Scientists and Ecological Society of America, some of the possible effects of climate change on San Francisco are:

- Sea-level rise may threaten coastal wetlands, infrastructure, and property.
- Increased storm activity together with sea-level rise could increase beach erosion and cliff undercutting.
- Warmer temperatures and more frequent storms due to El Niño will bring more rain instead of snow to the Sierras, reducing supply of water for summer needs.
- Decreased summer runoff and warming ocean temperatures will affect salinity, water circulation, and nutrients in the Bay, possibly leading to complex changes in marine life.

Such dramatic changes to San Francisco's physical landscape and ecosystem will be accompanied by financial and social impacts. Tourism would suffer, as would San Francisco's fishing industry and the regional agricultural industry, which is expected to be greatly disrupted by a warmer climate. Food costs would rise, property damage would be more prevalent, and insurance rates would increase accordingly.

The City's roads, pipelines, transportation, underground cables and sewage systems could be severely stressed or overwhelmed if rare instances of flooding or storm damage become common occurrences. Low lying areas such as San Francisco International Airport, built on a wetland, would be at high risk in the face of a rising sea level.

The environment plays a large role in some diseases carried by insects. Warming could make tick-borne Lyme disease more prevalent and could expand the range of mosquito-borne diseases such as West Nile virus. Another threat to the health of San Francisco residents is air pollution caused by higher temperatures and increased ozone levels. Neighborhoods in the Southeast of the City, where asthma and respiratory illness are already at high levels, would be especially at risk.

Existing Mandates to Curb Climate Change

The United Nations Framework Convention on Climate Change (UNFCC) process is comprised of 150 participating countries. As of June 2003, 110 countries had ratified the Kyoto Protocol, agreeing to targets and timelines for reducing their greenhouse gas emissions. The United States signed, but has not ratified the protocol.

California has set specific targets for reducing greenhouse gas emissions produced in the state.

- Senate Bill 1078 (Sher, 2002) set a Renewable Portfolio Standard (RPS) which requires 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 California Air Resources Board to develop regulations mandating vehicle tailpipe CO_2 emissions reductions.
- Senate Bill 1771 (Sher, 2000) established the California Climate Action Registry to serve as a certifying agency for companies and local governments to quantify and register their greenhouse gas emissions for possible future trading systems.

San Francisco's Greenhouse Gas Emissions: Inventory and Reduction Target

San Francisco's greenhouse gas emissions come principally from the CO_2 produced from the burning of fossil fuels in vehicles, in buildings, and in power plants. Methane, another major greenhouse gas, is released from the landfill used by the City for solid waste disposal.

Inventory

The first step in developing the *Climate Action Plan* was to conduct a baseline inventory of greenhouse gas emissions. The emissions inventory identifies and categorizes the major sources and quantities of ghg emissions being produced by City residents, businesses, and municipal operations.

In 1990, San Francisco's total ghg emissions were approximately **9.1 million tons eCO_2** (equivalent carbon dioxide).[1] Figure ES.2 shows the breakdown of these emissions from all sources for the 1990 baseline year. "Building Energy" includes the impacts of the electricity and natural gas used in both private and public sector buildings and facilities. "Transportation" includes emissions from in-City and intraregional personal and commercial vehicles, Muni, BART, and other transit as well as the City's municipal fleet.

Reduction Target

San Francisco's reduction target is 20% below 1990 levels by 2012. This is about **2.5 million tons** below 2000 levels. Figure ES.3 shows estimated emissions levels for the baseline year (1990), 2000 levels, forecast levels (2012), and San Francisco's 2012 target compared to the Kyoto Protocol and IPCC targets.

With "business as usual," greenhouse gas emissions are predicted to rise to 10.8 million tons per year in 2012. The 20% reduction target would reduce San Francisco's overall ghg emissions to **7.2 million tons per year by 2012**.

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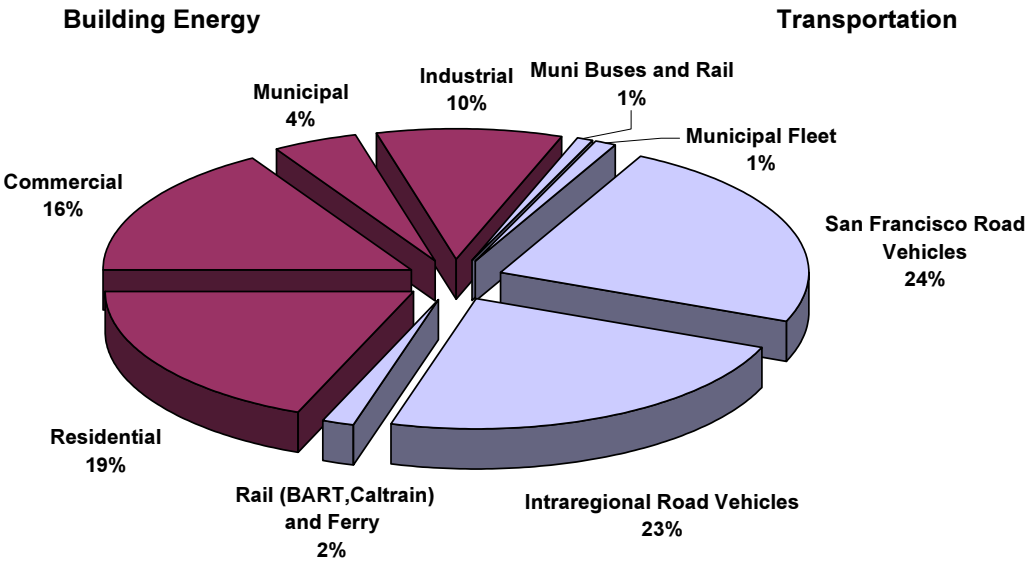
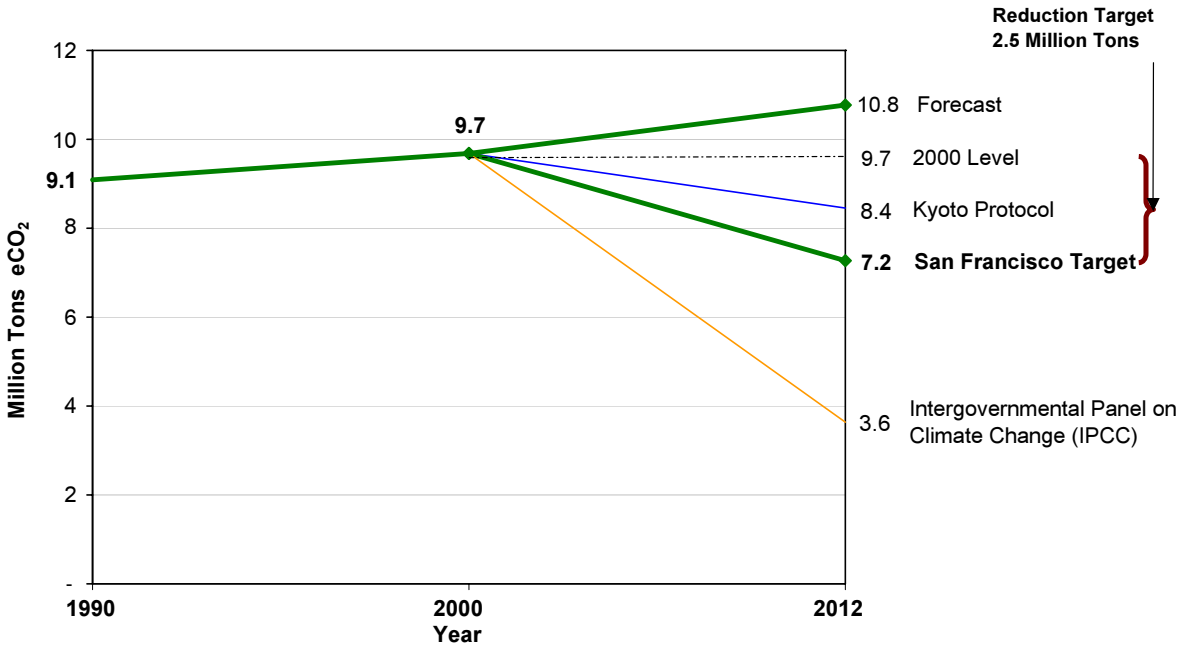
[1] All of the contributors to greenhouse gas emissions (e.g. electricity in kilowatt-hours x an electricity coefficient, natural gas in therms, vehicle travel in gallons of fuel, solid waste in tons x material coefficients) are combined and expressed here in the common unit of tons of "equivalent carbon dioxide" (eCO_2) released into the atmosphere in a given year.

Figure ES.2 - San Francisco Greenhouse Gas Emissions (eCO_2), 1990



1990 Baseline Greenhouse Gas Emissions. Total = 9.1 million tons eCO_2 per year
Source: PG&E, Hetch Hetchy Water and Power, CA. Dept. of Transportation, MTC, Muni, BART

Figure ES.3 - San Francisco Greenhouse Gas Emissions Forecast and Targets



Taking Action to Reduce Emissions

While San Francisco has been actively pursuing cleaner energy, transportation, and solid waste policies, it is clear that we need to do more to reduce the rate of ghg emissions. In order to meet our reduction goal, this Plan sets forth a comprehensive set of actions that should be set in motion immediately. The actions are organized into four categories—Transportation, Energy Efficiency, Renewable Energy, and Solid Waste. The estimated annual 2012 emissions reduction levels are listed for each set of actions below.

Transportation

The major ways to reduce transportation sector ghg emissions are by reducing vehicle trips and by traveling in vehicles with lower emissions. Reducing trips can be done by encouraging a shift from driving to alternative modes such as public transit, ridesharing, bicycling and walking. This would be accomplished through improved services and financial incentives. Vehicle emissions can be reduced by switching to more fuel-efficient or cleaner-fueled vehicles, and by downsizing fleets.

Transportation Action Categories	Estimated CO_2 Reduction (tons/year)
A. Increase the Use of Public Transit as an Alternative to Driving	87,000
B. Increase the Use of Ridesharing as an Alternative to Single Occupancy Driving	42,000
C. Increase Bicycling and Walking as an Alternative to Driving	10,000
D. Support Trip Reduction Through Employer-Based Programs	28,000
E. Discourage Driving	155,000
F. Increase the Use of Clean Air Vehicles and Improve Fleet Efficiency[2]	641,000
Total	**963,000**

[2] 555,000 tons of this reduction would be a result of a 5 miles per gallon increase in Federal CAFÉ (Corporate Average Fuel Efficiency) standards.

Energy Efficiency

Reducing energy use reduces ghg emissions from fossil fuels burned in power plants and in buildings. Offering incentives on select products can encourage consumers to invest in efficient appliances or in home improvements that lower energy use. Other methods to increase energy efficiency include providing technical assistance and energy management services such as energy audits and design assistance for residential, commercial and municipal buildings. Education and outreach programs need to broaden general public awareness and to train particular groups (such as designers and building contractors) on energy efficiency practices.

The City has the power to strengthen energy codes and standards for both existing buildings and new construction that would bring both immediate and long-term benefits in terms of financial savings to businesses and residents.

Energy Efficiency Action Categories	**Estimated CO_2 Reduction (tons/year)**
A. Increase Incentives, Direct Installation and Technical Assistance	
Residential Buildings	222,000
Commercial Buildings	433,000
Municipal Buildings	45,000
B. Expand Education and Outreach	36,000
C. Strengthen Legislation, Codes and Standards	65,000
Total	**801,000**

Renewable Energy

Renewable energy technologies such as solar, wind, and biomass are now available, reliable and often cost-effective alternatives to fossil fuels for producing electricity. Emerging technologies such as fuel cells and tidal power should be researched and pilot projects developed.

Increasing the amount of renewable sources ("green power") in the City's electricity mix through local projects as well as through the State's electricity grid can have a great impact on greenhouse gas emissions and should be an ongoing action item.

Renewable Energy Action Categories	Estimated CO_2 Reduction (tons/year)
A. Develop Renewable Energy Projects	
Solar Energy	35,000
Wind Energy	239,000
Biomass Energy	44,000
B. Conduct Pilot Projects for Emerging Technologies[3]	–
C. Support and Develop Green Power Purchasing	230,000
Total	**548,000**

Solid Waste

Recycling reduces CO_2 emissions by avoiding the energy used during the extraction and processing of virgin raw materials to manufacture new products. Also, reducing landfill reduces the amount of methane–a potent greenhouse gas–released into the atmosphere.

Actions should include expanding recycling and composting programs, to include more sectors of the city; encouraging recycling of construction and demolition debris; and increasing recycling in City departments.

Solid Waste Action Categories	Estimated CO_2 Reduction (tons/year)
A. Increase Residential Recycling and Composting	70,000
B. Increase Commercial Recycling and Composting	109,000
C. Expand Construction and Demolition Debris Recycling	57,000
D. Support Alternate Collection Methods for Recyclable Materials	66,000
E. Promote Source Reduction, Reuse and Other Waste Reduction[4]	–
F. Expand Municipal Programs[5]	–
Total	**302,000**

3 Research and Development projects.
4 Unknown materials breakdown. Savings not estimated.
5 Included under B. Increase Commercial Recycling and Composting.

Implementing the Plan

Our current level of activity will find us 20% above 1990 levels or 3.6 million tons short of our stated ghg emissions goal for 2012. If we are to reach our reduction target of approximately 2.5 million tons of CO_2 per year by the year 2012, it is imperative that over the next 1-3 years we act to:

Actions Summary	Estimated CO_2 Reduction
Transportation Actions	963,000
Energy Efficiency Actions	801,000
Renewable Energy Actions	548,000
Solid Waste Actions	302,000
Total	**2,614,000 tons/year**

- Accelerate and expand existing programs in all areas—transportation, energy efficiency, renewable energy, and solid waste.
- Develop the infrastructure to support new programs.
- Secure resources to implement actions.
- Set up tracking mechanisms and indicators to measure progress.

The City should set up a process to support City departments and private entities to integrate climate protection into their standard operating procedures. To be successful, this process must include participation of stakeholder groups and implementing agencies. As the coordinating agency, the Department of Environment (SF Environment) should:

- Establish a City interdepartmental working group and an external advisory group to implement the Plan.
- Establish and maintain a tracking system for quantifying CO_2 emissions and reductions.
- Collaborate with other cities through ICLEI's Cities for Climate Protection program.
- Increase outreach and education activities (such as publishing brochures on "simple things you can do" for climate protection).
- Investigate emissions credit trading systems.
- Seek grant funding from sources such as the US Department of Energy, US Environmental Protection Agency (EPA), and California Energy Commission (CEC).
- Document and report progress to decision makers and to the public.

While confronting global warming may seem insurmountable, local action can make a difference. It is imperative that San Francisco, a city at high risk from climate change impacts, takes action now to slow its effects. This can only be accomplished by a clear understanding of why climate change is occurring; conscious actions by City leaders and citizens to reduce local sources that are contributing factors; and concerted efforts to increase awareness and encourage action locally and at the state, national, and international levels.

Cost-effective solutions to reduce greenhouse gas emissions are available today. However, in order for these solutions to realize their potential, we must make climate protection a priority in our policies, budgets and investments, and personal and organizational actions.

Chapter 1

Climate Change: Causes and Impacts

"Local governments have plenty of reason to act to avoid the long-term local risks of climate change. They also have plenty of reason to act to realize the multiple benefits of cleaner and more efficient energy, including improved local air quality."

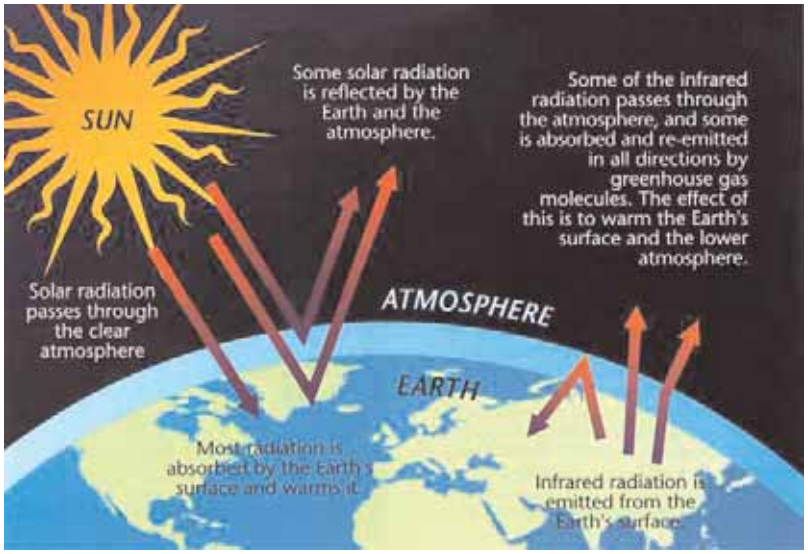
- International Council for Local Environmental Initiatives

1.1 Causes of Climate Change

Leading scientists around the world agree that climate change is a reality and that human activities are disrupting the earth's climate by intensifying the greenhouse effect. The greenhouse effect is a natural phenomenon that keeps the earth's temperature stable at an average of 60°F – warm enough to support life (see figure 1.1). Without this natural warming effect our planet would be uninhabitable at an average temperature of 14°F. However, human actions are disturbing this balance through over-production of large amounts of two main greenhouse gases (ghg), carbon dioxide (CO_2) and methane.

The increase in greenhouse gases is causing an overall warming of the planet, commonly referred to as *global warming*. The term *climate change* describes the variable consequences of global warming over

Figure 1.1 - The Greenhouse Effect



Source: U.S. EPA

Like the glass in a greenhouse, the earth's atmosphere forms an insulating blanket that traps some of the sun's rays as heat (long-wave infrared radiation). Adding CO_2 and other greenhouse gases to the atmosphere increases this effect.

time. In January of 2001, the United Nation's Intergovernmental Panel on Climate Change (IPCC) reviewed years of scientific research on climate change in order to understand the current and future situation of the planet. The panel agreed that the earth is warming at an unprecedented rate and that climate change poses serious threats to its inhabitants, and that more major challenges to the climate, ecosystems, and human life are on the way.[6]

The IPCC found that in the past 100 years, the average temperature of the globe increased by 1.5 °F. The IPCC has linked an alarming number of changes in the natural world over the past century to this seemingly minute increase in average temperature. For example, there has been widespread decrease in snow-cover and in the extent and depth of ice across the planet. The Arctic sea-ice thickness has decreased by 40% and global sea level has risen 4 to 8 inches during the 20th century. Since the late 1960s, there has been a 10% decrease in snow cover globally, and earlier spring thawing of rivers and lakes in the Northern Hemisphere.

Climate change has had a dramatic impact on plants and animals as well. Over the past two decades, 80% of the changes in distribution and behavior of organisms were consistent with changes in local temperature. Scientists have observed both pole-ward and altitudinal shifts of plant and animal ranges. These shifts can result in major declines of some animal and plant populations that are unable to adapt to the changing conditions of their habitats. The phenomena associated with global climate change have myriad impacts that are already changing the natural environment and climate throughout the planet— all of these changes have occurred with an average global temperature increase of only 1.5°F. The IPCC projects climate change-related global average temperature increases in the range of 2.5-10.4°F (1.4-5.8°C) over the next 100 years. (see figure 1.2).

Human Causes

The principal way humans cause increased greenhouse gases in the atmosphere is by burning fossil fuels such as coal, natural gas and petroleum. Other causes include deforestation and methane emitted from landfills. Current amounts of CO_2 and methane in the atmosphere are unprecedented, and most greenhouse gases are long-lived. About one quarter of the excess CO_2 emissions will still be present in the atmosphere several centuries after they occur and will continue to have impacts on the earth's climate and carbon cycle—the balance of CO_2 among the ocean, land and atmosphere.[7]

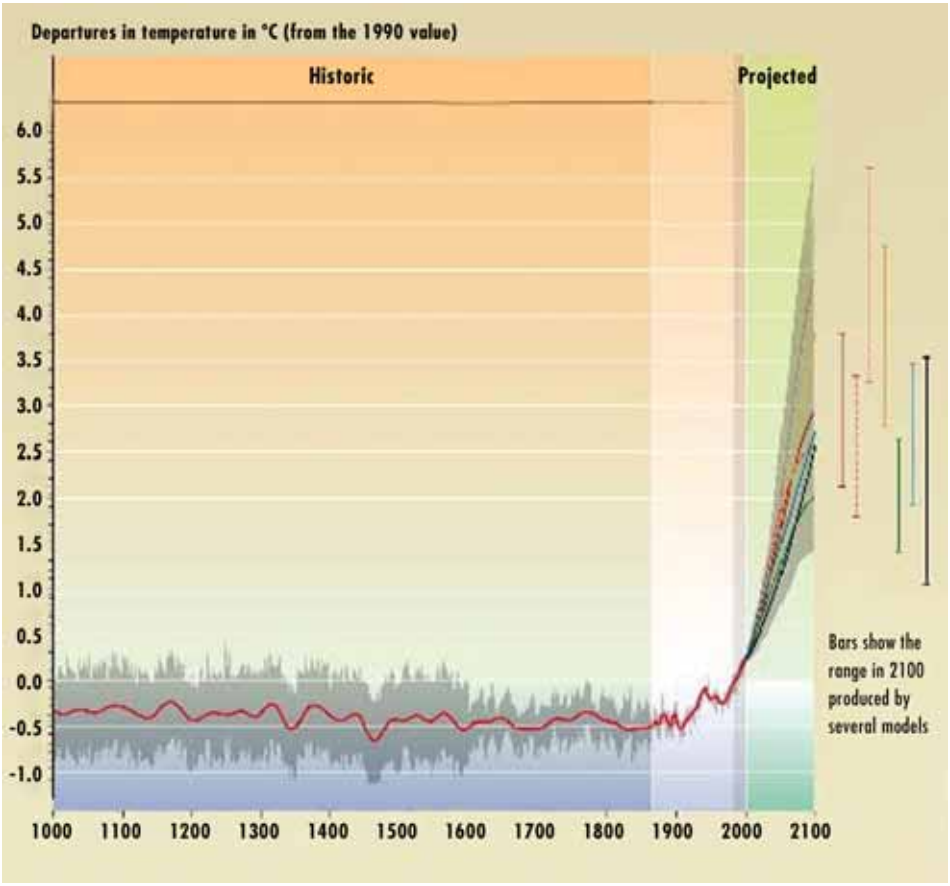
Burning Fossil Fuels

Burning fossil fuels in cars, power plants, industry and homes accounts for 75% of human-caused greenhouse gas emissions. The United States is the world's largest consumer of products from oil combustion and almost half of the U.S. contribution to greenhouse gases comes from this use of oil. With 5% of the world's population, the United States is responsible for 24% of the world's CO_2 emissions

6 Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2001: The Scientific Basis. Summary for Policy-makers. A Report of Working Group I of the Intergovernmental Panel on Climate Change.*

7 *ibid.*

Figure 1.2 - Historic and Projected Variations of the Earth's Surface Temperature



Source: Intergovernmental Panel on Climate Change
Climate scientists project a range of possible temperature increases over the next 100 years. The range–1.4-5.8°C (2.5-10.4°F) encompasses several emissions scenarios based on different sets of assumptions about driving forces (such as level of fossil fuel intensity, energy technology changes, population, economic growth, and land use).

Household Emissions of Greenhouse Gases

The average U.S. household emits 23 tons of CO_2 per year from driving and energy use.

Driving: 10 tons/year

Household energy use: 13 tons/year

- Space heating: 4.4 tons/year
- Water heating: 1.8 tons/year
- Refrigerators: 1.3 tons/year
- Lighting: 1 ton/year
- Air conditioning: .9 tons/year
- Cooking: .4 tons/year
- Other appliances: 3 tons/year

Source: Heede R. Cool Citizens: Everyday Solutions to Climate Change. Rocky Mountain Institute, 9 April 2002.

(figure 1.3). The United States per capita emissions of 22.2 tons per person is more than twice that of other developed nations such as Germany, Japan and the U.K., and more than five times the world average (figure 1.4). Households are a major source of greenhouse gases, directly contributing one-fifth of the total U.S. emissions of CO_2.

In comparison to other states, California uses relatively less heating and cooling energy because of its temperate climate. In addition, the state has been a leader in implementing energy efficiency and environmental protection programs in an effort to reduce carbon dioxide emissions. The state has a lower reliance on fossil fuels, using more energy sources such as hydroelectric, nuclear, and renewable energy.[8] However, California still relies on fossil fuels—natural gas and coal— for more than 50% of its electricity.

Despite these assets and strategies, California is still the second largest greenhouse-gas polluting state in the nation, and is responsible for 398 million tons of CO_2—7% of U.S. and 2% of global human generated CO_2 emissions. California also leads the nation in vehicle miles traveled and its largest contribution of CO_2 comes from burning fossil fuels for transportation.[9]

Land Use Practices

Deforestation has cleared the land of the ecosystems that keep the earth's temperatures cooler and serve as natural carbon sinks to reabsorb excess greenhouse gases. Over the past 150 years, California has lost 80% of its coastal wetlands, 96% of its interior wetlands, and 99% of its valley grassland.[10] During the 1990's, deforestation, landfills, and agricultural practices reduced the state's rate of carbon sequestration by 36% or 6 million tons CO_2.[11]

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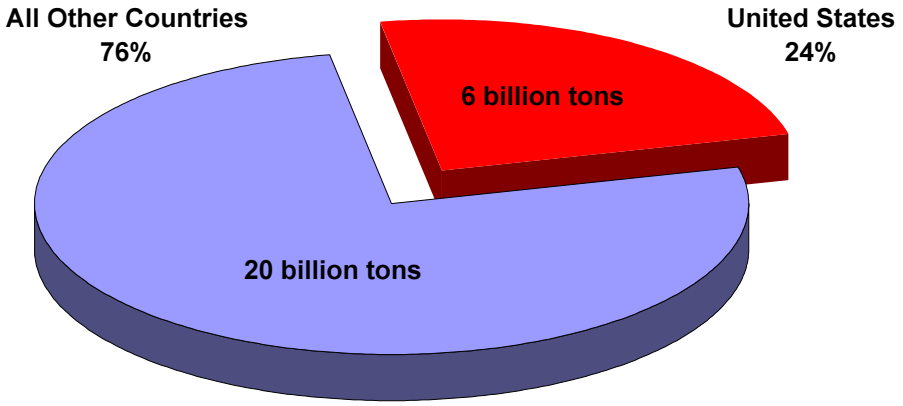
8 Franco, Guido. California Energy Commission: Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999. Publication #600-02-001F. November, 2002.

9 *ibid.*

10 Walter, H.S. Land Use Conflicts in California, in *Landscape Disturbance and Biodiversity in Mediterranean-Type Ecosystems*. Rundel, P.W., Montenegro, G., Jaksic, F.M., Eds. Springer, Berlin. 1998; 107-126.

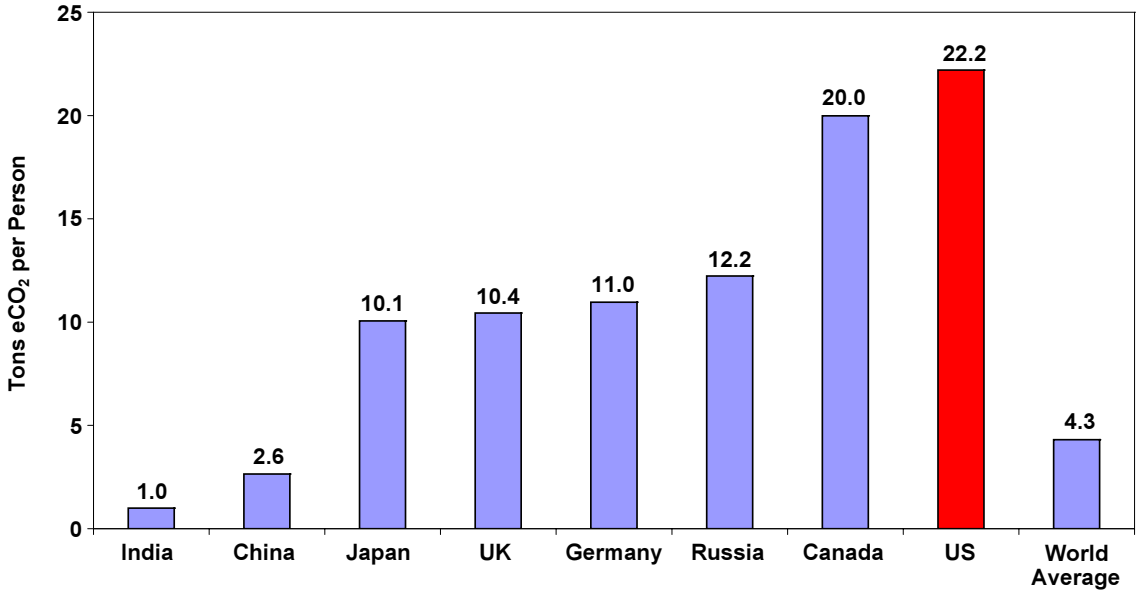
11 Franco, G. California Energy Commission.

Figure 1.3 - Global CO_2 Emissions



Source: Energy Information Administration: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1992-2001

Figure 1.4 - Per Capita CO_2 Emissions, 2001



Sources: Energy Information Administration: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1992-2001, U.S. Census Bureau: Countries Ranked by Population: 2001

1.2 Local Impacts of Climate Change

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

Scientists predict serious consequences of global warming. The rapid, unprecedented increase in temperatures accelerates the water cycle, which then increases the occurrence, variability, and severity of storms and drought.[12] Such extreme climate events will potentially disrupt ecosystems and damage food and water supplies. In addition, increased temperatures cause thermo-expansion of the oceans and accelerate the melting of the icecaps, thereby raising the overall level of the oceans. The sea-level rise may have multiple outcomes, including significant environmental disturbances, coastline destruction, major population displacement and economic disruption.

While in some cases global climate change may temporarily improve certain aspects of a region, such as lengthening the growing season, it is estimated that the ecology of the natural world will not be able to adjust quickly enough to prevent widespread environmental degradation.[13] In California, it is likely that warmer temperatures will result in frequent and longer periods of drought.[14] The majority of the scientific community has stated that beyond doubt, global climate change will be one of the most significant challenges the globe will face in the twenty-first century, and will impact almost every system we depend upon for survival.

In San Francisco, the impacts of climate change will be variable and widespread. Global and local climate change will impact weather, sea-level rise, water resources, ecosystems, human health, economy, and the infrastructure of California, the Bay Area, and San Francisco.

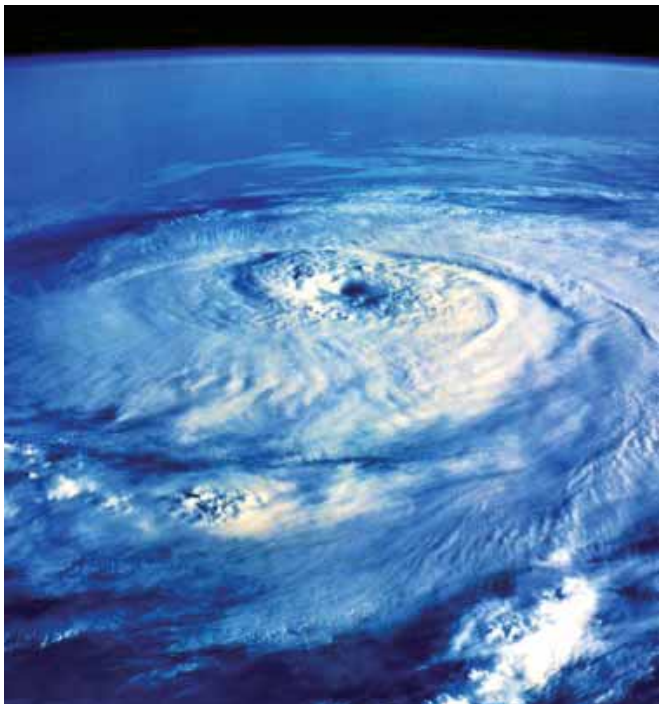
Climate and Weather

There is a key difference between climate and weather. According to the National Science Foundation

12 IPCC. The Scientific Basis.
13 Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2001: Impacts, Adaptation and Vulnerability: A Report of Working Group II of the Intergovernmental Panel on Climate Change.*
14 Union of Concerned Scientists/Ecological Society of America. *Confronting Climate Change: Ecological Impacts on the Golden State*. 1999.

report on climate change in California, "Weather is the day-to-day phenomena we experience—sun, rain, fog, warm, cold, wind—that vary greatly. Climate is long-term statistical patterns of weather…and is reflected in average temperatures, rainfall, and other weather events at a given location, and climate change is signaled by long-term changes in those averages" (emphasis added).[15]

In 1999, the Union of Concerned Scientists (UCS) and the Ecological Society of America published a report called *Confronting Climate Change in California*, which describes the predicted impacts of climate change in California. According to this report, California has had a 2 °F increase in temperature over the past 100 years, and annual precipitation has decreased by 10-25% in some regions The report also noted that most climate change models predict a temperature increase of 4° F in California in the next 20 to 40 years. These models also projected a decrease in the number of long dry spells, and an annual precipitation increase of 20-30% (with a



Potential Impacts of Climate Change in San Francisco

- Sea-level rise may threaten coastal wetlands, especially if they cannot move further inland because of levees, bulkheads, seawalls, roads and other development blocking the inland migration.
- Increased storm activity together with sea-level rise may cause increased beach erosion and cliff under-cutting.
- A one-foot rise in sea level by 2100 would mean that the current 100-year high tide peak measured at gauges in San Francisco Bay would become instead the 10-year high – thus a rare event would become common.
- Warmer temperatures, in conjunction with more frequent rainstorms associated with El Niño, will bring more frequent rainfall to the Sierras instead of snow. The increased rainfall will decrease the snow pack, reducing its ability to act as a water tower storing winter's snow for summer's dry periods.
- Decreased summer run-off into San Francisco Bay and warming ocean temperatures affect salinity conditions in coastal waters, water circulation and quality, and nutrient availability to marine organisms, possibly leading to complex changes in the marine food web, including impacts on fish and shellfish that use the bay as a nursery ground.

Source: Union of Concerned Scientists/Ecological Society of America

[15] California Regional Assessment Group for the U.S. Global Change Research Program. *Preparing for a Changing Climate: The Potential Consequences of Climate* Variability and Change. Wilkinson R. September, 2002. page 2-7.

range of 10-50%) in spring and fall, with somewhat larger increases in winter. One model reveals a large increase in precipitation over California, particularly in the form of rain, but with dry areas to the east of the Sierra. This regional model projects that winter precipitation over the coastal areas and the Sierra will increase by 25% or more, with an associated risk of increases in winter mud slides and flooding.[16]

Much of the anticipated changes in climate will depend on the frequency and strength of the El Niño-Southern Oscillation phenomenon (ENSO). Most global climate change models indicate the possibility of more frequent ENSO events. El Niño historically happens every two to seven years off the west coast of South America, as a result of changes in ocean currents and prevailing winds over the Pacific Ocean. These changes bring warm water from the western oceans, displacing the nutrient-rich cold water that normally wells up on the western coasts of the Americas from deep in the ocean. These changes bring more frequent and extreme weather anomalies, including severe droughts and floods, hurricanes and winter storms. According to the National Science Foundation, "the invasion of warm water disrupts both the marine food chain and the economies of coastal communities that are based on fishing and related industries".[17] The effects of El Niño in California vary across the state, but in the past have included abnormally frequent winter rains and storms, and abnormally dry summers and associated wildfires.[18] The 1982-83 El Niño, the strongest event in recorded history, brought $8 billion in economic impacts, and $100 million in California alone.[19]

Ultimately, in the next few decades, California will see warmer overall temperatures and an increase in precipitation events, with an increase of intensity and frequency of rainstorms (versus snowstorms).

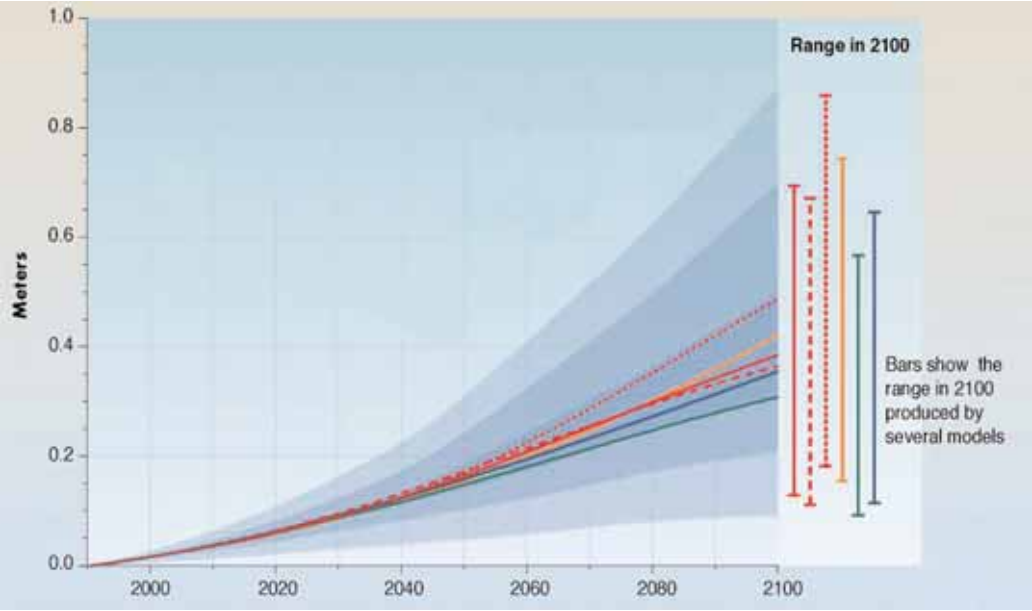
The day-to day impacts of climate change on weather in San Francisco will probably mean more frequent periods of wet days, and dry days will be warmer. In the future, with further increases in global climate change, San Francisco can expect that cold spells would still occur in winter, but heat waves in summer would be more extreme and more common. Perhaps more important, more precipitation may come in short, intense bursts (e.g., more than 2 inches of rain in a day), which could lead to mud slides and more frequent flooding.[20] In the next few decades, San Francisco will see warmer overall temperatures and more frequent and intense rainstorms.

Sea Level Rise

Over the past century, sea level has risen 2-4 inches. The global mean sea level is projected to rise by 4 to 36 inches between 1990 and 2100.[21] (see figure 1.5) The IPCC does not expect sea level change to be geographically uniform. The increase or decrease in sea level will be highly localized, depending on ocean surface changes, its interior conditions (warmth, density, salinity), and circulation. The most

16 Union of Concerned Scientists/Ecological Society of America.
17 California Regional Assessment Group, page 2-18.
18 Union of Concerned Scientists/Ecological Society of America.
19 California Regional Assessment Group.
20 IPCC, Impacts, Adaptation and Vulnerability.
21 IPCC, The Scientific Basis.

Figure 1.5 - Global Sea Level Rise Scenarios



Source: Intergovernmental Panel on Climate Change
Climate scientists project a range of possible sea level increases over the next 100 years. The range–0.1-0.9 meters (4-36 inches) encompasses several emissions scenarios based on different sets of assumptions about driving forces (such as level of fossil fuel intensity, energy technology changes, population, economic growth, and land use).

significant impacts occur where there are extreme changes in sea levels, especially from storm surges and extremely high waves forced by meteorological conditions. The Pew Center on Climate Change notes that "the West Coast is generally at lower risk [for sea level rise], with the exception of San Francisco Bay and Puget Sound". [22] In California, sea level is expected to rise up to 12 inches, twice as much as levels have risen in San Francisco over the past 100 years[23] (see figure 1.6). The Center anticipates that direct effects of sea level rise in California will include:

> *"erosion of beaches, bay shores, and tidally influenced river deltas; permanent inundation or wetland colonization of low-lying uplands; increased flooding and erosion of marshes, wetlands, and tidal flats, potentially resulting in net degradation and losses as a result of normal tidal inundation and episodic storm surges; increased flooding and storm damage in low-lying coastal areas as episodic storm surges and destructive waves penetrate further inland; and increased salinity in estuaries, marshes, coastal rivers, and coastal aquifers"*[24]

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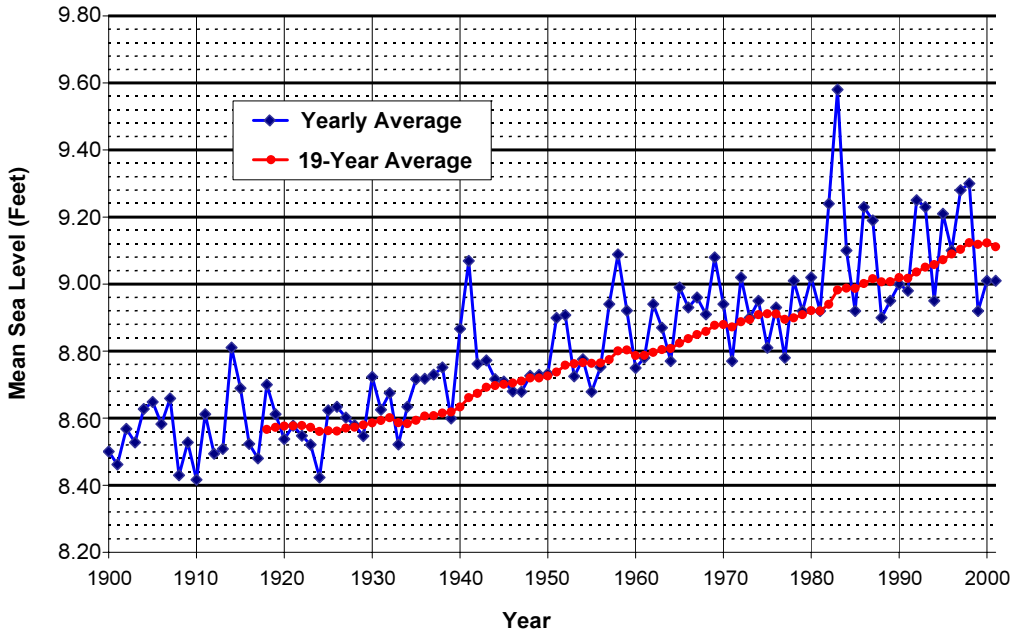
22 Neumann, J., Yohe, G., Nicholls, R., Manion, M. Sea Level Rise and Global Climate Change: A Review of Impacts to U.S. Coasts, Pew Center on Global Climate Change. February 2000.
23 Union of Concerned Scientists/Ecological Society of America, page 1.
24 Neumann, J. et.al.

Figure 1.6 - San Francisco Yearly Mean Sea Level



Source: California Department of Water Resources

Coastal airports are at risk, such as the San Francisco airport, which was built on wetlands only 10-feet above sea level. The NSF notes "A recent tidal flux in the San Francisco Bay area closed Highway 101 north of the city due to eight-foot tides, two feet above what had been expected. In the future, sea level rise, storm surges, and high tides could conspire to inundate runways. Harbors may suffer wave damage, additional siltation from storm runoff and other navigation and safety problems".[25] A 3-foot sea level rise scenario would inundate many developed and natural areas.[26] (figure 1.7).

These impacts will indirectly be made worse as residents try to combat the effects of sea-level rise with engineering projects to protect their homes. In addition, low-lying agricultural lands will be at increased risk of salt-water intrusion, which could pollute fresh water supplies and potentially damage or even wipe out crops. According to the UCS report, farmers in the Sacramento/San Joaquin Delta will need up to 700,000 acre-feet of fresh water to face this challenge. Threats to the Delta levees would add additional risks to these agricultural lands. Damaged coastlines may also cause damage to coastal buildings and other coastal infrastructure, including ports, ship channels, and bridges. Also at risk, pollutants in hazardous waste landfills may migrate because of flooding and changes in the water table.[27]

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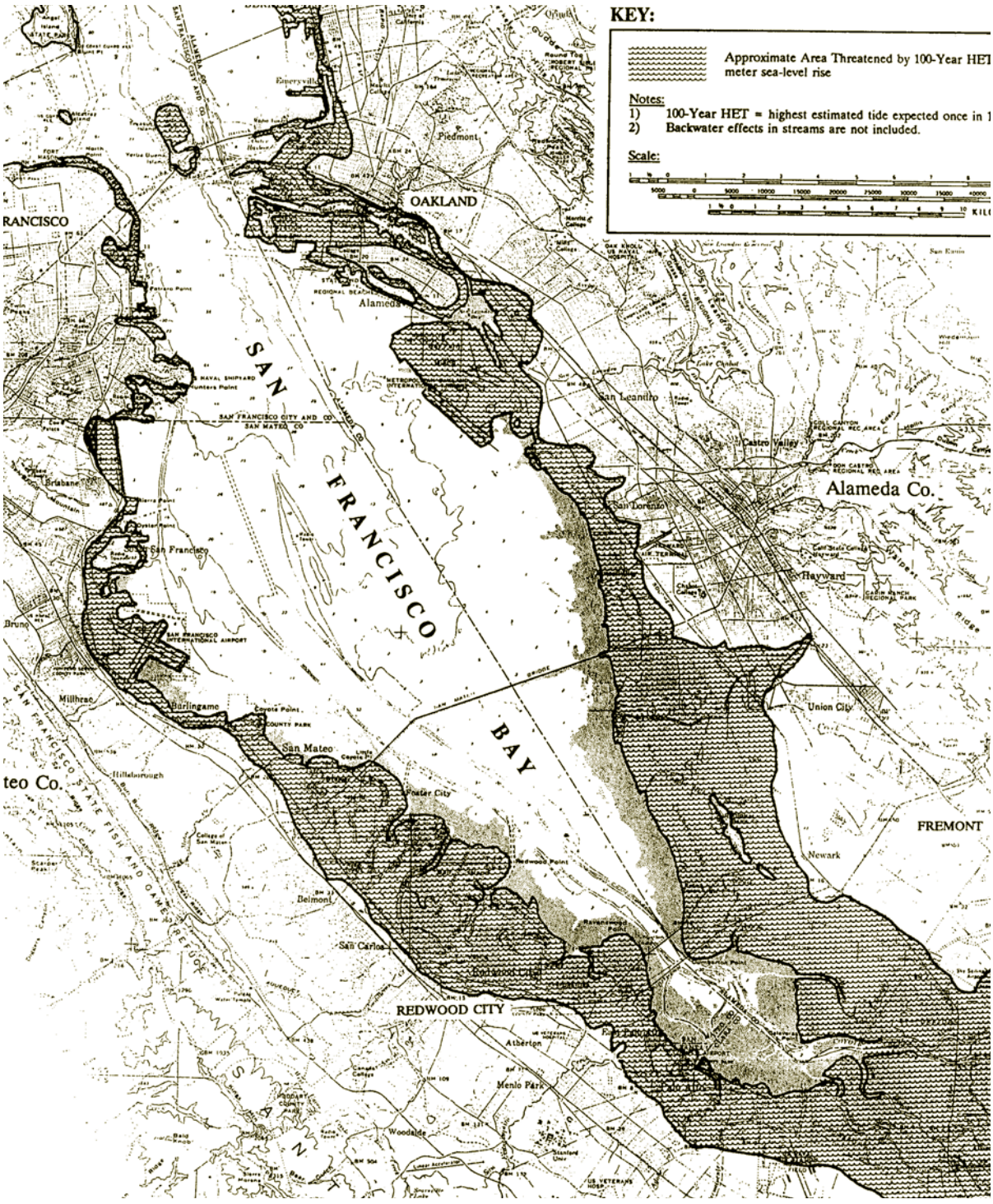
[25] California Regional Assessment Group, page 4-3-8.
[26] Gleick, Peter H. and Maurer, Edwin P., *Assessing the Costs of Adapting to Sea Level Rise: A Case Study of San Francisco Bay.* Pacific Institute for Studies in Development, Environment and Security and Stockholm Environmental Institute. 1990.
[27] Union of Concerned Scientists/Ecological Society of America, page 49.

Figure 1.7 - Effect of a 1 Meter Sea Level Rise on San Francisco Bay



Source: Pacific Institute

Water Resources

Global climate change will bring an additional burden to California's already over-taxed water supply system. According to the IPCC, there will be an increase in the number of intense precipitation days and flood frequencies in basins driven by snowmelt, such as California's Central Valley.[28] For this type of basin, the accumulation of snow in winter is the essential "water tower" that stores water until the spring's warmer temperatures begin to melt the snow, forming the streams and rivers that supply the entire watershed with water for the duration of the summer. San Francisco, which receives its water from the Hetch-Hetchy watershed in Yosemite National Park, would be greatly at-risk from a reduced snow pack.

Even under normal climate conditions, most (80%) of California's annual rainfall occurs in the winter and is stored in the snow packs of the various mountain ranges.[29] The warmer temperatures associated with climate change will increase rainstorms and decrease snowstorms, shorten the overall snowfall season, and accelerate the rate of spring snowmelt, ultimately–leading to more rapid, earlier, and greater spring runoff.[30] The anticipated early spring floods are likely to be followed by excessively dry summers. (see figure 1.8)

California's water supply is already under stress. According to the National Science Foundation report on climate change in California, "Every major water supply source in California is [decreasing in capacity and] currently over-allocated.[31] A combination of natural and human activities are causing this depletion of California water supplies as well as water intrusion and chemical contamination. According to the Union of Concerned Scientists, 95% of the state's wetlands have already been destroyed, including the largest wetland in the western US, the San Francisco Bay Delta.

Water demand in California is already increasing because of population expansion. In addition, demand for water for irrigation rises with warmer temperatures. The majority (87%) of all California agricultural land is irrigated, and all surface water is currently allocated based on past and current climates. According to the Union of Concerned Scientists, the increasing demand will impact a "wide range of water-system components, including reservoir operations, water quality, hydro-electric generation, navigation… [and] irrigation".[32] Summers with higher temperatures and even less rainfall and runoff than usual will exacerbate demands for water in California.

Climate change may impact the quality of San Francisco's water supply through the reduction in consistent water flows that keep watersheds clean, an increase in storm surges, and higher water temperatures. The clarity of mountain lakes is threatened by algal growth and acid rain. Soil erosion from flooding, and nutrient enrichment of lower rivers, streams and lakes may lead to murkiness in previously pristine lakes. More frequent thunderstorms will bring polluted air from lower regions into the Sierra

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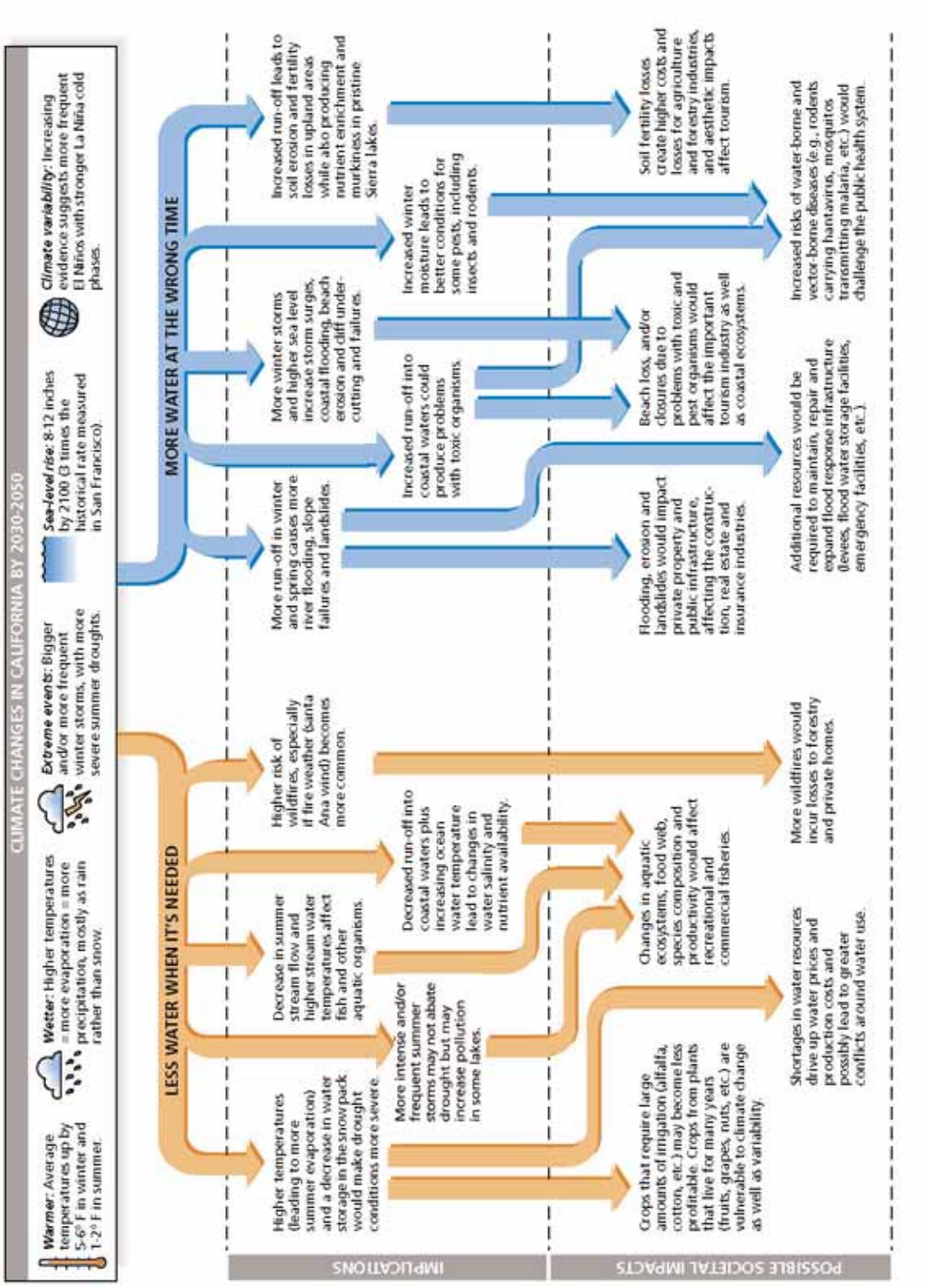
28 IPCC, Impacts, Adaptation and Vulnerability.
29 Union of Concerned Scientists/Ecological Society of America.
30 Frederick, K. and Gleick, P. *Water and Global Climate Change: Potential Impacts on U.S. Water Resources.* Pew Center on Global Climate Change. 1999.
31 California Regional Assessment Group, page 105.
32 Union of Concerned Scientists/Ecological Society of America.

Figure 1.8 - The Cascading Effects of Climate Change on California's Water



Source: Union of Concerned Scientists

Nevada high country. In addition, rain holds more nutrients and pollutants than does snow, thus with a higher ratio of rain to snow in the Sierras, more acid rain and pollution of rivers and lakes is expected.

The actual impacts of the climate-induced change in water quality, quantity, and demand will depend on the changes in water policy and operations, and on the water use patterns of San Francisco and its supporting communities and ecosystems

Ecosystems

While there is some degree of uncertainty, scientists are able to predict many of the challenges that climate change presents to California ecosystems. Warmer temperatures may force some species to higher altitudes or more northern latitudes. This migration may be prevented by human developments that literally block the path as well as non-native species that can out-compete native plants and animals in new locations or make those areas uninhabitable. For example, there is evidence that certain butterflies, often a species that is used to indicate the health of an ecosystem, are moving further north, and are seldom seen in the southern reaches of their range. In addition, warmer temperatures have enabled the Jeffrey pine beetle to have more than one birth cycle per season, lengthening the amount of time this pest is able to damage trees.[33] Furthermore, human impact other than greenhouse gas emissions will exacerbate challenges to ecosystems attempting to reestablish at higher elevations or new locations. According to the UCS report, "In many parts of California, fragmentation of the landscape by human developments, invasions by non-native species, and air pollution may limit the reestablishment of native ecosystems."

Another concern is the change in precipitation and runoff patterns from the Sierra Nevada through the Central Valley and into San Francisco Bay. Increases in winter runoff will reduce the amount of freshwater flowing into the Bay in the spring and summer, which could result in higher salinity of the water in the fall. According to the UCS report, "Higher salinity in the Bay can alter circulation within it and affect all levels of the food web, from phytoplankton (algae) to predators, including fish, in complex ways". Recently, the impact of higher autumn salinity in the Bay has been linked to the decline in populations of "fishes of economic and recreational interest, such as Chinook salmon or striped bass".[34] In addition, warm water poses a direct threat to marine life because some fish may require cooler water, and dissolved oxygen levels decline with every increase in temperature.[35]

Changes in water patterns as well as increased temperatures will have a major impact on the agricultural lands supporting San Francisco. The anticipated variability and fluctuation of California's previously predictable climate will present major challenges to California's most economically important crops, such as fruit and nut trees and grapes. These perennial crops take several years to reach the point of bearing fruit, which prevents farmers from responding to the changing climate conditions. Furthermore, if warmer temperatures are accompanied by drought, there will be an increased need for irrigation from an

33 *ibid*
34 *ibid*
35 Frederick, K. and Gleick, P.

already overburdened water supply. In many cases, increased irrigation can lead to higher levels of salt in the soil, making land unproductive.[36]

The ecosystems that support San Francisco through water and food supply as well as its economy will endure a variety of stresses associated with climate change. The key challenges will be through the detrimental impacts of changing water supply and quality on agriculture and fisheries in the Central Valley and San Francisco Bay. In addition, there is some uncertainty about exactly how changes in temperature and precipitation will impact the health of the many ecosystems of the state, and how sensitive their interdependent systems are to any significant level of change.

Human Health

According to the Pew Center's report on Human Health and Climate Change, health threats may depend on surpassing a threshold level of a climate factor such as significant change in temperature, precipitation, or storm frequency. Once that threshold has passed, the incidence of disease may drastically increase.

Environmental factors play a significant role in some diseases carried by insects. Warming could make tick-borne Lyme disease more prevalent. Mosquito-borne diseases such as West Nile virus, Dengue Fever, and Malaria could acquire new ranges and access to previously unexposed populations.[37] For example, the temperature range at which the malaria-carrying mosquito lives is sensitive to a mere one-degree in temperature change; thus an overall increase in global temperatures will increase the land areas where it may spread disease. These temperature changes affect not only the mosquitoes, but also disturb and in some cases decrease the habitats of its natural predators.[38]

One of the biggest threats to the health of San Francisco residents is air pollution. Increased heat may increase ozone levels and air pollution toxicity, which may intensify respiratory conditions such as asthma and has been associated with an increase in morbidity of pulmonary diseases.[39] Higher levels of ozone may also exacerbate asthma, and has been associated with pulmonary inflammation.

Economy

The health of San Francisco's economy is dependent on the regional economy and depends heavily on its attraction as an international tourism destination. Further, both the regional economy and a good deal of the tourism industry are based in part on regional and local environmental health. According to the IPCC, human settlements will be impacted by climate change in many ways including economic impacts on industries such as agriculture and tourism, and financial issues such as property damage and insurance.

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36 Union of Concerned Scientists/Ecological Society of America.
37 IPCC, Impacts, Adaptation and Vulnerability, page 5.
38 Rogers, D.J., Randolph, S.E., Snow, R.W., and Hay, S.I. Satellite Imagery in the Study and Forecast of Malaria. Nature. February 7, 2002. 415(6872):710-715.
39 Balbus, J., Wilson, M., *Human Health and Global Climate Change: Potential Impacts in the United States.* Pew Center on Global Climate Change. December, 2000.

Statewide industries form a supporting foundation to the San Francisco economy. Two of California's top four industries: tourism ($75 billion with 1,109,000 employees) and agriculture ($27 billion 418,000 employees) are likely to be directly and severely impacted by climate change. Forty-five million out-of-state and foreign travelers visited California in 2000. The impact on tourism would have a direct impact on San Francisco's businesses and tax base. Drought and other changes in the patterns and availability of water can cause dramatic declines in the productivity of California's agriculture. Excessive rain or hotter and drier weather would hurt the San Joaquin Valley and the Napa-Sonoma wine country as well as the output of California's forest and fishing industries. This would not only impact the availability and cost of food, but it would also depress the California economy in general, affecting the Bay Area and San Francisco.

One of the most significant impacts on the economy will involve property and health insurance. The IPCC notes that the global costs attributable to weather events have risen from $3.9 billion per year in the 1950's to $40 billion per year in the 1990's.[40] Charged with forecasting the impact of future events that might require their clients to request payment, many insurance companies have already demonstrated concern about how global climate change will affect their business. It's likely that insurance companies will raise their premiums in anticipation of increased need of payments for property damage from events such as storm-induced erosion, floods, and fires. Swiss Reinsurance, the second-largest re-insurer in the world, expects climate change to increase both property losses and life insurance losses as global warming extends the areas of high risk for skin cancer and the habitats of disease carriers such as mosquitoes. The company now requires applicants for coverage to explain their strategy for meeting the Kyoto targets.[41]

Infrastructure

Flooding, erosion, and a rising water table could have profound impacts on roads, pipelines, transportation, underground cables, and sewage systems.

San Francisco's sewage system is designed to handle water input from sewage and rainstorms from the largest storm expected in a typical five-year period. The main determinant of whether the city's sewage system can handle the influx of water is the intensity of storms and water input over a certain time period. For example, if the city experiences 4-5 inches of rain over the course of a month, the water system is equipped to handle it. However, if that much rain were to come in the course of a week, there may be damage to catchment systems, ponding into the streets, and clogging of sewage drains. During the 1998 El Niño season heavy rains came over the course of two months. While the water system was able to effectively treat and drain the runoff the system was extremely taxed and needed considerable repair. If that weather pattern were to be repeated year after year, the storm water system would be severely degraded.[42]

Erosion is another concern. Since 1995, storms have severely eroded the bluffs from Sloat Blvd. to Fort Funston. The City installed a quarrystone protective structure in 1997 but had to provide more re-

40 IPCC, Impacts, Adaptation and Vulnerability.
41 Boston Globe Editorial. *Burning Kyoto's Bridges*. Sunday, Jan. 19, 2003.
42 Telephone interview with Tom Franza, San Francisco Public Utilities Commission, Water Pollution and Control, January, 2003.

enforcement to the face of the bluff in 1998 during extremely severe erosion associated with El Niño. This protective structure continues to degrade. A sand barrier put in place in 2000 was eroded away by 2001 and annual restoration of the sand barrier is required to reduce risk of erosion removing the remainder of the bluff.[43]

Sea level rise may have an impact on other infrastructure, roads, underground pipes and cables. In 2000, storm and tidal surges caused widespread flooding and the closure of Highway 101. Nearby San Francisco International Airport is only ten-feet above sea level. It is not known what damage could be caused to the foundation of buildings, roads, runways, and other infrastructure now sitting in areas that would be affected by a rising water table.

1.3 Policy and Legislation

The process of global climate change is not unstoppable, but turning it around will require changes in the ways industries function and people in developed countries currently live. As a result of the overwhelming evidence that climate change is a real and increasing problem, governments have created policies at the international, national, state and local levels to reduce greenhouse gases.

International

The United Nations Framework Convention on Climate Change (UNFCC) is the governing body for international research and agreements on climate change. Both the Intergovernmental Panel on Climate Change (IPCC) research reports and Kyoto Protocol were completed under its auspices.

National

In 1997, the U.S. signed support for the Kyoto Protocol goals and targets. While some policy initiatives have been undertaken at the Federal level, the U.S. Congress has yet to ratify the Protocol.

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[43] Ocean Beach 2001: Status and Erosion Report, San Francisco Department of Public Works.

International Policy and Research on Climate Change

- **1972**. The **Stockholm Declaration** laid the first foundations of contemporary environmental policy at the global level.
- **1990**. Given a mandate to assess the state of existing knowledge about the climate; the environmental, economic, and social impacts of climate change; and possible response strategies, the **Intergovernmental Panel on Climate Change** (IPCC) released its First Assessment Report. This report confirmed the scientific evidence for climate change.
- **1991**. The **Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC)**, approved by the UN General Assembly and comprised of participants from 150 countries, negotiated and adopted the Climate Change Convention.
- **1992**. The **Earth Summit at Rio de Janeiro** became the largest-ever gathering of Heads of State to discuss environmental issues and the UN Framework Convention on Climate Change was signed by 154 states.
- **1995**. The **Conference of the Parties (COP-1)** held its first session in Berlin. The participating delegates from 117 Parties and 53 Observer States agreed that the commitments contained in the Climate Change Convention for developed countries were inadequate and launched the "Berlin Mandate" talks on additional commitments. They also finalized much of the institutional and financial machinery needed to support action under the Convention in future years.
- **1997**. The **Kyoto Protocol** was adopted **at COP-3** in Kyoto, Japan.. Some 10,000 delegates, observers, and journalists participated in this high-profile event. 84 countries have since signed the Protocol, agreeing to targets reducing their greenhouse gas emissions.
- **2000**. **COP-6**. An agreement was reached on an operational rulebook for the Kyoto Protocol that addressed the emissions trading system, the Clean Development Mechanism, rules for counting emissions reductions from carbon "sinks", and a compliance regime. It also outlined a package of financial and technological support to help developing countries take action on climate change.
- **2001**. The **IPCC Third Assessment Report** concluded that the evidence for humanity's influence on the global climate is now stronger than ever, presented the most detailed picture to date of how global warming will affect various regions. It also confirmed that many cost-effective solutions to rising greenhouse gas emissions are available today; in many cases, however, governments will need to address various institutional, behavioral and other barriers before these solutions can realize their potential.
- **2002 COP - 8**, Delhi, India. Met on progress toward implementation of agreements made at previous COPs.
- **2003 COP - 9**, Milan, Italy. Funded technology transfer and adaptation projects in developing countries. Established new emission reporting guidelines for carbon sequestration.

Source: United Nations Framework Convention on Climate Change - http://unfccc.int/resource/convkp.html#kp.

- In 2001, the Bush Administration asked the National Research Council to review the IPCC's statements and recommendations. The committee addressed a series of specific questions regarding climate change science and largely agreed that the findings of the IPCC were accurate.[44]

- In 2003, Senators John McCain and Joseph Lieberman introduced the *Climate Stewardship Act of 2003*. The bill failed by a vote of 57 to 43. This bill would have required a scientific research program on abrupt climate change to accelerate the reduction of greenhouse gas emissions by establishing a market-driven system of tradable allowances that could be used interchangeably with passenger vehicle fuel economy standard credits.

Most substantive action on climate change is taking place at the state and local levels.

State

California has taken the lead in setting specific targets for reducing greenhouse gas emissions from the burning of fossil fuels in both power plants and vehicles. State legislation includes:

- **Senate Bill 1078** Sher, 2002. Established a Renewable Portfolio Standard 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 Air Resources Board to develop and adopt regulations that achieve the maximum feasible reduction of greenhouse gases from vehicles primarily used for non-commercial transportation by January 2005.

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

San Francisco

San Francisco has joined with more than 500 cities around the world to participate in the *Cities for Climate Protection* campaign, sponsored by the International Council on Local Environmental Initiatives (ICLEI). As part of the campaign, member cities have committed to: inventory their emissions of greenhouse gases; set reduction targets; describe local actions required to meet these targets; implement the actions to reduce emissions; and measure the results.

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[44] California Regional Assessment Group, page 2-11.

While confronting climate change may seem insurmountable, local action can make a difference. San Francisco's Board of Supervisors has passed resolutions and ordinances that, when implemented, will have significant impacts on the City's greenhouse gas emissions.

One important step the City has taken is to adopt the 2002 ***Electricity Resource Plan*** as a policy guideline to be used in proposing and implementing specific actions. The Plan includes implementing energy efficiency programs and developing renewable energy resources such as wind and solar power.

In 2002, the San Francisco Board of Supervisors passed the ***Greenhouse Gas Emissions Reduction Resolution*** (Appendix C), committing the City and County of San Francisco to a greenhouse gas emissions reductions goal of 20% below 1990 levels by the year 2012. The resolution also states that the Mayor and Board of Supervisors actively support the Kyoto Protocol, and calls upon national leaders to do so as well. In 2003, Mayor Willie Brown joined mayors of over 100 other cities including Seattle, Atlanta, Houston, Minneapolis and Boston in signing a statement which was presented to Congress and the President urging their leadership on climate change (Appendix B).

This ***Climate Action Plan***, called for in the resolution, describes what San Francisco can do to achieve its stated goal and to slow the effects of climate change.

It is imperative that San Francisco, a city at high risk, takes action now to slow the effects of climate change. Cost-effective solutions to reduce greenhouse gas emissions are available today. However, in order for these solutions to realize their potential, we must work to raise awareness and make climate protection a priority in our policies, budgets and investments, and personal and organizational actions.

Chapter 2

San Francisco's Greenhouse Gas Emissions: Inventory and Reduction Target

2.1 Methodology

The first step in developing the *Climate Action Plan* was to establish a baseline inventory of San Francisco's greenhouse gas emissions. The purpose of this inventory is to identify and categorize the major sources and quantities of greenhouse gas emissions being produced by the City's residents, businesses and municipal operations. The Plan uses 1990 as the baseline year, in conformance with the ICLEI Cities for Climate Protection program standard. The baseline inventory provides a framework on which to design programs and projects ("actions") to specifically target reductions in these sources of emissions. These actions are described in Chapter 3. The baseline inventory also serves as a reference against which to measure the City's progress towards reducing greenhouse gas emissions over time, and documentation for potential emission trading opportunities.

In estimating San Francisco's total greenhouse gas emissions, we drew upon many data sources from city, regional and state agencies. For community energy statistics, we consulted Pacific Gas & Electric Company and the California Energy Commission. Transportation data sources included the California Department of Transportation, Metropolitan Transportation Commission, Bay Area Rapid Transit, Caltrain, and the Department of Motor Vehicles. Solid waste data was gathered from NorCal and Altamont Landfill. The City's Department of Environment, Hetch Hetchy Water and Power, Muni, Purchasing and Planning Departments provided data on municipal operations.

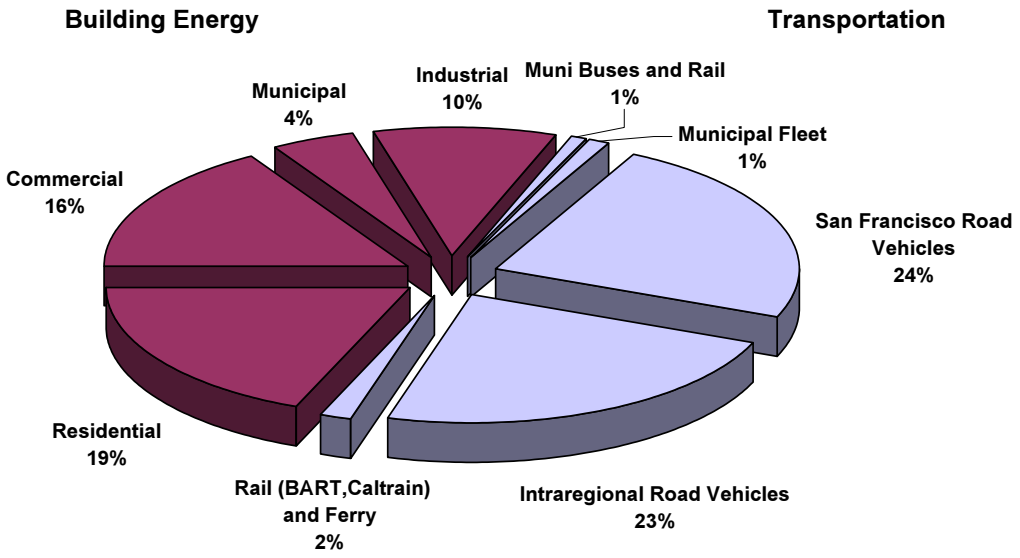
In cases where specific historical or forecast data was not available, estimates were made by extrapolating from existing data. Specific sources, estimate methodologies and assumptions are cited in text and footnotes throughout this report and in Appendix A. All of the contributors to greenhouse gas emissions (kilowatt-hours of electricity generated by fossil fuel combustion in power plants, natural gas in therms, vehicle travel in gallons of fuel, solid waste in tons) are expressed here in the common unit of tons of "equivalent carbon dioxide" (eCO_2) released into the atmosphere in a given year. ICLEI's Cities for Climate Protection software was used to calculate these equivalent emissions.

2.2 Emissions Inventory

Burning fossil fuels in vehicles and for energy use in buildings and facilities are the major contributors to San Francisco's greenhouse gas emissions. In 1990, these activities produced approximately 9.1 million tons eCO_2.

Figure 2.1 shows San Francisco's total greenhouse gas emissions from all major sources for the 1990 baseline year. "Building Energy" includes the impacts of the electricity and natural gas used in both private and public sector buildings and facilities. "Transportation" includes emissions from private vehicles within San Francisco, and between the City and the Bay Area, as well as Muni, BART, and other transit and the City's municipal fleet.

Figure 2.1 - San Francisco Greenhouse Gas Emissions (eCO_2), 1990



Sources: PG&E, Hetch Hetchy Water and Power, CA. Dept. of Transportation, MTC, Muni, BART

Section 2.2 describes Transportation emissions – from private vehicles, public transit, and the municipal fleet; Energy emissions – from electricity production and natural gas use; and Solid Waste emissions - due to landfill gases.

Transportation Emissions

The transportation sector creates approximately 50% of San Francisco's total greenhouse gas emissions. Transportation sources considered in this analysis include all road and rail vehicles (both trips within the City, and regional trips generated into and out of the City) and cross-Bay ferries. Transportation emissions associated with these sources produced approximately 5.1 million tons of CO_2 in 2000. This is an increase of 10 percent from the 1990 level of 4.6 million tons. Transportation emissions are projected to continue to increase to approximately 5.5 million tons in the target year of 2012 (table 2.1). The following section describes how these emissions were calculated and provides a breakdown of community and municipal sources.

Table 2.1 - Emissions from San Francisco Transportation Sources

Transportation Source	Emissions (million tons CO_2)		
	1990	2000	2012**
Transportation within San Francisco County			
San Francisco Road Vehicles*	2.15	2.23	2.41
Muni Buses and Rail	0.09	0.10	0.10
Municipal Fleet	0.08	0.08	0.08
Subtotal:	**2.32**	**2.42**	**2.59**
Intraregional Transportation			
Intraregional Road Vehicles	2.12	2.39	2.66
Rail (BART and Caltrain)	0.12	0.15	0.17
Ferry	0.04	0.11	0.11
Subtotal:	**2.28**	**2.65**	**2.94**
All Transportation Sources, TOTAL:	**4.6**	**5.1**	**5.5**

*Not including Muni buses and the municipal fleet.

** Projected

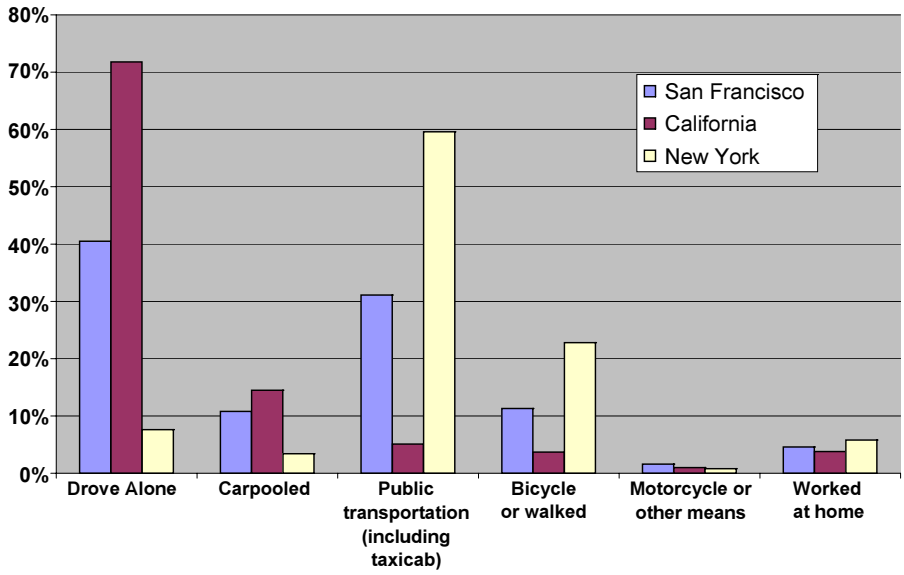
Sources: Estimates of CO_2 emissions were generated using ICLEI's software, Cities for Climate Protection™ U.S. Greenhouse Gas Emissions. Inputs include vehicle miles traveled, gallons of fuel, or kilowatt-hours of electricity consumed. Road vehicle calculations are based on assumptions for the breakdown of vehicle types and average fuel efficiencies of vehicles on the road (see Appendix A for more detail.) Data sources include the California Department of Transportation; Metropolitan Transportation Commission; Golden Gate Bridge District; San Francisco Municipal Railway; Bay Area Rapid Transit; Caltrain; and Water Transit Authority.

Community Transportation

The City's high density, limited parking, and few entry points naturally encourage the use of modes of transportation other than driving. San Francisco residents have one of the highest rates in California of using transit, bicycling, and walking to reach their destinations. However, these rates are relatively low when compared to New York, another dense urban area (figure 2.2). San Francisco also has one of the lowest vehicle ownership rates in the state. According to 2000 Census data, the mean number of vehicles per household in San Francisco was 1.1, compared with an average of 1.7 for the state of California.

As shown in figure 2.1, total transportation emissions are roughly split between trips within the City boundaries and trips between San Francisco and the surrounding region. While trips within county boundaries are relatively easy to measure, intraregional trips are included in the analysis to provide a more complete representation of transportation sector emissions generated by the City. San Francisco is

Figure 2.2 - Residents' Means of Transportation to Work



Transportation Mode	San Francisco	California	New York
Drove Alone	40.5%	71.8%	7.6%
Carpooled	10.8%	14.5%	3.4%
Public transportation (including taxicab)	31.1%	5.1%	59.6%
Bicycle or walked	11.3%	3.7%	22.8%
Motorcycle or other means	1.6%	1.0%	0.8%
Worked at home	4.6%	3.8%	5.8%

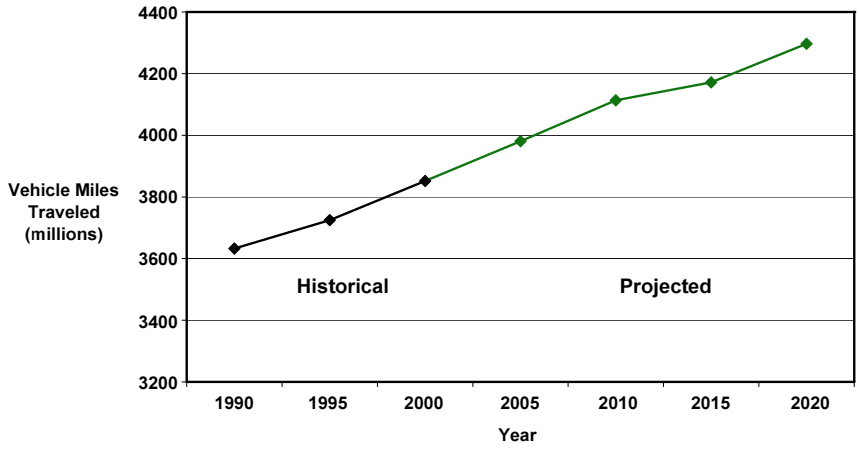
Source: 2000 U.S. Census. Census Transportation Planning Package (CTPP 2000).

centrally located in the nine-county Bay Area metropolitan region and historically has been a major employment center, as well as a prime shopping and entertainment destination. Thus a significant number of trips are generated both into and out of the City. According to the San Francisco Transportation Authority's Congestion Management Program, non-resident commuters currently fill about half of the City's approximately 580,000 jobs, and the city's daytime population swells to approximately 1.1 million, compared with a resident population of about 746,000.[45]

Road and rail vehicles operating within San Francisco generated approximately 2.3 million tons of CO_2 emissions in 1990. Calculations for road vehicles are based on figures for total vehicle miles traveled

[45] *Congestion Management Program 2001.* San Francisco County Transportation Authority. November 19, 2001.

Figure 2.3 - Trends in Vehicle Miles Traveled within San Francisco County



Source: California Motor Vehicle Stock, Travel and Fuel Forecast. November 2001. California Department of Transportation, Transportation System Information Program.

(VMT) in San Francisco County from the California Department of Transportation.[46] VMT in San Francisco County have been increasing steadily since 1990, as depicted in figure 2.3. San Francisco VMT were measured at 3,633 million in 1990, and 3,852 million in 2000, an increase of 6%. VMT are anticipated to increase another 7% by 2010 and reach a projected 4,137 million in 2012.

Public transit vehicles operated by the San Francisco Municipal Railway (Muni) generated approximately 99,000 tons of CO_2 in 2000 (based on 2002 data). Muni vehicles include diesel buses, electric trolley buses, light rail vehicles, historic streetcars, and cable cars. With the exception of the diesel buses, all of these vehicles operate on electricity. Emissions calculations for the electric vehicles are based on the emissions produced in generating the electricity used to operate the vehicles. Total Muni emissions in 1990 are estimated to be slightly lower (87,000 tons) because several of the light rail and streetcar lines present in 2000 did not exist in 1990. Further system additions over the next decade will result in slightly higher projected emissions in 2012 (approximately 102,000 tons). Calculations are based on data provided by Muni.[47]

Trips between San Francisco and the surrounding region generated approximately 2.3 million tons of CO_2 emissions in 1990 — 93% of which are from road vehicles. Rail vehicles (BART and Caltrain) and commuter and recreational ferries between San Francisco and other Bay Area cities generated the remaining 7% of emissions. While intraregional trips generated slightly less than half of total transportation sector emissions in 1990, these trips generated slightly *more* than half in 2000 and are projected to continue growing faster than trips within the City.

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46 *California Motor Vehicle Stock, Travel and Fuel Forecast.* November 2001. California Department of Transportation, Transportation System Information Program.

47 Based on VMT, fuel efficiency, and energy consumption data provided by Marty Mellera, Muni. March 2003.

Intraregional road vehicle emissions were calculated using base data from the Metropolitan Transportation Commission's regional travel model for average weekday trips.[48] Several assumptions were then applied to arrive at an estimate of vehicle miles traveled. Traffic counts over the bridges provided a comparison of weekday and weekend trips. Intraregional rail emissions are based on data provided by BART and Caltrain. Caltrain operates on diesel fuel and BART on electricity. BART emissions are based on the total estimated electricity needed to operate trains for the San Francisco market. Ferries operate on diesel fuel and their emissions are based on data from the Water Transit Authority.[49] Ferry traffic is anticipated to increase only slightly by 2012.

Municipal Fleet

Emissions from municipal fleet vehicles generated approximately 81,045 tons of CO_2 emissions in 1990, or approximately 3.5% of total San Francisco County transportation emissions.[50] The municipal fleet includes all vehicles owned and operated by the City and County of San Francisco and some contractor vehicles performing City functions (Laidlaw school buses and NorCal refuse/recycling trucks). It does not include public transit vehicles. At least twenty major departmental agencies use vehicles for city business, including emergency fire response, law enforcement, recreation and parks, and public works. Some municipal fleet vehicles are operated outside the City limits, including San Francisco International Airport, and the Public Utilities Commission operations on the Peninsula, in the East Bay and in the Sierra.

The City fleet, not including contractor vehicles, currently consists of approximately 5,400 vehicles of various types.[51] Most of the City's vehicles are light-duty automobiles or trucks, but the City also has many medium- and heavy-duty trucks and other miscellaneous types of vehicles such as parking enforcement scooters and police motorcycles. Estimates of municipal fleet emissions are based on 1998 fuel consumption data obtained from fuel purchase records and a survey of departmental fleet managers (table 2.2).[52]

The majority of City vehicles operate on gasoline or diesel fuel, but in 1998, the City also had a small proportion of fleet vehicles fueled by alternative fuels, mostly propane. Since 1998, the number of alternative fuel vehicles (AFVs) in the fleet, such as compressed natural gas (CNG), electric, and hybrid-electric, has increased due to the implementation of the Healthy Air and Smog Prevention Ordinance in 1999 which requires City Departments to purchase alternative fuel and low emission vehicles.

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48 Weekday data from *MTC Travel Demand Models for the San Francisco Bay Area*. Estimates for weekend trips based on comparisons of weekday and weekend traffic provided by the Golden Gate Bridge District and Caltrans.

49 Water Transit Authority. *Draft Program Environmental Impact Report: Expansion of Ferry Transit Service in the San Francisco Bay Area*. August 2002.

50 Municipal emissions are not an exact subset of San Francisco County emissions because some municipal fleet activities take place outside City limits and are not captured in the community emissions figures; however, the calculation provides a good approximation of the municipal fleet contribution to total transportation emissions.

51 In early 2003, the Mayor issued a mandate to reduce the size of the light-duty, general-purpose fleet by 15%. Approximately 160 vehicles were decommissioned or replaced by newer vehicles. This was primarily a cost-reducing measure, but may also have impacted vehicle miles traveled and overall fleet emissions.

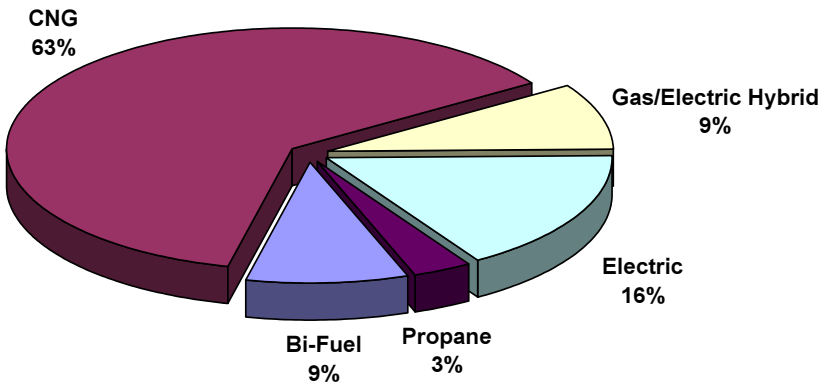
52 1998 figures are used as an approximation of 1990 fuel purchases, as fleet size does not change significantly from year to year and sufficient data was not available to estimate changes in fleet fuel consumption over time. Changes in fuel efficiency between 1990 and 1998 also would have been minor.

Table 2.2 - Municipal Fleet Fuel Usage 1990

Fuel Type	Gallons of Fuel	Tons CO_2
Gasoline	3,273,400	35,700
Diesel	4,181,700	44,581
Propane	114,200	763
	Total	**81,045**

Sources: Municipal Fleet data from fuel purchase records from the Purchasing Dept. and a telephone survey of departmental fleet managers. 1998. Some figures do not include fuel purchased separately by credit card. Municipal fleet includes Muni operation and maintenance vehicles, but not transit vehicles.

Figure 2.4 - Alternative Fuel Vehicles in the City Fleet by Fuel Type, 2002



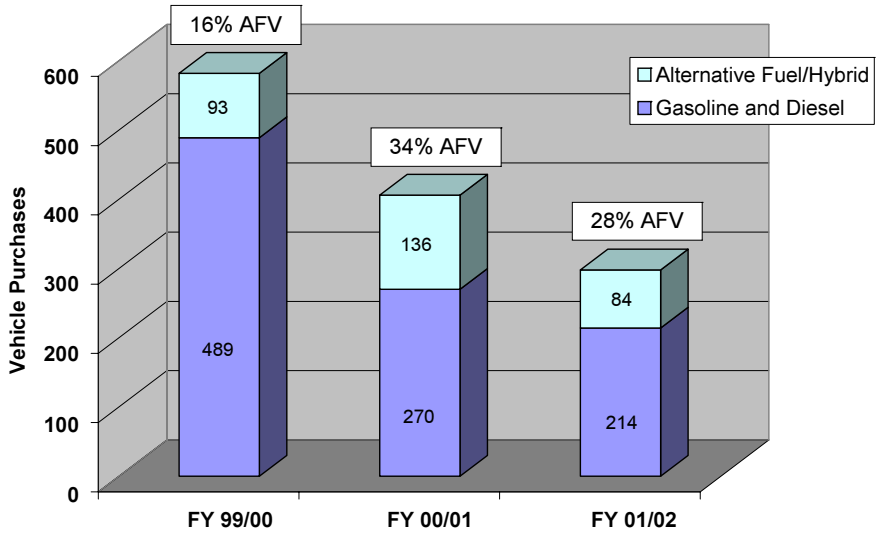
Source: San Francisco Purchasing Dept./Central Shops. January 2003.

At the beginning of 2003, the City had almost 600 alternative fuel vehicles in its fleet, representing approximately 11 % of the total City vehicle fleet. The majority of these were CNG vehicles (figure 2.4). In terms of vehicle type, over half of the AFVs in the fleet are automobiles, approximately 27% are other light duty vehicles (pick-ups, sport utility vehicles [SUVs], and vans), 3% medium and heavy-duty vehicles, and 15% other types of vehicles (for example, parking enforcement vehicles). Generally, it is more difficult to find suitable AFVs that meet the required specifications for medium and heavy-duty vehicles than for the other categories.

Approximately 24% of all City vehicle purchases over the past three fiscal years have been either alternative fuel or hybrid vehicles. The percentage of AFVs purchased has fluctuated from year to year depending on budget constraints and availability of needed models (figure 2.5). AFV purchases were higher in Fiscal Year (FY) 00/01 due to increased availability of needed models. AFV purchases decreased in FY 01/02 due to budget constraints and discontinuation of particular models.

The City has also worked with its major service contractors to switch to AFVs. It is currently implementing an ambitious plan with Norcal, its garbage/recycling collection contractor to convert the entire fleet of vehicles serving the City to AFVs, specifically CNG and liquid natural gas (LNG) heavy-duty vehicles. Currently, the contractor has 14 heavy-duty LNG long haul transfer trucks in operation, which travel more than 600 miles daily from the City's transfer station to the Altamont landfill site. Within the next few years, the remaining fleet of transfer trucks (18 vehicles) will be converted to LNG.

Figure 2.5 - Alternative Fuel Vehicle Purchases Fiscal Years 99/00 to 01/02



Source: Clark Aganon, San Francisco Department of Environment Clean Air Program, 2003.

Table 2.3 - Summary of CO_2 Savings from AFV's in Municipal Fleet

Alternative Fuel Type	Total Number of Vehicles in Fleet	Estimated Annual CO_2 Savings	Annual CO_2 Savings Per Vehicle
Bi-Fuel (CNG and Gasoline)	55	61 tons	1.1 tons
CNG	368	485 tons	1.3 tons
Hybrid	52	70 tons	1.3 tons
Electric	97	189 tons	1.9 tons
Propane	20	63 tons	3.2 tons
TOTAL	**592**	**868 tons**	**1.5 tons**

Source: Estimates of CO_2 emissions were generated using ICLEI's software, *Cities for Climate Protection™ U.S. Greenhouse Gas Emissions,* using inputs of number of vehicles, VMT, and average fuel efficiencies. Data on number of vehicles and VMT obtained from Central Shops 2003. Fuel efficiencies from Ryan Bell, ICLEI, April 2003 and www.fueleconomy.gov.

The City has also begun the conversion of curbside collection trucks to natural gas.

The annual CO_2 savings resulting from AFV purchases in the City fleet totals approximately 868 tons, based on 2002 fleet data (table 2-3). This represents a 1.2% reduction in CO_2 from emissions that would have occurred if the fleet were entirely conventionally fueled. As the Healthy Air and Smog Prevention Ordinance continues to be implemented, the number of gasoline and diesel vehicles replaced by AFV's will increase further, yielding greater reductions in municipal emissions by 2012.

Based on the current trend of approximately 25% AFV purchases per year, and assuming total annual purchases of 300 vehicles per year (75 AFVs) over the next 10 years, annual CO_2 savings in 2012 would be approximately 2,000 tons.

Energy Emissions

Energy Supply

Energy use in buildings and facilities is responsible for approximately 50% of San Francisco's total greenhouse gas emissions. These emissions are a result of the combustion of fossil fuel (mainly natural gas) either directly in buildings, or in power plants to generate electricity. San Francisco's energy use resulted in a total of approximately 4.5 million tons of CO_2 emissions in 1990.

San Francisco receives its electricity from a mix of sources both inside and outside of the City. There are two plants generating power within the City limits. In 2001, the Potrero and Hunters Point power plants together provided about 30% of San Francisco's total electricity[53] while 70% was imported to the City through the power grid (see figure 2.6).

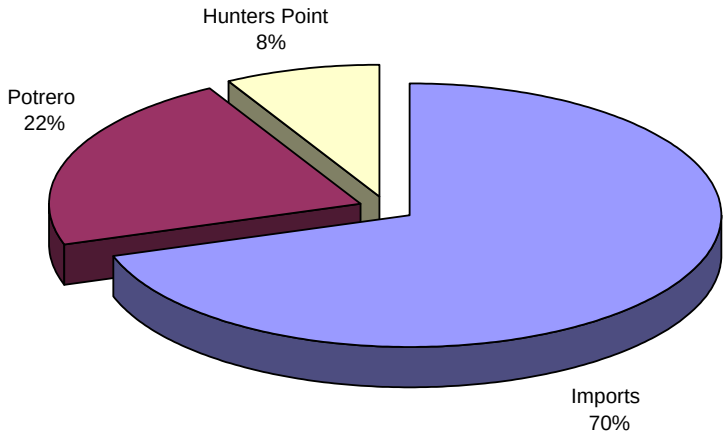
San Francisco's imported power comes from a variety of sources, including natural gas, coal, nuclear, renewables and hydroelectric power. This mix of sources changes depending on demand, fuel costs, weather conditions, regulatory requirements and other factors that influence the cost of generating power. Power from these various sources is delivered to San Francisco's homes and businesses by Pacific Gas & Electric Company (PG&E). A portion of the hydroelectric power is generated by the City's Hetch Hetchy Water and Power, primarily to serve the City's municipal buildings.[54]

Figure 2.7 shows the mix of fuel sources used in 2001 to generate the power imported through the transmission grid into San Francisco. This breakdown includes all sources of generation of electricity used in California. All of the coal and some of the hydroelectric electricity was generated outside of California. The types of power sources that make up this statewide electricity generation mix have a significant impact

[53] Hunters Point Plant is owned by PG&E. Potrero is owned by Mirant. The amount of power generated by these plants is based on demand for electricity in the City and the region and is regulated by the California Independent System Operator (CAISO).

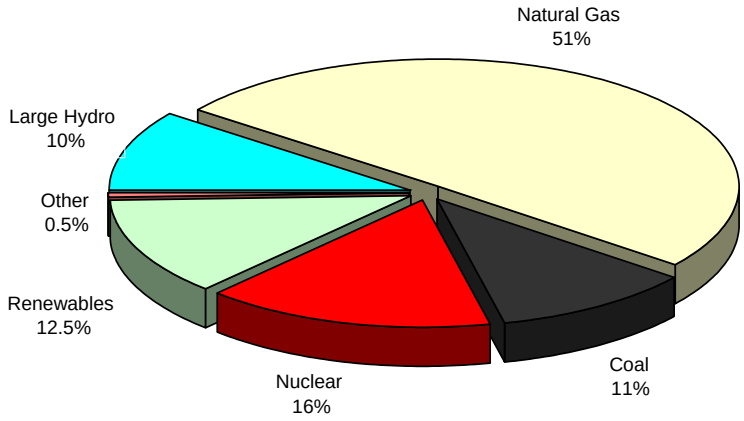
[54] In 2001, 817 gigawatt-hours were billed to Municipal customers. This includes some facilities located outside the San Francisco city limits, including San Francisco International Airport.

Figure 2.6 - San Francisco Electricity Sources % Total Generation (kilowatt-hours), 2001



Source: PG&E

Figure 2.7 - California Electricity Fuel Mix % Total Generation, 2001



Source: California Energy Commission. Net System Power

in San Francisco's overall greenhouse gas emissions. A coal fired plant, for example, releases 1.3 tons of CO_2 per megawatt-hour of electricity generated versus 0.7 tons for gas turbines and 0 tons for renewable sources such as solar, wind or hydroelectric power.

San Francisco's Electricity Resource Plan[55] recommends decommissioning the Hunters Point plant, reducing generation at Potrero and installing smaller scale gas combustion turbines. Renewable energy projects

[55] Electricity Resource Plan: Choosing San Francisco's Energy Future. December 2002. www.sfenvironment.org, www.sfenergy.org

such as wind and solar are also planned. These factors, along with changes in the statewide generation mix will affect San Francisco's overall emissions factor, the amount of CO_2 released per unit of electricity generated. In 2001, this factor was about 521 tons CO_2 per gigawatt-hour.

Energy Demand

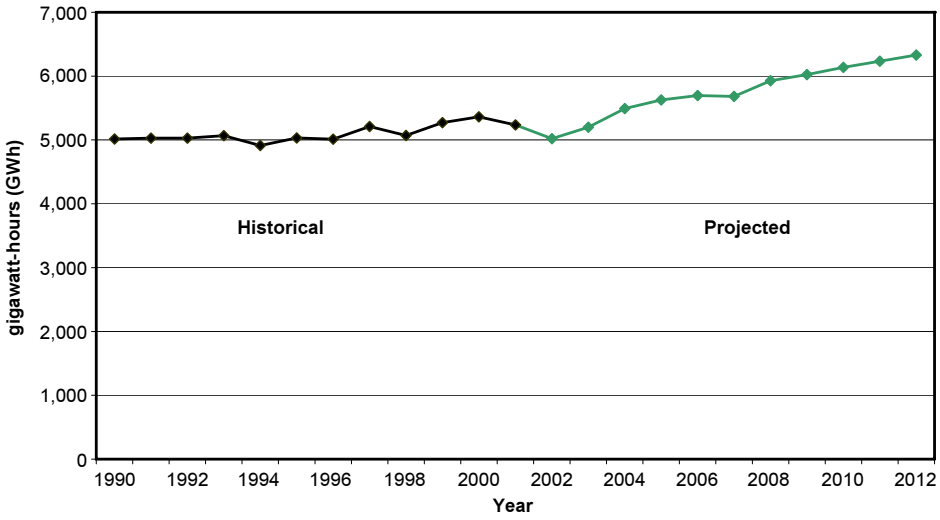
In 1990, San Francisco's total energy consumption was about 5,000 gigawatt-hours of electricity and 300 million therms of natural gas. This translates to a total of 4.5 million tons of CO_2 emitted due to energy use in San Francisco's homes, businesses and City facilities. Figures 2.8 and 2.9 show historical and projected electricity and gas use for San Francisco.

Figure 2.10 shows the breakdown of total greenhouse gas emissions from both electricity and natural gas combined. Of the total 4.5 million tons of CO_2 emitted due to energy use in San Francisco, 38% was from residential buildings, followed by 33% commercial, 20% industrial, and 9% municipal buildings and facilities.

Residential

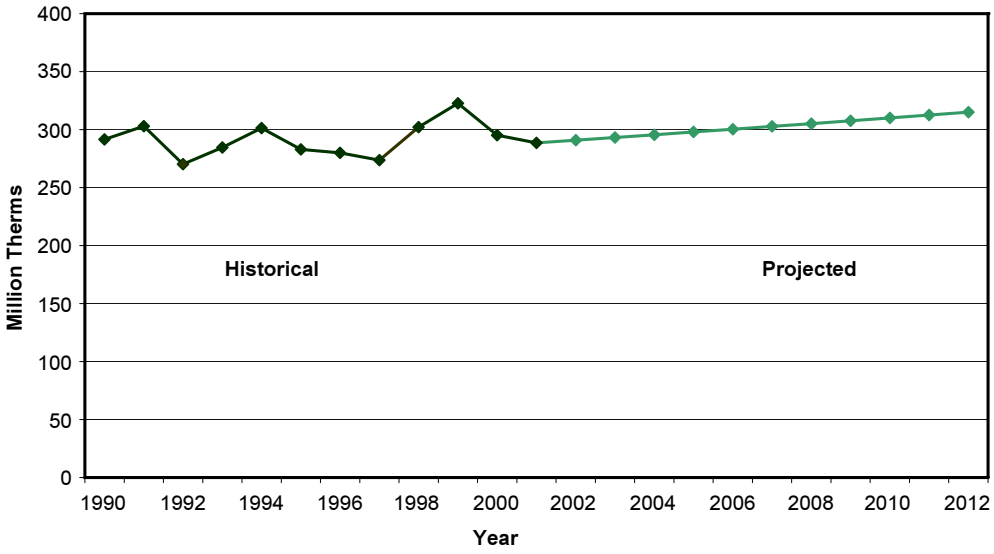
In 1990, San Francisco's 724,000 residents consumed 1,174 gigawatt-hours of electricity, or about 3,800 kilowatt-hours per household, and 179 million therms of gas, or about 586 therms per household, at an expense of $222 million or $726 per household. This consumption resulted in a release of 1.7 million tons of CO_2 into the atmosphere by the City's 306,000 households. Major residential energy uses include refrigeration, lighting, space heating and water heating.

Figure 2.8 - San Francisco Electricity Use



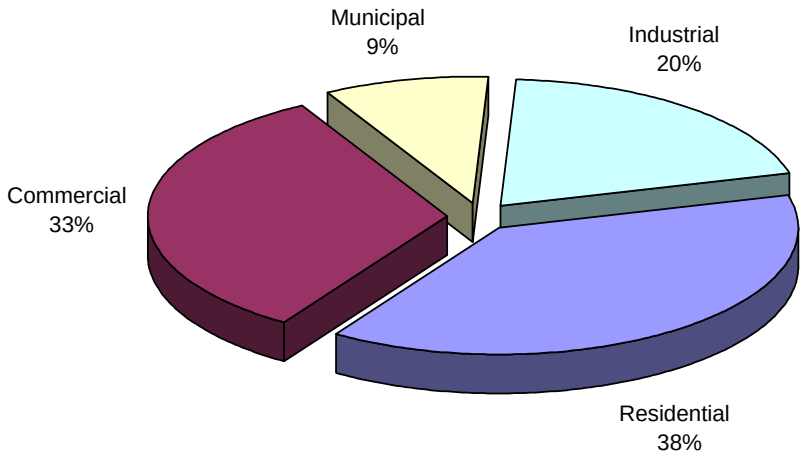
Sources: 1990 - 2001 PG&E, 2002 -2012 adjusted based on CEC *California Energy Demand 2003-2013 Forecast Staff Draft Report*. Feb 11, 2003.

Figure 2.9 - San Francisco Natural Gas Use



Sources: 1990 - 2001, PG&E. 2002 – 2012, adjusted based on CEC growth rate assumption of 0.8% per year. 1999-2001 data adjusted to reflect changes in reporting categories.

Figure 2.10 - San Francisco Buildings Emissions (eCO_2), 1990



Buildings and facilities by building type, gas and electricity combined. Sources: Estimates of CO_2 emissions were generated using ICLEI's software, *Cities for Climate Protection™ U.S. Greenhouse Gas Emissions*, using input electricity and gas usage data from PG&E, Hetch Hetchy Water and Power, and CEC.

Commercial

In 1990, San Francisco's commercial sector buildings consumed 1,878 gigawatt-hours of electricity, and 81 million therms of gas, at an expense of $234 million. This consumption resulted in a release of 1.5 million tons of CO_2 into the atmosphere by the city's 32,000 businesses.

Industrial

In 1990, San Francisco's industrial sector consumed 1,297 gigawatt-hours of electricity, and 31 million therms of gas, at an expense of $116 million. This consumption resulted in a release of 894,000 tons of CO_2 into the atmosphere.

Municipal

The City and County of San Francisco operates 50 departments, comprising more than 1,000 buildings and facilities. These include fire stations, police stations, and libraries as well as hospitals, sewage treatment facilities, convention centers and over 100 Recreation and Park facilities. San Francisco International Airport is the City's largest single user of electricity at approximately 39% of municipal use.

In 1990, San Francisco's municipal buildings and facilities consumed 676 gigawatt-hours of electricity, and 13 million therms of gas, at an expense of $40 million, which resulted in a release of 402,000 tons of CO_2 into the atmosphere.

The breakdown of electricity and gas usage in municipal buildings and facilities is shown in table 2.4.

Solid Waste Emissions

In 1990, San Francisco generated about one million tons of solid waste (figure 2.11). Of this amount, 65% or about 670,000 tons was transferred to the Altamont Landfill in eastern Alameda County. By 2001, through great strides in recycling, the percentage landfilled was reduced to 48%. However, the total amount landfilled increased by 110,000 tons. Total waste generation is projected to stay fairly flat through 2012. If current diversion rates remain constant, 800,000 tons of waste will be landfilled in 2012.

Because more than 75% of the methane produced from solid waste disposed of in the Altamont landfill is recovered – flared off or used as fuel, and some portion of the carbon from the waste disposed is stored in the landfill, emissions appear to be slightly negative, 185,000 tons eCO_2 in 1990. However, the benefits gained through recycling and the associated reductions in "upstream" energy use associated with raw material extraction, processing, manufacturing, and transportation of products far outweigh this, resulting in a net reduction in greenhouse gas emissions, 768,000 tons eCO_2 in 2001.

Table 2.4 - Municipal Energy Use, 1990

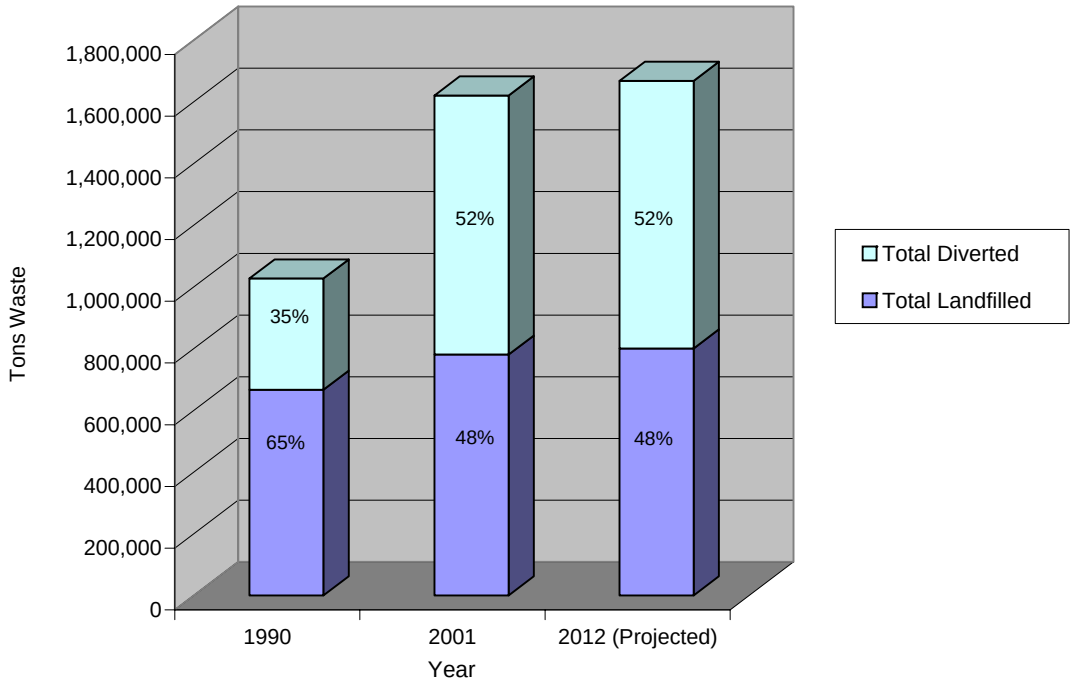
Building group	Electricity (million kilowatt-hours)	Gas (million therms)
Airport	265.2	1.7
Sewage	54.5	38
Schools	40.8	1.1
Hospitals/Clinics	37.4	6.4
Street Lights	35.6	0
Water	34.5	.08
Misc.	29.0	1.2
Maintenance Facilities	22.4	.91
Police Services	19.5	1.5
Auditoriums	18.2	.28
City Hall	17.7	.26
Museums	12.3	.44
Parking Garages	9.0	0
Recreation Centers	7.2	.67
Traffic Signals	7.2	0
Stadium	5.1	.09
Fire Services	2.6	.29
Libraries	2.6	.07
Zoo	2.2	.13
Totals	**676.5**	**15.5**

Source: Hetch Hetchy Water and Power

Different materials produce varying amounts of methane depending on the chemistry of their decomposition processes. Though organic materials are responsible for most of the greenhouse gases emitted directly from the landfill, most of the emissions caused by waste are the result of upstream energy used in production.

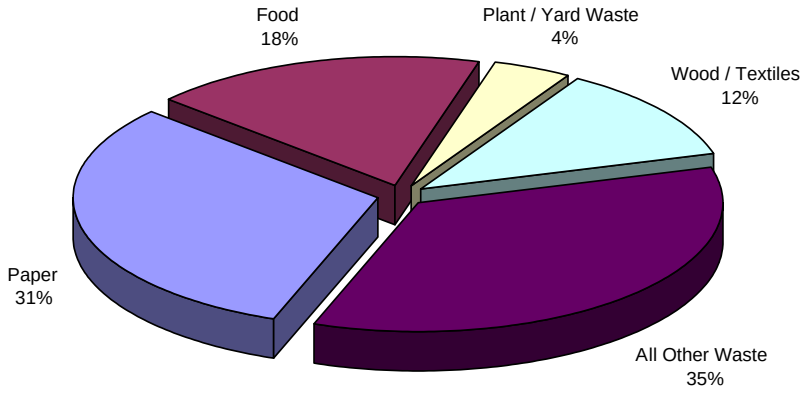
Figure 2.12 shows the approximate breakdown of the materials San Francisco sent to the landfill in 1990. Organic materials such as food and yard waste disposed of in landfills decompose and emit methane, a greenhouse gas 21 times more potent than CO_2.

Figure 2.11 - San Francisco Solid Waste



Source: San Francisco Department of the Environment. 1990 and 2001 numbers based on landfill and recycling records. 2012 projection assumes programs continue at current levels and increased source reduction efforts will result in a near flat increase in waste generation.

Figure 2.12 - Landfilled Contents, 1990



Source: San Francisco Department of the Environment

Recycling reduces CO_2 emissions because manufacturing products with recovered materials avoids emissions from the energy that would have been used during the extraction and processing of virgin raw materials. Net carbon emissions from producing a ton of new material are 4 to 5 times higher than producing with recovered material in the steel, copper, glass and paper industries, and 40 times higher for aluminum.[56] For example, producing an aluminum can from recycled aluminum saves nearly 90% of the energy compared to using virgin materials. Recycling a ton of paper saves 4,200 kilowatt-hours – enough to power the average San Francisco home for a year.[57] Another indication of the upstream impact that material product lifecycles have is that for every ton of municipal waste landfilled, more than 70 tons of waste are produced upstream from activities such as virgin resource extraction, manufacturing, production, and agriculture.[58]

Recycling paper also conserves forests, which contributes to carbon "sequestration"— a process that removes carbon from the atmosphere and stores it for long periods. Forests, organic material in soil, (and also landfills) all store carbon.

Composting organic materials, especially food scraps, avoids landfill methane emissions while generating compost that helps to sequester carbon in the soil. Composting does emit CO_2 from its aerobic process, however methane is a more potent greenhouse gas than CO_2. The net greenhouse gas impact of diverting organic materials from the landfill to composting depends in part on the methane recovery rate at the landfill. EPA estimates that landfill methane recovery systems average about 75% nationwide.[59] Another greenhouse gas benefit from composting, which is not factored into the EPA numbers, is that using compost offsets the use of petroleum based fertilizers and pesticides thus reducing their upstream emissions.

Figure 2.13 illustrates the life cycle stages and greenhouse gas sources, sinks (sequestration) and offsets.

Source reduction, reuse, recycling and composting appropriate materials can dramatically reduce the "life cycle" impacts that materials have on emissions.

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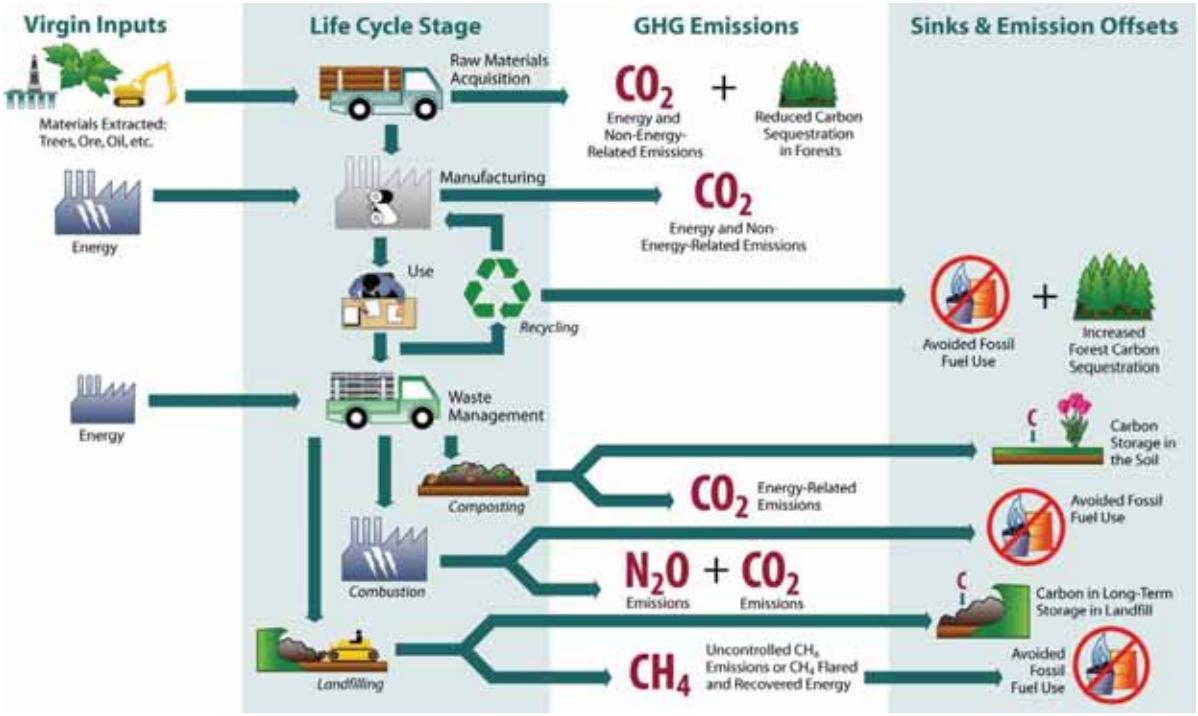
56 White House Task Force on Greening the Government Through Waste Prevention and Recycling (Task Force on Recycling) brochure; "Recycling for the Future", November 1998.

57 South Carolina Electric & Gas Company (1991) "Recycle – Save Energy", PG&E residential energy use 2000, U.S. Census, 2000.

58 Office of Technology Assessment. *Managing Industrial Solid Wastes from manufacturing, mining, oil and gas production, and utility coal combustion.* (OTA-BP-o-82), February 1992.

59 Cities for Climate Protection software- Torrie Smith Associates, based on *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, U.S. EPA, May 2002.

Figure 2.13 - Greenhouse Gas Sources and Sinks Associated with the Material Life Cycle



Source: Solid Waste Management and Greenhouse Gases, A Life-Cycle Assessment of Emissions and Sinks, U.S. EPA, EPA 530-R- 02-006, May 2002, 2nd Edition

2.3 Reduction Target

In 2002, the Mayor and Board of Supervisors, through passage of the *Greenhouse Gas Emissions Reduction Resolution*, committed San Francisco to a greenhouse gas emissions reductions goal "in excess of the targeted goals of the Kyoto Protocol," and called for continued actions towards achieving these goals (see Appendix C).

The resolution states that the Mayor and Board of Supervisors of the City and County of San Francisco actively support the Kyoto Protocol, and call upon national leaders to do so as well; and established the goal of reducing San Francisco's greenhouse gas emissions to 20% below 1990 levels by the year 2012. In order to meet this ambitious goal, San Francisco will need to take action now and sustain it over the long term.

Figure 2.14 - San Francisco Greenhouse Gas Emissions Forecast and Target

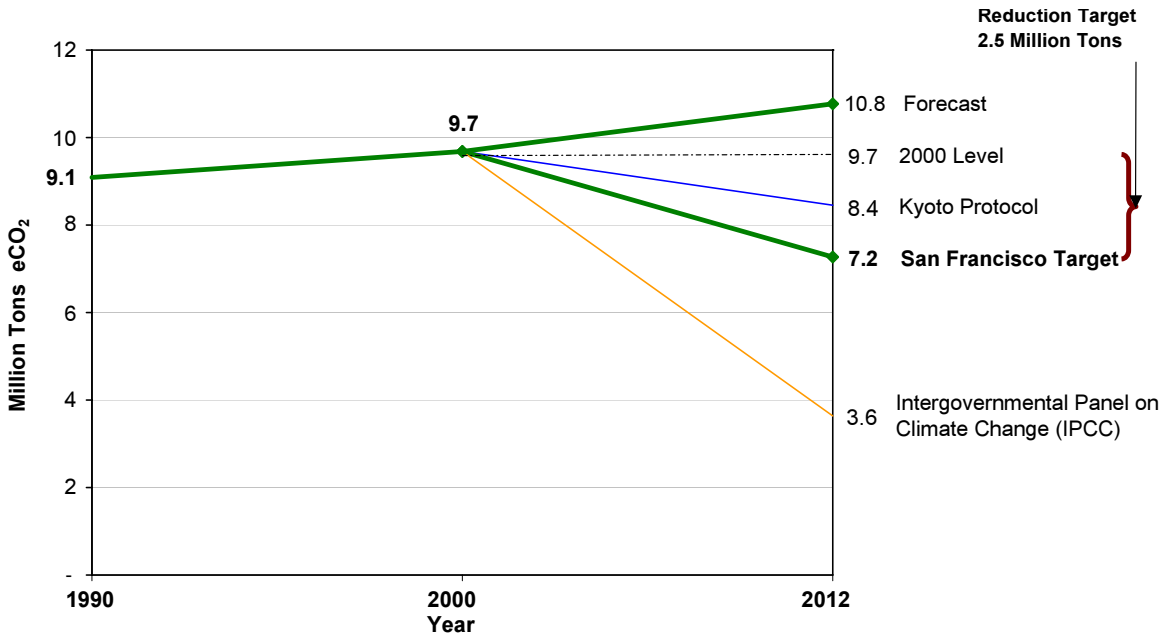


Figure 2.14 shows estimated emissions levels for the baseline year (1990); 2000 levels; forecast levels (2012); and San Francisco's 2012 target compared to the Kyoto Protocol and IPCC targets. Greenhouse gas emissions are projected to rise approximately 9% from current levels to 5.6 million tons/year in the transportation sector, and 14% to 5.2 million tons/year in buildings, for a total of 10.8 million tons/year in 2012. This "business as usual" forecast is based on growth projections and assumptions described above in section 2.2.

The Kyoto Protocol target of 7% below 1990 levels was the target the United States agreed to in principal at the 1997 United Nations Council of Parties meeting, but has yet to ratify in Congress. Several European nations set similar goals and some have begun action towards meeting them.

The San Francisco target of 20% below 1990 levels is approximately 35% below 2000 levels. Other ICLEI Cities for Climate Protection members such as Seattle, Portland, and Denver have set similar targets and are implementing actions to reach them. While ambitious, this goal is attainable with existing technologies, but will require substantial investments and will require changes in how we operate our businesses and households. IPCC research suggests that we would need to achieve as much as a 60% reduction below 1990 levels in order to reverse global warming and stabilize the climate. This would require radical changes in the transportation and energy infrastructure.

The San Francisco target translates to approximately 2.5 million tons per year reduction from current levels. Chapter 3 describes what actions it will take for San Francisco to reach this goal.

Chapter 3

Actions to Reduce San Francisco's Greenhouse Gas Emissions

3.1 Introduction

Chapter 3 describes how San Francisco can achieve its emissions reduction target of 20% below 1990 levels by 2012. In order to meet this ambitious goal, a comprehensive set of actions must be set in motion. This chapter discusses which existing programs and activities are already reducing emissions, how these actions could be expanded to maximize their climate protection benefits, and what new initiatives city government, businesses and citizens can put in place to meet our greenhouse gas emissions reduction goal.

To develop this list of action items, we have drawn from several related plans and policies governing transportation, energy and recycling in the City, including the City's Sustainability Plan, Electricity Resource Plan, Countywide Transportation Plan, Assembly Bill 939 recycling law, and others.

While the original objectives of most of the existing actions listed here (e.g. reducing air pollution, increasing energy efficiency, increasing recycling) were not explicitly developed to reducing greenhouse gas emissions, they do just that. The Climate Action Plan seeks to reinforce and expand these existing efforts and to link them under the common goal of climate protection.

The actions are organized into four categories—Transportation, Energy Efficiency, Renewable Energy, and Solid Waste—and an estimate of the resulting annual emissions reduction level in 2012 is listed for each set of actions. In some cases, emissions reduction quantification is straightforward (e.g. x gallons of gasoline saved is equivalent to y tons of CO_2 reduced). However, in order to quantify the benefits of the actions, several estimates and assumptions were made (e.g. the average fuel efficiency of cars driven in San Francisco, the percentage of households who would participate in a refrigerator rebate program). Assumptions and quantification methodologies are described in footnotes and in Appendix A.

3.2 Transportation Actions

Introduction

Transportation activities in San Francisco generate approximately 5.1 million tons of CO_2 or 50% of total emissions. Reducing transportation sector emissions is a challenging task because sources are widely dispersed – transportation patterns are the end result of the numerous individual decisions people make about how to get from one place to another. In addition, actions to reduce transportation sector emissions often depend more on policies and programs on the national, state, and regional level than the

local. For example, regional transit services such as Bay Area Rapid Transit (BART) and Caltrain; and the high occupancy vehicle (HOV) lanes on the freeways operated by CalTrans exert considerable influence on transportation choices for those traveling into and out of the City. Federal and state decisions also influence fuel efficiency standards and funding for key transportation programs and infrastructure.

Locally, several different departments and agencies have jurisdiction over transportation policies and services, including the San Francisco Transportation Authority, the San Francisco Municipal Railway (Muni), the Planning Department, the Department of Parking and Traffic, and the Department of Public Works. The City has existing policies in place to support reducing transportation-related greenhouse gas emissions, including those in the Transportation Element of the San Francisco General Plan and the Countywide Transportation Plan. In addition, the 1997 Citywide Bicycle Plan is being updated.

Transportation Actions to Reduce Emissions

One major approach to reducing transportation sector emissions is to reduce vehicle trips by encouraging a shift to alternative modes such as public transit, ridesharing, bicycling, and walking. Typically, mode shift is the result of multiple actions that cumulatively increase the attractiveness of alternatives to driving alone. Improving services, infrastructure, and providing incentives as well as creating disincentives for driving encourages citizens to consider alternate modes of transportation.

Compared with other counties in the region, San Francisco has historically had the lowest rate of driving alone or carpooling, and the highest use of transit and bicycling/walking to commute to work. This is a result of the region's unique geography, limited access points into and out of the city, an extensive transit service, and limited parking (only 48% of commuters who live in San Francisco have free parking compared to 78% region-wide).[60] However, according to census data, the drive-alone rate increased from

Table 3.1 Percentage of San Francisco Residents' Work Trips by Mode

Means of Transportation to Work	1990 Census	2000 Census
Drove Alone	38.5%	40.5%
Carpooled	11.5%	10.8%
Public Transportation (including taxicab)	33.5%	31.1%
Bicycled or Walked	10.8%	11.3%
Motorcycle or Other Means	1.9%	1.6%
Worked at Home	3.8%	4.6%

Source: Census Transportation Planning Package (CTPP 2000). www.transportation.org/ctpp

[60] Commute Profile 2002: A Survey of San Francisco Bay Area Commute Patterns. RIDES for Bay Area Commuters, Inc. October 2002.

1990 to 2000, while the rate of public transportation use and carpooling decreased (table 3.1). This indicates that more must be done to encourage the use of alternative modes.

Another major approach to reducing transportation sector emissions is to modify the vehicles themselves – by improving fuel efficiency and switching to alternative fuel vehicles; as well as by downsizing fleets. The City has very progressive policies for its municipal fleet. However, community-wide changes in the types of vehicles used depend largely on federal and state action.

Recommended transportation sector actions are grouped into six categories, listed in table 3.2. CO_2 reduction has been estimated by category. Specific actions are described below.

Table 3.2 Summary of Transportation Actions and Estimated CO_2 Reductions

Transportation Action Categories	Estimated CO_2 Reduction (tons/year)
A. Increase the Use of Public Transit as an Alternative to Driving	87,000
B. Increase the Use of Ridesharing as an Alternative to Single Occupancy Driving	42,000
C. Increase Bicycling and Walking as an Alternative to Driving	10,000
D. Support Trip Reduction Through Employer-Based Programs	28,000
E. Discourage Driving	155,000
F. Increase the Use of Clean Air Vehicles and Improve Fleet Efficiency	641,000
Total	**963,000**

A. Increase the Use of Public Transit as an Alternative to Driving

Estimated CO_2 Reduction: 87,000 tons

Public transit is an important alternative to driving. San Francisco has many natural incentives for transit use, including high density and limited parking, which have resulted in a very high transit use rate among residents. Census data for 2000 show a transit use rate of 31% in San Francisco, compared with a statewide and national average of only 5%[61] and Bay Area average of approximately 10%.[62] While the number of transit trips has increased over the past decade, transit's share of total trips has decreased. According to Census data, transit use decreased from 35% in 1990 to 31% in 2000. Data from RIDES annual commuter survey show a similar trend.[63]

61 Census Transportation Planning Package (CTPP 2000). www.transportation.org/ctpp.
62 *Commute Profile 2002: A Survey of San Francisco Bay Area Commute Patterns.* RIDES for Bay Area Commuters, Inc. October 2002.
63 Transit comprised 35% of total work trips among San Francisco residents in 1993 and 32% in 2002, with a peak of 41% in 1996.

Public transit can attract more riders in a variety of ways – increased reliability, more frequent service, more routes, better safety and customer service, and lower fares. All of these factors are contingent on the amount of funding available for public transportation. More funding would allow transit operators to replace old vehicles, add vehicles to busy routes, add new routes, invest in capital improvements, and keep fares low.

Land use patterns also affect transit use. Transit-oriented development (TOD) concentrates development around transit centers, reducing the need for vehicle trips and increasing the use of transit. Because San Francisco has already been built out, most opportunities to apply TOD strategies can only be applied to redevelopment of existing sites.

Existing Actions

San Francisco Municipal Railway (Muni), a system of buses, electric trolleys, electric rail cars, historic streetcars, and cable cars provides extensive coverage of the city. Muni operates approximately 80 lines, with routes within one-quarter mile of nearly every location in San Francisco. Fares are affordable[64] and service is reasonably reliable.[65]

Regional transit, serving passengers traveling into and out of the City includes various bus and rail operators—BART, Caltrain, Golden Gate Transit, Samtrans and AC Transit. Much of the local and regional service has been planned to coordinate multi-modal connections between Muni, BART, and Caltrain. Numerous ferries also provide service, connecting San Francisco with several cities around the Bay.

The City's *Transit First Policy*, passed in 1973 and incorporated into the City Charter, gives priority to public transit investments and provides street capacity and parking policies to discourage increases in automobile traffic. This policy has guided investment in transit priority improvements, such as designated transit lanes and streets and improved signalization, and increased transit service to meet the needs generated by new development.

San Francisco's Downtown Transportation Impact Fee (DTIF), implemented in 1981, has helped fund increases in transit services to meet peak demand generated by new offices in the downtown area. This $5 per square foot fee is assessed on new office construction and commercial office space renovation within a designated downtown district and is paid directly to the Municipal Transit District. In the first seven years, $82 million in fees were collected.

Through its Better Neighborhoods Program, the City has been pursuing transit-oriented development, which includes using an extensive community involvement process to redevelop areas around BART

64 One-way base fares are currently $1.25, one of the lowest fares of any major transit system in the country.

65 Muni was plagued by on-time performance problems in the mid to late 1990's, which negatively impacted ridership. Since then, service has improved considerably. The annual Muni Riders' Survey conducted by Rescue Muni shows a significant drop in the percentage of passengers delayed, from a high of 28% in 1998 to 14% in 2002 (Rescue Muni. *Transfer*. No. 17, July 2002).

stations. The resulting improvements are designed to better integrate the stations into the surrounding neighborhoods and increase access to goods and services around the stations, increasing ridership and reducing the need for riders to make vehicle side trips for errands.

Proposed Actions

- **Expand Local Transit Service.** Improve local service and attract more riders by increasing frequency and adding more routes. Increasing frequency, particularly on crowded routes and at peak times, was one of the top local transit improvements identified in the San Francisco Transportation Authority's 1997 Citywide Mobility Study.

- **Increase Funding for Major Local Service Improvements.** Muni's *A Vision for Rapid Transit in San Francisco* outlines several major long-term projects, including construction of new rail lines and bus rapid transit features such as dedicated busways and signal priority on heavily traveled corridors. These features would allow the system to accommodate higher volumes, reduce trip times, and increase passenger comfort and convenience, and thus attract more riders. Increased funding is needed in order to implement these projects.

- **Expand and Improve Regional Service and Connections.** Improve service and attract more riders on regional services such as BART, Caltrain, and ferries by extending service hours, increasing frequency, adding new routes, and keeping fares low. Improve inter-modal connections between local and regional service.

- **Develop Regional Pass System.** The Translink regional pass system, similar to pass systems in other major metropolitan areas, is currently in the pilot phase and scheduled to be implemented by BART and Muni within the next few years. By reducing the number of different passes and tickets required on transit systems in the Bay Area, Translink will facilitate intersystem transfers and encourage transit users. Speedy implementation of Translink on all Bay Area transit systems should be encouraged.

- **Improve Safety, Customer Service and User-Friendliness of Muni.** Improve local service and attract more riders with additional shelters and benches, better lighting at stops, and clearer street-level designation of routes and stops. Ensure that Muni maps are free and widely available for both residents and visitors. Improve customer service by training operators and attendants to be more courteous to passengers and provide better information, especially during service disruptions.

- **Implement "Smart Bus" Technology.** Recent technological innovations have coupled Global Positioning Systems (GPS) with electronic displays at transit stops to provide "real time" data to passengers. These tracking systems not only allow riders to know exactly when the next vehicle will be arriving, but also enables the system operator to track, schedule, and repair vehicles in service. Providing better information to passengers about scheduled arrivals can result in dramatic increases in passengers' perceptions of the service, even if the actual service provided is the same in terms of

frequency and on-time arrivals. Similar systems implemented in Portland Oregon and other cities have resulted in increased ridership and lower operating costs. Muni has invested in this technology and steps should be taken to ensure that its primary purpose is to improve passenger information and customer service, rather than just operational tracking.

- **Increase Marketing and Promotion of Public Transit.** Increase awareness of public transit through advertising campaigns and internal promotion at work sites. Improve public access to transit information through promotion of the Metropolitan Transportation Commission's (MTC) 511 toll-free phone and web service providing transportation information, and the Take Transit Trip Planner on the web.

- **Expand Transportation Impact Fee Assessment.** Apply the current transportation impact fee to all of the downtown commercial space that benefits from transit, and not just to new construction. Such a fee would provide more predictable and higher levels of revenue to San Francisco's transit system.

- **Create a Free Tourist Shuttle System.** Create a free shuttle system, similar to those in other cities, with a fixed route and stops at a variety of popular tourist destinations. This would eliminate vehicle trips and parking spaces at popular destinations and provide an easy transportation alternative for tourists who are uncomfortable with a complex transit schedule.

B. Increase the Use of Ridesharing as an Alternative to Single-Occupancy Driving

Estimated CO_2 Reduction: 42,000 tons

Ridesharing provides another alternative to driving alone. In 2002, carpooling and vanpooling comprised 13% of San Francisco residents' commute trips and 18% of commute trips Bay Area-wide. Much ridesharing occurs spontaneously among family, friends, co-workers, and/or neighbors. Ridesharing is also facilitated by the ride-matching and referral services of RIDES for Bay Area Commuters, and by an informal system known as "Casual Carpool."

Existing Actions

RIDES provides an easy-to-use, web-based ride-matching service for residents throughout the Bay Area that links drivers and riders, facilitating the formation of carpools and vanpools. RIDES also provides referral services for vanpool vehicle leasing.

Many commuters from the East Bay find their ride through Casual Carpool, an informal system that developed more than 20 years ago so commuters could access HOV lanes on the highway and bypass the toll plaza on the Bay Bridge, saving both time and money. Drivers and riders congregate at one of the more than 19 designated pick-up locations for the morning commute and form carpools of at least 3 people per car, the minimum needed to zip though the toll plaza. Casual Carpool also exists for the return commute, although it is less popular.

Ridesharing is facilitated by the presence of HOV lanes on several major regional highways and free bridge tolls during peak for carpools and vanpools, both of which reduce the time and cost of the commute, compared with driving alone.

Preferential parking also provides an incentive. The City and County of San Francisco provides designated vanpool spaces at three different locations in the City and allows vanpools to park free at any city meter with a time limit of one-hour or more.[66] The City also provides discounted parking for carpools at many of its City-owned garages located throughout the City, and employers can apply for preferential carpool spaces near their worksites.[67]

Proposed Actions

- **Increase the Number of Miles of HOV Lanes.** HOV lanes can significantly reduce commute times and are critical for increasing the attractiveness of ridesharing over driving alone.[68] More HOV lanes would improve this incentive and send a strong message to drivers.

- **Expand Carpool and Vanpool Designated Parking.** Preferential parking for carpool and vanpool vehicles provides a strong incentive for ridesharing. Increase the use of the City's existing programs and designation of additional carpool and vanpool spaces through outreach to large employers and coordination with the Department of Parking and Traffic.

- **HOV Requirements in New Large Developments.** To facilitate ridesharing as a viable and attractive option, the City can ensure that accommodations for ridesharing are included in any new large development or renovation. Requirements could include designating a certain percentage of parking spaces for high-occupancy vehicles, providing larger parking spaces to accommodate vans, and adequate passenger loading/unloading and waiting areas.

- **Implement School Ridesharing Program.** Introduce a formal program to assist parents in forming carpools to drop off and pick up kids at school.

- **Increase Marketing and Promotion of Ridesharing.** Increase the use of carpooling and vanpooling as an alternative to driving through additional outreach and education on the benefits of ridesharing and the services and incentives available.

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66 Users must display a valid vanpool parking permit, available from the City's Department of Parking and Traffic for $27 per year.

67 Carpools of three (3) persons or more can receive a 50% discount on the monthly parking rate in City-owned garages. Annual carpool permits are available for $27 per year. Spaces are first-come, first-served.

68 According to RIDES 2002 Commute Profile, approximately 29% of ridesharing commuters say they would not rideshare without HOV lanes.

C. Increase Bicycling and Walking as an Alternative to Driving

Estimated CO_2 Reduction: 10,000 tons

Shifting trips from driving to bicycling or walking reduces CO_2 emissions. San Francisco has typically had relatively high rates of bicycling and walking due in large part to a high population density, mild weather, and limited parking, which discourages car ownership. According to Census data, San Francisco residents make approximately 11% of their work trips by bicycling or walking.[69]

Bicycling and walking could be increased through provision of better infrastructure, improved safety, and incentives. A 1997 survey of residents identified several priorities for bicycling and pedestrian improvements, including: more bicycle routes/lanes/paths; cleaner streets; better street and sidewalk maintenance; wider bike lanes; and more lighting.[70]

Existing Actions

San Francisco does much to improve conditions for bicycling and walking. The City has added myriad new bike lanes, paths, and routes and currently has approximately 205 miles of designated bicycle network.[71] The City has improved safety and access to walkways by repairing sidewalks and installing video cameras at traffic lights to record red light runners, and has worked closely with bicycling and pedestrian groups in the City on safety and access issues. Working with the San Francisco Bicycle Coalition, the City developed a bicycle safety brochure that includes maps of bike lanes, safe routes, and basic rules of the road. Bike to Work Day is a major annual event promoting bicycling for commuters.

Bicycle passage is facilitated by rules allowing bicycles on several major transit providers, including BART, Caltrain, and some Muni buses. To improve parking, the City's Department of Parking and Traffic annually installs an average of 300 new bike racks throughout the City. In addition, the City provides bicycle racks and/or lockers in several of the City-owned parking garages and is helping to promote bike stations to provide secure parking at major transit locations.

Proposed Actions

- **Continue to Increase the Number of Bicycle Lanes, Routes, and Paths.** Lack of adequate infrastructure is a major barrier to bicyclists. Accelerate efforts to expand the current system and include mandatory bicycle lanes in future street improvements.

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69 Figures were similar for both 1990 and 2000.
70 San Francisco Transportation Authority's 1997 Citywide Mobility Study.
71 This includes 34 miles of streets with bicycle lanes, 88 miles with bicycle routes (signed), 54 miles with wide curb lanes (signed), and 29 miles of bicycle paths (2002 figures. Department of Parking and Traffic website: www.sfgov.org/site/dpt_index.asp.

- **Continue to Improve Safe Access and Passage on Pedestrian Walkways.** Increase sidewalk maintenance, widen sidewalks, add and improve crosswalks, increase the use of "countdown" crosswalk signals, and implement traffic calming actions in heavily used pedestrian areas.

- **Improve Bicycle Access to Transit.** Currently bicycles are only allowed on particular train cars and buses at particular times, limiting access to transit, particularly during peak hours. Transit agencies should expand the times and available space for bicycles on buses and trains.

- **Continue to Improve and Expand Bicycle Parking Facilities.** Augment existing parking with new bicycle racks, lockers, and bike stations through requirements on new developments, and/or grant programs for existing facilities.

- **Increase Workplace Shower Facilities for Bicyclists.** Facilitate bicycle commuting by requiring new developments to provide shower and changing facilities, and/or offer grant programs for existing buildings to add shower facilities for bicyclists.

- **Increase Marketing and Promotion of Bicycling.** Increase awareness and education about bicycling as a transportation option through expanded advertising and more events.

Encouraging Bicycling in Municipal Operations

City Hall Bicycle Room. This secure bicycle parking facility serves employees working in the Civic Center area, and offers showers and lockers for bicyclists.

Fleet Replacement with Bicycles. The City has obtained several grants over the years to provide bicycles as replacements for vehicles on the job. Nearly 200 bicycles were provided for San Francisco Police Department officers and approximately 40 bicycles and 20 utility trailers were provided to gardeners in the Recreation and Parks Department. The Police Department now regularly purchases bicycles for its officers to use on the beat.

Proposed: *The City should continue these fleet replacement efforts with the Recreation and Parks Department and other appropriate departments.*

D. Support Trip Reduction through Employer-Based Programs

Estimated CO_2 Reduction: 28,000 tons

Employer-based strategies can be an effective way to reduce vehicle trips because a large percentage of trips are work-related and workers typically travel to the same place at about the same time every day, making it easier to find a practical substitute to driving. Employers are motivated to provide incentives for their workers as part of their overall benefits package to help attract and retain workers, and because

of the increased worker productivity achieved through reduced commute time and related stress.

In terms of financial incentives, federal law allows employers to provide "commuter tax benefits" through which employees can deduct up to $100 per month, pre-tax, to use for transit and vanpool expenses saving employees up to 40% on their commute costs. Employers receive a savings on payroll taxes and they can further increase the incentive to workers by subsidizing the expenses. Another financial incentive is "parking cash-out," through which employers provide a payment to employees who voluntarily forgo their parking space at a rate equivalent to the cost of the subsidized parking space. This type of program is appropriate when employers must lease parking spaces for their employees.

Commute Assistance Program for City & County Employees

Commuter Tax Benefit Program. All City and County employees are eligible for pre-tax payroll deductions for transit and vanpool expenses. As of 2003, approximately 2,400 employees were enrolled.

Hall of Justice Employee Shuttle. Transporting employees between the Civic Center station and the Hall of Justice during the morning and evening commutes, this shuttle provides nearly 20,000 passenger-trips a year.

San Bruno Videoconferencing Project. Utilizing advanced technology, the City's criminal justice staff can privately confer with clients in the San Francisco County Jail in San Bruno without making the 40-mile round trip drive. The program is eliminating an estimated 600,000 vehicle miles traveled per year.

Compressed Work Week. Some departments allow employees to work a "9-80" schedule, receiving one day off every other week in exchange for working an extra hour every day.

Employer sponsored shuttles between transit stations and work sites can help to increase the attractiveness and viability of transit. Guaranteed ride home programs can provide the insurance of a free or low-cost ride home in cases of emergency. On-site facilities such as daycare centers and lunchrooms reduce the need to travel by car during the day to run errands. Access to company vehicles for meetings and errands also reduces the need for workers to commute by car when if they make trips from work during the day.

Telecommuting and compressed work weeks (working longer hours but fewer days in a week) allow workers to eliminate work trips altogether.[72] Another way to reduce the demand for trips is through teleconferencing or videoconferencing in place of in-person meetings that require travel.

Existing Actions

Employers throughout the City utilize the strategies described above to varying degrees. RIDES conducts outreach to employers to educate them about the strategies available and assist them with implementation. Many large employers and institutions in the City, such as hospitals and colleges, operate employee shuttles between BART stations and worksites.

[72] A 1995 study for the California Air Resources Board showed that employees on compressed work weeks reduce their number of trips by 0.5 to 0.8 per week and their miles traveled by 13 to 20 per week as compared to employees on regular five-day work weeks (Philip Winters, Center for Urban Transportation Research).

To eliminate the need for employees to drive to work in order to make midday trips, employers can join City CarShare, a local non-profit organization that provides a network of vehicles parked in neighborhoods throughout the City. Vehicles can be reserved on an as-needed basis and fees are paid by the hour and by the mile. City CarShare is open to residents as well as employers and their employees.

The City encourages alternative commuting downtown through its requirement that employers in specifically designated commercial buildings[73] provide on-site transportation management services, including a transportation management coordinator (TMC) to coordinate alternative commuting promotional activities and services, and conduct employee transportation surveys. The San Francisco Transportation Management Association (TMA) provides a networking forum and support services for all of the TMCs.[74]

Proposed Actions

- **Expand Employer Commute Assistance and Outreach.** Increase commute assistance and outreach for employers in San Francisco to educate them about the various trip-reduction strategies available (commuter tax benefits, parking cash-out, telecommuting, etc.), increase marketing of alternative modes to employees, and connect them with services available. Expand RIDES' outreach services or establish a new San Francisco-based outreach program.

- **Implement Countywide Guaranteed Ride Home Program.** San Francisco is currently one of the only counties in the Bay Area that does not offer a guaranteed ride home program. A relatively low-cost method of supporting alternative mode use, guaranteed ride home programs provide an "insurance policy" against being stranded in cases of illness, family crisis, rideshare vehicle breakdown, etc.

- **Conduct General Marketing and Promotion of Commuter Services.** By generating employee demand for programs and services, employers will be encouraged to provide more incentives for their employees to use alternative modes. Develop advertising and marketing campaigns to promote commuter tax benefits and other employer-based incentives and services.

- **Expand Employer Transportation Management Requirements.** Mandatory employer trip reduction programs yield significantly greater benefits than voluntary programs.[75] The current requirements should be expanded to include other areas of the city and implementation of requirements for existing developments should be explored.

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[73] Includes all "C-3" designated commercial buildings with at least 100,000 square feet of office space in the downtown area, or at least 25,000 square feet in the South of Market area.

[74] San Francisco Department of City Planning. *Transportation Management Programs in Greater Downtown: Developer's Manual for Procedures and Performance Criteria.* January 1988. San Francisco Transportation Authority. *Congestion Management Program*. Nov. 2001.

[75] An unpublished report prepared for the Transit Cooperative Research Program states that employers engaging in [transportation demand management] under a legal/regulatory mandate produced trip reductions that were three times as great as those performing voluntary efforts (24.5% vs.7%) (Eric N. Schreffler. "What Makes for Successful TDM Programs?").

E. Discourage Driving

Estimated CO_2 Reduction: 155,000 tons

In addition to incentives and services designed to *encourage* the shift to alternative modes, strategies that create *disincentives* to single-occupancy driving and vehicle ownership can also be effective. This can be accomplished through restrictions, as well as setting price signals. For example, the cost and availability of parking can have a huge impact on driving behavior and vehicle purchasing decisions.

Motor vehicle revenue such as gas taxes and registration fees cover only 10 to 40% of the costs incurred by local governments in providing the infrastructure, maintenance and services needed for automobiles.[76] Setting price signals ensures that automobile drivers pay more of the full environmental and social costs of driving.

While price signals can be a powerful mechanism to discourage driving and reduce vehicle miles traveled, they can also be very controversial and politically difficult to implement. In particular, pricing can be perceived as having a disproportionate impact on low-income individuals. It is imperative to have a good idea of demand before implementing pricing or restrictions.

Existing Actions

San Francisco already has a great deal of experience with some conventional strategies, including bridge tolls, parking fees, and residential parking permits. A 25% tax on parking fees collected by private garages and lots provides a significant source of revenue for the City's public transit system. Residential parking permits limit the amount of available parking by controlling spillover parking from adjacent areas.

City Carshare supports the choice to not own a car by providing alternative access to a vehicle when one is needed. Evaluations conducted for City CarShare indicate that people who do not own a car drive less and take alternative modes more often.

Proposed Actions

- **Increase the Gas Tax.** Adjusted for inflation, gasoline prices in the U.S. were lower in 1998 than at any other time during the past fifty years. Even though fuel costs average only about 12% of the cost of owning and operating a car, drivers tend to consider gasoline prices to be the main indicator of their cost

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[76] José A. Gomez-Ibañez. "Estimating Whether Transport Users Pay Their Way: The State of the Art," in The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement. David L. Greene, et. al. Berlin: Springer. 1997.

Mark A. Delucchi. "The Annualized Social Costs of Motor-Vehicle Use in the U.S. Based on 1990-91 Data: Summary of Theory, Data, Methods, and Results," in The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement. David L. Greene, et. al. Berlin: Springer. 1997.

Federal Highway Administration, U.S. Department of Transportation. 1997 Federal Highway Cost Allocation Study Final Report. Washington D.C. 1997.

of transportation. Europeans face steep gasoline taxes that provide strong disincentives to driving.[77]

- **Implement Congestion Pricing and Cordon Tolls.** To discourage driving, the City could implement congestion pricing on bridges or develop cordon tolls for entrance into designated areas of the City, such as downtown. These strategies have been successful in Norway and Singapore and were recently introduced in downtown London, England.[78]

- **Cap or Reduce the Number of Parking Spaces.** Change requirements for new developments to lower parking minimums or switch to parking maximums. Reduce parking in areas well-served by transit. Restrict the number of parking permits issued to the number of on-street spaces and consider charging market rates. Some of these actions are currently being considered as part of the City's Better Neighborhoods Program.

- **Collect Parking Lot Taxes from Hotels.** Because the City considers hotel guests "temporary residents," it exempts them from parking lot taxes. By applying these taxes to hotel guests, the City would encourage visitors not to drive while in town, and generate additional revenue that could be used to fund transportation alternatives, such as increased Muni service or a free tourist shuttle.

F. Increase the Use of Clean Air Vehicles and Improve Fleet Efficiency

Estimated CO_2 Reduction: 641,000 tons

The Corporate Average Fuel Economy (CAFE) standards set minimum levels of fuel efficiency for different categories of vehicles. Increasing CAFE standards would have perhaps the largest impact on reducing greenhouse gas emissions of any single transportation action. While the City can advocate for a shift in these standards and create a demand for more fuel-efficient vehicles, increasing CAFE standards requires action on the federal level through the U.S. Environmental Protection Agency.

Aside from changing CAFE standards, fuel efficiency can be improved through fleet management policies. Purchasing the most fuel-efficient vehicle available in a given vehicle class can help to reduce greenhouse gas emissions. Purchases can be geared toward what the vehicle will be used for on a regular basis rather than the exception, while still providing access to a range of different-sized vehicles. This ensures access to larger vehicles when needed while allowing an employees to use more fuel-efficient vehicles for the majority of trips.

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[77] In some states, local governments can raise gas taxes on their own. Oregon gives local governments the right to raise local gas taxes, subject to voter approval. Current local gas taxes range from $0.01 to $0.15 per gallon (compared to the federal tax of $0.183 per gallon and Oregon's state tax of $0.24 per gallon.) However, these are relatively small tax increases that are not likely to do much to reduce vehicle travel. Studies show that increased gas taxes on the order of $0.25-0.50 per gallon would be necessary to substantially affect travel behavior. Obtaining changes in California state law and voter approval for a local gas tax surcharge on the order of $0.50 per gallon would be very difficult in most jurisdictions under present circumstances, and such a tax would not work for a single municipality in a larger urban area because of competition from municipalities without the tax.

[78] Traffic levels fell by an estimated 25% on the first day of London's congestion pricing scheme (BBC News. http://news.bbc.co.uk/1/hi/england/2772583.stm. February 18, 2003.)

Alternative Fuel Vehicles in Municipal Operations

City Fleet Vehicles. As a result of Chapter 4, the Healthy Air and Smog Prevention Act, approximately one quarter of all City vehicle purchases over the past three fiscal years have been AFV's. Currently, the City has almost 600 alternative fuel vehicles in its fleet, including 368 CNG, 97 electric, 55 bi-fuel, 52 hybrid, and 20 propane vehicles.

Private Contractor Fleets. The City has also worked with its major service contractors to switch to AFVs, including an ambitious plan with its garbage/recycling collection contractor to convert to CNG and LNG heavy-duty vehicles. This includes the long haul transfer trucks that travel over 600 miles daily from the City's transfer station to the landfill site, as well as curbside collection trucks.

Public Transit Vehicles. The City's public transit system has historically had a high percentage of AFV's. Muni was originally an all-electric fleet. The current fleet is approximately 50% electric.

Right Sizing and Down Sizing of the City Fleet. The City is in the process of implementing citywide carshare practices in its fleet operations. The City currently has two vehicle pools in operation that serve a number of City department staff. Many of the vehicles in the pools are AFVs. The City's Green Fleets team continues to seek additional vehicle pool locations.

Proposed: *The City should continue implementation of Chapter 4, purchasing AFVs for the City fleet, as well as installing AFV fueling stations (especially those with public access), facilitating conversion of private sector fleets, right sizing and down sizing the City fleet, and creating carsharing vehicle pools. Muni should move forward with replacement of its old and highly polluting diesel buses with cleaner technologies.*

As mandated in Chapter 4, the City should also develop a plan to encourage the County's residents to purchase AFVs and continue to support the efforts of the San Francisco Clean Cities Coalition to do likewise.

The City should participate in demonstration projects to further advance the use of fuel cell technology and position itself to take advantage of future advances.

Rapidly changing technology in the area of alternative fuel vehicles (AFVs) has produced a wide range of alternatives to conventional gasoline and diesel-powered vehicles. Replacing conventionally fueled vehicles with AFVs can yield significant emissions reductions.[79] Currently viable alternative fuel technologies include compressed natural gas (CNG), liquefied natural gas (LNG), electric vehicles (EV), and hybrid-electric vehicles. Hydrogen vehicles – such as those that use fuel cells or that burn hydrogen in internal combustion engines – though not currently viable, are being developed by a variety of automakers.

Development and implementation of AFV technology is driven largely by state requirements. California has been a leader in the nation, beginning with the California Air Resource Board's adoption of the 1990 Low-Emission Vehicle (LEV) regulation requiring auto manufacturers to produce vehicles that meet increasingly stringent air quality standards. Of all vehicles sold in California by auto manufacturers, 2% were to be Zero-Emission Vehicles (ZEV) by 1998 and 10% were to be ZEV by 2003.[80]

Existing Actions

Although the City cannot directly affect CAFE standards, the Board of Supervisors passed a resolution supporting increased CAFE standards in the early 1990s. In 1999, the Board adopted the Healthy Air and Smog Prevention Act, which became Chapter 4 of the City's Environment Code. This ordinance requires that all new purchases or leases of passenger vehicles and light duty trucks must either be rated as ultra-low emission vehicle (ULEV) or ZEV (at least 10% were to be ZEV by July 1, 2000). Requirements were also set forth for medium and heavy-duty vehicles and motorized equipment, and for phasing out all highly polluting vehicles and equipment.[81]

The City's Green Fleets team coordinates procurement and purchasing of AFVs and processes departmental requests for exemptions. It also applies for specific federal, state and regional funds on a project-by-project basis and helps subsidize the conversion of private sector fleets. One of the barriers to purchasing AFVs is the lack of vehicles available on the market with the needed specifications, as manufacturers are often unwilling to produce certain types of vehicles unless they are certain that sufficient demand exists. The Green Fleets team works closely with manufacturers to facilitate

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79 Emissions reductions achieved with natural gas vehicles depend on the vehicle type and engine efficiencies. Natural gas is a source of methane, which offsets some of the CO_2 savings. Total greenhouse gas emissions savings for light duty natural gas vehicles are in the range of 7% to 20%. Without additional controls, heavy-duty natural gas vehicles may actually produce more greenhouse gas emissions than diesel vehicles. Emissions reductions achieved with electric vehicles depend on the source of electricity. All of these technologies are changing rapidly, and there are indications that greenhouse gas emissions savings with AFVs will increase in the future.

Greenhouse Gas Emission Reductions and Natural Gas Vehicles: A Resource Guide on Technology Options and Project Development. National Energy Technology Laboratory. June 2001. www.ccities.doe.gov/international/pdfs/climate_change_guide.pdf

Topical Reports: Alternative Fuels for Fleet Vehicles. Pacific Northwest Pollution Prevention Resource Center website. http://www.pprc.org/pprc/pubs/topics/altfuels.html.

80 Auto industry lobbyists have succeeded in relaxing many of these requirements over time and the regulatory landscape is still in flux.

81 Exemptions are granted for public safety vehicles, public transportation fleet buses, or when the specific types of vehicles needed are not available, would be cost prohibitive, or fueling or maintenance infrastructure is not available. (City and County of San Francisco Environment Code, Chapter 4.).

development of needed vehicles and stimulate the market for AFVs.

Adequate fueling infrastructure is a key component to making AFV fleets viable and the City has contributed grant funds towards the development of three CNG fueling facilities. It continues to seek funds to expand this CNG fueling infrastructure and has also been successful in developing a number of electric vehicle charging stations both in San Francisco and throughout the Bay Area.

City CarShare provides a community-wide solution to vehicle fleets. By providing a network of vehicles in locations around the city, available for reservation on an as-needed basis, residents can utilize small, fuel-efficient and electric vehicles and reduce car ownership. City CarShare is also available for use by businesses and public entities.

Proposed Actions

- **Lobby for Increased CAFE Standards.** The City should continue to advocate for higher CAFE standards by lobbying regional environmental agencies as well as its state and national representatives.

- **Support LEV/ZEV Sales Mandates in California.** Support efforts to maintain state requirements of automakers to produce or sell vehicles with no or very low emissions.

- **Support State-Level Development of Greenhouse Gas Emissions Standards.** Support state efforts to develop carbon pollution (greenhouse gas) standards for vehicles, such as Assembly Bill 1493.[82]

- **Implement Tiered Vehicle Registration Fees Based on Vehicle Size or Emissions.** Discourage the purchase of high emission vehicles and encourage the purchase of low and zero emission vehicles by implementing a tiered vehicle registration fee system based on vehicle size or greenhouse gas emissions, as listed in the US EPA's annual Green Vehicle Guide.

- **Introduce Tiered Parking Rates Based on Vehicle Size.** A tiered fee structure for residential parking permits and in parking garages based on vehicle size and/or emissions would encourage the purchase of smaller, more fuel-efficient (and less polluting) vehicles while discouraging larger and higher emission vehicles, such as Sports Utility Vehicles (SUVs).

- **Promote Bridge Toll and HOV Lane Waivers for AFV's.** Increase awareness of the existing program that allows AFVs with special stickers issued by the California Air Resources Board to use HOV lanes and cross for free on Caltrans-operated bridges.[83] Expand the program to include the Golden Gate Bridge.

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[82] Assembly Bill 1493, authored by Fran Pavley (D-Agoura Hills), requires the California Air Resources Board to develop carbon pollution (greenhouse gas) standards for vehicles in model year 2009 and beyond. The standards will apply to automakers' fleet averages, rather than each individual vehicle, and carmakers will be able to partially achieve the standards by reducing pollution from non-auto sources (e.g. factories, etc.).

[83] Under CARB's policy AFVs include battery electric vehicles and natural gas vehicles (including CNG, LNG and propane). Hybrids are excluded.

- **Lobby Regional Agencies to Open Grants for Private Sector Uses.** Current grant programs are restricted to public sector operations. However, tremendous potential exists to influence private sector use of AFVs and current limited efforts could be greatly expanded if grants were made available to private sector operations.

- **Support Efforts to Expand City CarShare.** Increase accessibility and availability with additional locations and vehicles, particularly fuel-efficient vehicles and AFVs.

- **Promote and Enforce Bus Idling Traffic Code.** The Department of Parking and Traffic (DPT) is responsible for enforcing the bus idling rule that the City passed in 1991. However, the rule is not well known and violations are often not reported to DPT. The City should disseminate information about this law to businesses that may have the most impact on bus idling violations, such as hotels, tourist destinations, and other places where buses are likely to stop and wait for passengers to load or unload.

3.3 Energy Efficiency Actions

Introduction

In San Francisco, Pacific Gas and Electric Company (PG&E) provides energy to commercial and residential buildings, while the City's Hetch Hetchy Water and Power[84] provides electricity to municipal buildings and facilities such as hospitals, fire stations, and the airport. Similarly, energy efficiency programs and services in the private sector are generally managed by PG&E, while municipal buildings are served by Hetch Hetchy programs.

A Public Goods Charge (PGC) is added to PG&E's customers' monthly energy bills to fund energy-efficiency and renewable energy programs. About $8 million[85] is collected annually from San Francisco rate-payers to fund these programs, which PG&E administers under the direction of the California Public Utilities Commission (CPUC). Ongoing demand-side management (DSM) programs administered by PG&E over the last two decades have helped to keep San Francisco's growth in demand for electricity to a minimum. The City's municipal energy efficiency programs are currently funded through a combination of Hetch Hetchy revenue, state grants and loans, and the City's General Fund at approximately $5.5 million annually. In 2001, the City's Department of Environment (SF Environment) received $7.8 million of state funds to manage an energy efficient lighting retrofit program for small businesses in San Francisco.

Law and policy mandates that govern energy efficiency implementation in San Francisco include Title 24 State Energy Code[86] and appliance efficiency standards, both set by the California Energy Commission

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[84] Hetch Hetchy Water and Power is a City agency governed by the San Francisco Public Utilities Commission.
[85] CPUC Energy Efficiency OIR. PG&E Data Response R.01-08-028. 2/7/03. Five year average 1998-2002.
[86] 2001 Energy Efficiency Standards for Residential and Nonresidential Buildings. California Energy Commission. P400-01-024.

(CEC); City ordinances including the Green Building Ordinance, and Residential Energy Conservation Ordinance (RECO); and City energy policies such as those set forth in the Energy Policy of the City's General Plan, the 1997 Sustainability Plan, and the 2002 Electricity Resource Plan.

One of the goals of the Electricity Resource Plan is to maximize energy efficiency in San Francisco. The Plan recommends that the City "periodically review and set annual targets for increasing the efficiency of electricity use and the amount of electricity produced by renewable sources of energy so that ultimately all of San Francisco's electricity needs are met with zero greenhouse gas emissions and minimal impacts on the environment".[87] Goals include 107 megawatts of electric demand reduction and 759 gigawatt-hours of energy efficiency by 2012. In order to reach our 2012 greenhouse gas reduction target, San Francisco must exceed these goals, and corresponding accelerated actions for increasing natural gas efficiency must also be put in place.

The potential for CO_2 reductions though electricity and gas savings in San Francisco's buildings is tremendous. Key actions required to reach this potential include incorporating policies in both the private and public sectors such as designing new buildings beyond code, implementing energy efficient retrofit projects in existing buildings, and promoting employee energy awareness.

Individual actions such as purchasing energy efficient appliances and practicing conservation in our homes are also important components in reducing San Francisco's building-generated greenhouse gas emissions.

Reducing electric demand means in-city power plants run less, creating fewer emissions. Investments in energy efficiency and practicing conservation are generally cost-effective, paying for themselves many times over. The challenge is to increase the pace of these investments. The City is engaged in cooperative efforts with PG&E, state agencies, community groups, and the business community to enable San Francisco's businesses and residents to better take advantage of existing energy efficiency programs, and to design new programs to serve their needs.

Energy Efficiency Actions to Reduce Emissions

To meet our emissions reduction goals, San Francisco must accelerate the pace of implementation of energy efficiency programs for existing and new buildings. Energy efficiency programs fall into three broad categories: incentives and technical assistance; education and outreach; and legislation, codes and standards.

Proposed actions will include continuation and expansion of existing programs, as well as new initiatives designed for San Francisco's unique populations, building types, summer and winter peak periods, and end uses, and implemented in cooperation with PG&E or by the City.

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87 Electricity Resource Plan: Choosing San Francisco's Energy Future December 2002. www.sfenvironment.org, www.sfenergy.org

Recommended energy efficiency actions are grouped into three categories, listed in table 3.3. CO_2 reduction has been estimated by category.[88] Specific actions are described below.

Table 3.3 Summary of Energy Efficiency Actions and Estimated CO_2 Reductions

Energy Efficiency Action Categories	Estimated CO_2 Reduction (tons/year)
A. Increase Incentives, Direct Installation and Technical Assistance	
Residential Buildings	222,000
Commercial Buildings	433,000
Municipal Buildings	45,000
B. Expand Education and Outreach	36,000
C. Strengthen Legislation, Codes and Standards	65,000
Total	**801,000**

A. Increase Incentives, Direct Installation and Technical Assistance

Incentives programs encourage investments in energy efficiency by lowering the consumer's cost of implementing energy efficiency actions. Incentives can take the form of direct rebates to customers or manufacturers, low-interest loans, or payments to customers or energy services companies for delivered energy savings. The major types of incentives are either "prescriptive" programs which offer rebates on specific items such as electronic ballasts for light fixtures or high efficiency motors, or "performance" programs which offer a payment for each kilowatt-hour or therm saved in the first year after installation of new equipment.

Often provided in conjunction with incentives programs, technical assistance includes energy management services such as energy audits, design assistance, and other services directly to customers to help them implement energy projects. These programs consist of actions that target the following types of buildings:

- Residential Buildings (including single-family and multi-family homes)
- Commercial Buildings (such as offices, restaurants, hotels, colleges and warehouses)
- Municipal Buildings (such as fire stations, libraries, hospitals, recreation and convention facilities)

"Upstream" programs are designed to increase the availability of efficient technologies to consumers through working with research and development facilities such as the U.S. Department of Energy to develop them, and by providing incentives to product manufacturers to produce and distribute them.

[88] The energy efficiency programs and actions described here target electricity savings (measured in gigawatt-hours (GWh)– millions of kilowatt-hours, natural gas savings (measured in therms) or both. The estimated cumulative amount of greenhouse gas emissions reduced as a result of these actions is expressed in tons of carbon dioxide (CO_2).

Residential Buildings

Estimated CO_2 Reduction: 222,000 tons

Existing Actions

PG&E's residential energy efficiency programs serve both single family and multifamily buildings. These include incentives such as rebates on purchases of high efficiency appliances, compact fluorescent lamps and high efficiency central heating and cooling systems; incentives for comprehensive home improvements; services to facilitate purchase of Energy Star rated homes; and upstream programs including incentives for manufacturers and distributors. PG&E uses media, bill inserts, and their website for public education, and classes at their energy centers for training contractors, architects, and other building professionals.

PG&E and SF Environment's joint Peak Energy Program (SF PEP) targets multi-family buildings, as well as residents of single-family homes in the Bayview-Hunters Point area who are elderly, disabled, or low income. These programs focus on lighting, and coin-operated washing machines in multifamily complexes. The program also exchanges old halogen torchiere lamps for free new efficient fluorescent models.

Replacing Old Refrigerators

A new high efficiency refrigerator can be up to 25% more efficient than a refrigerator built in 1990 and 50% more efficient than a unit manufactured in 1980. The most efficient Energy Star models available are 15-20% more efficient than the models meeting minimum standards.

If every household in San Francisco upgraded its refrigerator to an efficient model, greenhouse gas emissions could be reduced by 75 million kWh or 39,000 tons CO_2 per year.

Proposed Actions

- **Expand Residential Efficiency Programs**

  The goals of these programs would be both to encourage consumers to choose the most efficient models when selecting new appliances and to encourage early replacement of old, inefficient appliances with new, more efficient ones. The programs would focus on the highest energy-using appliance types in San Francisco, such as water heaters, furnaces, refrigerators and washing machines, with emphasis on electric heating and natural gas appliances.

  The program mechanisms would include financial incentives such as rebates on setback thermostats that exceed existing levels; weatherization and building testing services to reduce energy "leaks" in buildings; and refrigerator bulk purchasing programs targeted to multifamily building owners. The

programs would also provide information at retail outlets and publicity for vendors who participate. Potential partners are retail stores, equipment vendors and landlords.

- **Implement Residential Lighting Efficiency Programs**

  Fluorescent lighting uses about 75% less energy than incandescent lighting to deliver the same amount of light. In the past few years, the quality and variety of compact fluorescent lighting have improved dramatically, and costs have decreased. Nonetheless, most residential lighting fixtures still use incandescent lamps.

  These programs would target common residential lighting applications such as porch lights, table lamps, and torchieres for conversion to compact fluorescent lamps (CFLs). Program mechanisms include:

  Multi-family Buildings. Conversion from incandescent to permanent "hard wired" fluorescent fixtures in enclosed common area hallways and in kitchens and bathrooms.

  Torchiere Turn-In. Residents turn in their incandescent torchiere lamps for coupons to buy fluorescent units. The program would utilize fire stations and local hardware and lighting outlets.

  Upstream Lighting. Point of sale rebates are available at retail outlets. Partners would include building owners, retail stores, schools, San Francisco Fire Department, and equipment vendors.

Commercial Buildings

Estimated CO_2 Reduction: 433,000 tons

Existing Actions

Most energy efficiency programs for the commercial sector are funded by the Public Goods Charge and administered by PG&E. PG&E's *Express Efficiency* program provides rebate payments for purchases of lighting, refrigeration, and HVAC equipment based on assumptions of how much these technologies typically save. The *Standard Performance Contract* (SPC) program is a performance program with incentive payments based on measurement and verification of actual energy savings. PG&E's *Savings by Design* program provides design services for new mid to large commercial building projects as well as incentives for implementing certain recommendations that go beyond the State's Energy Code (Title 24).

The City's Department of Environment administered the state-funded *Power Savers* program, which used a combination of incentives and technical assistance to reduce lighting energy use in 4,000 small businesses such as grocery stores, small retail, and restaurants. The program offered free energy audits and coordinated lighting retrofit installation, as well as buydowns of the cost of lighting retrofits.

The 2003/04 PG&E and SF Environment's joint *Peak Energy Program* (SF PEP) provides rebates to businesses to install energy efficient lighting, motors, HVAC and refrigeration equipment, as well as performance based incentives for installation of equipment such as efficient chiller replacements and lighting controls. These programs focus on energy efficiency and peak load reduction in office buildings, hotels, hospitals, food service and retail businesses. SF Environment provides customer "turnkey" services, which include energy site surveys, technical analysis, savings estimates, and assistance in selecting equipment and contractors.

Proposed Actions

- **Support Building Tune-ups**

  Studies indicate that up to 25% of energy use can be saved in commercial buildings through recommissioning of existing building control systems, without large investments in new equipment.[89] Recommissioning a building, also called "retrocommissioning" or a "building tune-up", means checking, repairing, and readjusting the controls that operate heating, ventilation, and air conditioning, lighting, and domestic hot water equipment. These controls include time clocks, occupancy sensors, thermostats, and more complex energy management systems.

  Building tune-up programs would promote recommissioning through training and certification of building operators and building commissioning contractors. The programs would target heating, cooling, lighting, and hot water end uses in large commercial buildings.

  Potential partners include PG&E's Pacific Energy Center, building industry professional associations, Lawrence Berkeley National Laboratory, and local colleges and universities.

- **Increase Targeted Incentives**

  The energy efficiency incentives offered through PG&E's *Express Efficiency* rebate and *Standard Performance Contract* (SPC) performance incentive programs are statewide, designed to serve the average mix of facilities in the State. Local programs - like SFPEP and Power Savers - can augment statewide programs with incentives targeted to technologies and market sectors that have the greatest potential for savings in San Francisco. These incentives should include additional incentives for efficiency actions that reduce San Francisco's peak demand (both summer and winter).

  The building types and end-uses representing the largest share of electricity and gas use in the City are office cooling and equipment; office, hotel, and retail lighting; food service refrigeration; and gas water heating and space heating (all building types).[90] The programs should be tailored based on

[89] Liu, Mingsheng, "Improving Building Energy System Performance by Continuous Commissioning", Energy Engineering, Vol. 96, No. 5, 1999, page 46.
[90] Based on statewide end-use data provided by the California Energy Commission.

analysis of specific energy savings opportunities applicable to targeted critical distribution zones and priority building types and end-uses.

Partners would include Building Owners and Managers Association, Hotel Associations, Restaurant Associations, Food Service Technology Center.

- **Provide Large Account Energy Management Services**

  These programs should be designed to offer free energy management services to the largest energy users in San Francisco. A relatively small number of buildings such as large office buildings are responsible for the majority of commercial electricity use in San Francisco. These programs would work with building owners to provide a high level of individualized services to San Francisco's largest customers to help them implement a wide range of actions.

  The programs would facilitate implementation of energy efficiency projects by offering services such as energy audits and project management. Target end-uses include HVAC, lighting, hot water, and motors.

- **Provide Turn-key Commercial Retrofit Services**

  Small to midsize businesses have been difficult to reach through most conventional utility energy-efficiency programs. The goal of this new initiative would be to provide a "one stop shop" program to cover energy uses beyond lighting (such as refrigeration and HVAC) for small to midsize commercial customers in San Francisco. The target building types would be small commercial buildings, including grocery stores, restaurants, and small offices.

  The programs would provide "turn-key" retrofit services including technical assistance and incentives. These services include assessing audit recommendations, providing design services, and construction management. Partners would include building owners and small business associations.

Municipal Buildings

Estimated CO_2 Reduction: 45,000 tons

Existing Actions

The San Francisco Public Utilities Commission (SFPUC) manages and implements energy efficiency projects in municipal buildings and facilities for Hetch Hetchy Water and Power customers. SFPUC provides energy efficiency services such as RFP and contract development, building audits, design, and construction management. Direct retrofits include energy efficient equipment such as lighting, HVAC, motors, controls and energy management systems.

Municipal energy efficiency projects are funded by Hetch Hetchy revenue as well as state grants and loans. The Mayor's Energy Conservation Account (MECA) provides a financing mechanism whereby investments in energy efficiency can be paid back though City departments' energy savings.

Municipal energy efficiency projects recently completed or underway include: lighting retrofits at Moscone Convention Center (North and South), San Francisco General Hospital, Mental Health Clinics, City parking garages, Golden Gate Park and West Portal Library; Department of Parking and Traffic LED traffic signal conversions; efficient refrigerators at Housing Authority facilities; motor replacements at the Southeast Wastewater Treatment Plant; and efficient lighting, HVAC, building shell, and energy management controls upgrades at the new Moscone West Convention Center.

In order to meet our goals, municipal energy efficiency and demand reduction programs must be continued and expanded. Programs should promote efficient use of natural gas as well as electricity.

Proposed Actions

- **Develop Comprehensive Energy Efficiency Programs for City Departments.**
  Develop and implement programs for City departments with a broad range of energy efficiency services. Target large energy using facilities in both Enterprise and General Fund departments such as the Airport, SFPUC, the Port, Muni, Convention Facilities, San Francisco Unified School District, Department of Public Health, Public Libraries and Recreation and Parks. The effort would begin with development of a departmental 5-year energy plan. Energy services should be tailored to departmental needs and could include building energy audits, direct retrofits, design review services, retrocommissioning, energy efficiency training for O&M staff, energy education for building occupants, and development of departmental energy policies and procedures.

- **Implement Demand Management Program.**
  Design and implement peak load management and demand response programs for City departments such as Water Pollution Control, City Distribution Dept., and Water Supply & Treatment. Provide services and equipment to interface with existing automated systems such as building energy management and SCADA systems to enable facilities' demand response capabilities.

- **Develop Energy Services Available to all City Departments.**
  Coordinate with SF Environment to support City departments in complying with LEED requirements for new construction and renovation projects through energy design review services. Integrate energy efficient equipment (e.g. lamps, ballasts, computers) into City purchasing contracts. Provide energy efficiency training to City design, engineering, and building operations and maintenance staff. Provide energy use data to facility managers.

B. Expand Education and Outreach

Estimated CO_2 Reduction: 36,000 tons

Public education and training programs are designed to raise awareness and educate the general public and particular target groups (such as designers and building contractors) regarding energy conservation and efficiency practices.

Existing Actions

California's Flex Your Power campaign, first implemented by the State Department of Consumer Affairs (DCA) during the energy crises of 2001, is a public education campaign which includes television advertisements, radio spots and a website. This campaign primarily has a conservation message, focusing on behavioral changes people can make to alleviate power emergencies. DCA is also developing an education campaign associated with *Flex Your Power* but focusing on energy-efficiency actions, which are considered to have a longer-lasting impact than conservation efforts.

PG&E has ongoing education and outreach programs for consumers and for schools. Specialized training classes for contractors, architects and engineering professionals are offered at several PG&E facilities, including the Pacific Energy Center, located in San Francisco. The Pacific Energy Center provides education, design tools, advice, and support in the areas of architecture, lighting, HVAC, and whole building performance.

Proposed Actions

- **Develop Local Outreach Program**

  The City can use its knowledge of the local community to develop an education campaign that complements the State-administered Flex Your Power campaign, but is designed to address San Francisco's cultural diversity, large renter population, unique climate and end use patterns (e.g. focusing on lighting and space heating rather than air conditioners).

  Program mechanisms would include advertising, website, grassroots outreach, educational materials at retail outlets, city demonstration projects at schools, libraries, recreation centers, and other public buildings. Partners would include schools, neighborhood organizations, California Energy Commission, and PG&E.

- **Provide San Francisco Focused Training**

  Collaborate with PG&E's Pacific Energy Center and target group representatives to design energy efficiency training classes for San Francisco's designers, contractors, and building operators. For

example: training downtown building maintenance engineers in energy efficient operations and maintenance; building designers and City plan checkers in *Title 24* and local energy codes; City restaurant owners in energy efficient food service technologies and practices; local lighting, refrigeration and HVAC contractors in energy efficient technologies; and local weatherization contractors in whole building and indoor air quality techniques.

Training in energy efficient technologies and practices also supports the continuation of the actions implemented through incentives programs. Partners would include PG&E's Pacific Energy Center and Energy Training Center, the Food Service Technology Center, restaurant associations, and trade unions.

C. Strengthen Legislation, Codes and Standards

Estimated CO_2 Reduction: 65,000 tons

The State of California sets energy codes and standards such as *Title 24*, which requires all new buildings to meet certain prescriptive and performance energy efficiency criteria. The City can set policies through local ordinances which require energy efficient retrofits in existing buildings or set standards that go beyond state code. Regulatory changes can be achieved with a small amount of money but potentially can have a significant impact.

Existing Actions

The State of California sets energy efficiency building standards through *Title 24*, the state energy code, which requires all new buildings to meet certain prescriptive and performance criteria. The U.S. Department of Energy's *Energy Star* program also certifies appliances such as computers and refrigerators that meet stringent energy efficiency standards.

San Francisco's existing local energy efficiency legislation includes the *Green Building Ordinance*, administered by SF Environment, which sets energy efficient retrofit, commissioning and design standards for municipal buildings; the *Residential Energy Conservation Ordinance* (RECO) which requires certain energy efficiency actions such as water heater and attic insulation be put in place at the time of sale of a property; and a recent amendment to the City's Rent Stabilization Act, will allow landlords to pass through to tenants the costs of capital improvements for energy efficiency and renewable energy.

Proposed Actions

San Francisco can support the development of stricter State and Federal energy codes while developing its own more stringent local energy codes to encourage energy efficiency in existing buildings and new construction.

- **Expand Energy Efficiency Requirements for Existing Buildings**

  The City should expand the Residential Energy Conservation Ordinance to include a home energy rating, infiltration reduction, and high efficiency appliances. The City should develop guidelines that implementation the Rent Stabilization Act's provision to allow landlords to recover the cost of energy efficiency improvements.

  Requirements should also be developed for commercial buildings such as required lighting retrofits, certification of energy efficiency training of maintenance engineers, and periodic verification of energy systems performance.

- **Strengthen Local Building Codes for New Construction and Renovation**

  The City should develop local building codes that promote a higher level of energy efficiency than Title 24 State code for residential and non-residential construction projects. The codes should place an emphasis on renovation projects, which are more common than new construction in San Francisco. This may be achieved by lowering the threshold for triggering *Title 24* for renovation projects.

  The City should work with the California Energy Commission and San Francisco Department of Building Inspection (DBI) to develop and enforce the standards.

- **Support and Enforce Green Building Ordinance**

  Adoption of an ordinance amending the San Francisco Environment Code Chapter 7, has established *LEED Silver*[91] as a green building standard for all new construction, renovation and additions over 5,000 square feet in municipal buildings. This demonstrates the City's commitment to incorporating green building practices, including energy efficiency, into standard designs for all City projects. SF Environment and SFPUC should work together to enable City departments to comply with the requirements of the ordinance.

3.4 Renewable Energy Actions

Renewable energy resources are derived from the natural flows of energy through the earth's biosphere. These include solar, wind, geothermal, biomass, and tidal energy. Some renewable energy technologies such as wind power have evolved to the point where they now can provide reliable and cost-effective alternatives to fossil fuels.

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[91] LEED (Leadership in Energy and Environmental Design) is a point-based rating system developed by the U.S. Green Building Council (USGBC) for measuring the environmental performance of a building on a "whole building" perspective over a building's life cycle. The five categories of evaluation are Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials, and Indoor Environmental Quality. See www.usgbc.org

Replacing fossil fuel resources with renewable resources will have the greatest impact on reducing greenhouse gas emissions. In 2002, renewables provided 11% of California's electricity.[92] Local actions to achieve our greenhouse gas reduction goals must include increasing the amount of renewable energy in the City's electricity mix.

In San Francisco, elected officials and the public have already voiced strong support for renewable energy through the Sustainability Plan, the Electricity Resource Plan, and the November 2001 election that overwhelmingly passed Propositions B & H. Proposition B authorized $100 million in revenue bonds to develop solar, wind, and energy efficiency projects in City facilities. Proposition H authorized the City to issue revenue bonds for private sector as well as municipal projects without returning to the voters for further approvals. Together, these policies and laws indicate broad public support for renewable energy and energy efficiency and a desire to see applications developed for all sectors of energy use and production. Support for renewable energy includes not only the development of renewable electricity resources, but also includes the potential for renewables to supplant vehicle fuels, e.g. solar derived hydrogen for fuel cell vehicles, and solar water heating to supplant natural gas fired water heaters and boilers.

Renewable Energy Actions to Reduce Emissions

Renewable energy options currently available include solar, wind, biomass and geothermal. Emerging technologies like renewable hydrogen fuel cells and tidal current power may be available in the future. Each of these resources has unique opportunities, advantages, and sometimes disadvantages. The following is a summary of actions the City can pursue to develop renewable energy resources.

Recommended renewable energy actions are grouped into three categories, listed in table 3.4. Estimated CO_2 reduction has been estimated by category. Specific actions are described below.

Table 3.4 Summary of Renewable Energy Actions and Estimated CO_2 Reductions

Renewable Energy Action Categories	Estimated CO_2 Reduction (tons/year)
A. Develop Renewable Energy Projects	
Solar Energy	35,000
Wind Energy	239,000
Biomass Energy	44,000
B. Conduct Pilot Projects for Emerging Technologies[93]	–
C. Support and Develop Green Power Purchasing	230,000
Total	**548,000**

92 2002 gross system power. California Energy Commission *2002 Net System Power Calculation*. April, 2003. 300-03-002.
93 Research and Development projects.

A. Develop Renewable Energy Projects

Solar Energy

Estimated CO_2 Reduction: 35,000 tons

Solar energy can be used for heating and for creating electricity. Solar technology can be distributed widely and is most efficiently used on-site where the energy is to be used. Solar technologies are modular, they can be increased or decreased in very small increments and, therefore, can be placed almost anywhere there is direct sunlight. Clouds, fog and shading can limit the amount of heat or power that a system produces – so sites should be selected carefully. Solar electric photovoltaic (PV) systems are particularly valuable when used at the local level to reduce peak power usage and to defer distribution infrastructure development.

To develop a well thought-out implementation strategy, the City must understand the market barriers and develop projects where it is most cost effective. If sufficient participation by commercial and residential customers is obtained, at least 50 megawatts of solar could be installed in San Francisco. The cost of systems is a major consideration in achieving this magnitude of installation. A sustained program to develop solar in San Francisco can help reduce the overall cost of solar technologies.

The State of California provides rebates for the installation of solar electric systems through two programs. One, administered through the California Energy Commission offers rebates for smaller systems located on residential and commercial facilities. Another, administered by the state's investor-owned utilities under the supervision of the California Public Utilities Commission provides rebates for systems from 30 kilowatts to one megawatt in size. Rebates under both of these programs will decline over time. Other tax credits are available.

Existing Actions

SFPUC is currently developing solar electric projects for City facilities. The first project, a 675 kilowatt PV system is located on the Moscone Convention Center's roof. This

Moscone Convention Center Solar Project

The Moscone Center project consists of two parts: solar power generation and energy efficiency. The solar installation includes high efficiency, photovoltaic panels on the Moscone Center roof. The installation's peak output is 675 kilowatts, and it will produce at least 826,000 kilowatt-hours per year. The energy efficiency measures implemented at Moscone include new efficient lighting equipment and improved energy controls, which will save an estimated 4 million kilowatt-hours annually. Together, the solar electric system and energy efficiency measures will produce and save the city enough electricity to power over 1,000 homes.

project will generate 826,000 kilowatt-hours of electricity per year and provide a solar showplace for visitors from all over the world. A second 250 kilowatt solar project is under development at the Southeast Water Pollution Control Plant.

SFPUC has installed radiometers at eleven sites on City buildings and schools to collect data about the availability of sunlight. The variability in solar incidence is based on microclimate and geography, and when cross-referenced with availability of appropriate space, limits the application of solar technologies in some areas of the City. This data will be used to help select appropriate sites for future solar projects.

SF Environment is developing streamlined permitting and public information systems to pave the way for accelerated construction of solar in San Francisco for both hot water heating and electricity. Permit fees are being reduced and requirements standardized. Additionally, SF Environment is managing a solar training and installation program to fit 54 homes in Bayview Hunters Point with solar water heating systems.

SF Environment is also promoting the integration of solar into the construction of new City facilities through its Green Building program.

SFPUC and SF Environment are cooperating to implement the *Generation Solar* program to facilitate the installation of solar electric systems on residential and commercial rooftops in San Francisco. SFPUC provides overall oversight of the program, technical assistance, and contractor screening. SF Environment has responsibility for program marketing and proposing changes to building and planning codes, procedures, permitting and fees.

Proposed Actions

- **Implement Generation Solar**

  The goals of the *Generation Solar* Program are to install at least 100 solar electric systems on residential and commercial rooftops in San Francisco, to help overcome the structural, institutional and market barriers that currently inhibit solar power, and to benchmark processes and gain experience to determine the most effective way to structure future expanded solar programs.

  SFPUC and SF Environment should continue implementation of Generation Solar through implementing the marketing plan, pursuing identified financing options, expediting approval and permitting processes, and matching applicants with qualified solar contractors.

  SFPUC and SF Environment should evaluate the Generation Solar Program and, based on findings of barriers and incentives, adjust the program to expand the development of solar projects on privately owned facilities.

- **Expand Solar PV Installations on Municipal Buildings.**

  SFPUC should continue to identify suitable sites and oversee installation of solar systems at municipal facilities. Two new projects have been identified and funding obtained that will allow the development of an additional 700 kilowatts of electricity on City facilities by the end of 2005. The SFPUC should continue working with other city agencies such as the Airport, the Port, the Department of Parking and Traffic and the City Water Department to develop other large-scale solar projects.

  SFPUC should identify at least 10 additional municipal sites for the installation of smaller-scale solar electric systems. These sites would include schools, libraries, health facilities, and police and fire stations. These sites are included for their educational value, high visibility in the surrounding neighborhoods, and their value as demonstration sites.

  SFPUC and SF Environment should expand programs to install solar on existing facilities and new construction projects, leveraging funding through the authority provided by Propositions B and H.

Wind Energy

Estimated CO_2 Reduction: 239,000 tons

Wind has been used for centuries to create mechanical power for uses such as pumping water and milling grain. In recent years, wind turbines have been used to produce electricity. Modern wind turbines have increased in size and output to megawatt scale machines and can be used to generate significant amounts of relatively low-cost power. San Francisco could obtain significant amounts of wind power in areas such as the Altamont Pass, where wind speeds are high and other conditions like proximity to transmission can be met.

Additionally, individual San Franciscans have expressed interest in urban wind applications. Concerns about these machines include safety, sound, height limits, and impact on bird populations.

Existing Actions

The estimated potential for wind development in the greater Bay Area for San Francisco's use could exceed 150 megawatts. Electricity from these projects would require transport using PG&E's transmission lines. SFPUC is currently looking at several sites including those adjacent to its own Bay Area reservoirs. Wind monitoring equipment is being installed in five sites in and around the city and additional data is being obtained for City property in the Sierra foothills.

SF Environment is researching small-scale wind equipment appropriate for urban use. This could provide up to 5 megawatts of additional generation.

Proposed Actions

- **Develop Large Scale Wind Generation.**

  SFPUC should continue to monitor the wind resources within San Francisco and on City-owned property outside the City limits (e.g. Hunters Point Shipyard, Crystal Springs). It should also develop and apply models to quantify the value of energy storage capabilities of the hydroelectric system for adding value to intermittent renewable energy generation such as wind.

  SFPUC should develop a Request for Proposals (RFP) for 50 megawatts of wind generation to supplement Hetch Hetchy power after the expiration of the Calpine contract. This effort would include investigating the benefits of entering into a power purchase contract for new wind generation to take advantage of project tax benefits and reduce city risk.

- **Research Develop Small Scale Wind Generation.**

  SF Environment should research feasibility of small-scale wind generators appropriate for urban use and offshore wind generation capability.

Biomass Energy

Estimated CO_2 Reduction: 44,000 tons

Sewage treatment and landfill biogas can be collected for use in combustion generators to generate electricity. The combustion or gasification of wood, agricultural waste, and other forms of biomass are also potential sources.

Existing Actions

In 2002, the SFPUC installed a small reciprocating engine to use biogas recovered from the Oceanside Water Treatment Control Plant. In 2003, a 2 megawatt biogas plant began operation at the Southeast Water Treatment Control Plant. Both of these plants use sewage-produced methane gas that would otherwise be flared-off.

Proposed Actions

- **Research Biomass Energy Opportunities.**
  Assess new opportunities for expanding biogas generation at existing City wastewater treatment facilities. Identify opportunities for gasification of biomass waste materials for use in modular generation technologies such as fuel cells.

B. Conduct Pilot Projects for Emerging Technologies

In order to achieve the greenhouse gas reductions required in the long term, San Francisco will need to explore and develop additional renewable energy technologies. Emerging new renewable technologies include fuel cells, tidal current and offshore wave energy generation.

Fuel cells chemically convert hydrogen into electricity and heat, with water as their only byproduct. Applications include stationary power as well as automotive. San Francisco is surrounded on three sides by water and has enormous potential for application of technologies such as tidal currents, wind generated waves, and ocean thermal. The tidal flow through the Golden Gate has a very large energy potential.

Existing Actions

The City is initiating partnerships with appropriate agencies to develop demonstration projects for emerging technologies that are not yet cost effective or in mass production, but show promise for application in San Francisco.

Fuel cells are being developed and demonstrated by the California Fuel Cell Partnership – a consortium of auto manufacturers, fuel cell manufacturers, energy companies, and state and federal agencies. SF Environment and SFPUC are developing demonstration projects to bring working fuel cells, both stationary and mobile, to San Francisco.

SF Environment is developing a partnership for a pilot project to generate electricity from the tidal current flow through the San Francisco Bay.

Proposed Actions

The City should assess the resource potential and feasibility for emerging renewable technologies in San Francisco, and develop partnerships with appropriate agencies to implement demonstration projects.

- **Implement Fuel Cell Pilot Projects.** The City should site and install 2 proton exchange membrane fuel cells obtained as part of a grant award from the U.S. Department of Energy. Implement an "energy station" hybrid fuel cell demonstration project to provide hydrogen for stationary and vehicle fuel cells.

- **Implement Tidal Power Pilot Project.** SF Environment should work with partners such as state and federal agencies, foundations and manufacturers to conduct a feasibility study, implement a pilot project installation, and conduct community education and outreach. The ultimate goal would be the design, siting, and construction of a grid inter-tied tidal power project.

C. Support and Develop Green Power Purchasing

Estimated CO_2 Reduction: 230,000 tons

Existing renewables currently make up approximately 11% of the state power grid. Strategies for increasing this percentage are to create a market for renewable resources and create requirements for the development of those resources. Polls show a majority of consumers across the country prefer renewable energy -and almost 30% said they would be willing to pay premiums for it. Every household in California that switched to 100% new renewable electricity would annually reduce CO_2 by 3 tons.

In 1998, California's electric industry restructuring law gave customers the choice to buy power from companies selling renewable electricity products. Many local governments in California committed to purchasing green power for their own municipal facilities. However, in 2001, “direct access” was suspended. At that time about 1% of residential customers had switched suppliers, most choosing companies that provided renewable sources of electricity.

Subsequently, the State legislature adopted a minimum requirement for the amount of renewable energy in the makeup of statewide electricity resources - a Renewable Portfolio Standard (RPS) with a goal of 20% renewables by 2017.[94]

In 2002, California passed Assembly Bill 117, which allows local governments to aggregate customers in their jurisdictions into power purchasing pools and manage the power purchases on their behalf. When implemented, this will give local governments the option to offer green power and create additional investment in renewables.

Recently, advocates for the development of renewable energy sources have proposed a new way to buy and sell renewable electricity that divides the generation into two separate products, "electricity" and "renewable energy attributes." The bundle of renewable attributes associated are now being sold as “tradable renewable credits” or “green tags”. The renewable attributes and the commodity electricity may be bought and sold separately, or combined at the point of sale by a power marketer. Tradable renewable credits are an innovative new electricity market tool that, if used properly, can help finance new renewables and add liquidity to retail and wholesale renewable energy markets.

Existing Actions

The City supports the enforcement of the Renewable Portfolio Standard as state policy. Additionally, the City is fully engaged in the proceedings to develop implementation rules for Assembly Bill 117. The SFPUC is the lead agency on this issue.

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[94] Senate Bill 1078, Sher, 9/12/02, California Renewables Portfolio Standard Program.

Proposed Actions

- **Support Accelerated Implementation of California's Renewable Portfolio Standard (RPS).** Several bills have been introduced in the State legislature to accelerate the integration of renewables into the State's mix of electricity resources. Senate Bill 1478 (Sher) proposes increasing the RPS to 20% by 2010. Since San Francisco imports approximately 70% of its electricity, increasing the amount of renewables in the State power mix could have a great impact on reducing emissions.

- **Evaluate Community Choice Aggregation for a Citywide Power Purchasing Pool.** Utilize the authority under AB 117 to aggregate San Francisco residents and businesses into a power purchasing pool and purchase green power under a local RPS and/or offer a green power rate to interested customers. Supervisor Tom Ammiano sponsored a City Ordinance establishing a Community Choice Aggregation Program to allow San Francisco to aggregate the electrical load of electricity consumers within San Francisco and to accelerate the introduction of renewable energy and energy efficiency into San Francisco's portfolio of energy resources. The ordinance directs SFPUC and SF Environment to develop a Draft Implementation Plan, and a RFP for prospective Energy Service Providers, including use of Proposition H bonds to finance energy efficiency and renewable projects.

- **Support Legislation to Allow the City to be Compensated for Exported Solar Power.** Assemblyman Mark Leno introduced, and the legislature passed, Assembly Bill 594 which would authorize the City and County of San Francisco to designate photovoltaic generation facilities meeting specified conditions as Hetch Hetchy Water and Power solar generation facilities and would require Pacific Gas and Electric Company on a monthly basis, to pay the City and County of San Francisco for the electricity generated and delivered to the electric grid at the established time-of-use rate.

3.5 Solid Waste Actions

Introduction

San Francisco has a long history of implementing recycling programs—from the early industrial recovery of metals and paper, to the birth of the environmental movement around Earth Day 1970, up to the current leading edge programs and the City's adoption of waste diversion goals of 75% by 2010 and "Zero Waste" by 2020.

A 1932 voter approved Refuse Ordinance created a permit system for the exclusive right to collect garbage and recyclables that have no "commercial value" – where the generator is charged for collection service. Eventually, various companies owning these permits combined through corporate buy-outs into Norcal Waste Systems Co., which now owns all 97 permits.

Recycling services, while not specified in the 1932 ordinance, have been included by interpretation. Other recycling collectors may only collect materials with "commercial value", and may not charge for collection services. Construction and demolition (C&D) waste activities are specifically outside the 1932 ordinance. Numerous companies do compete for this business but Norcal still handles well over 50% of all C&D materials. Reuse collection is also outside of the ordinance.

Oversight of the garbage and recycling system is unusual in that there is no standard contract. Residential rates are set by a three person Rate Board (City Administrator, Controller and head of Public Utilities) with technical review assistance by City staff from the Department of Public Works (DPW), Department of the Environment (SF Environment) and City Attorney. Commercial rates are not regulated, but reflect the rate increases set by the Rate Review process. DPW staff administer the financial aspects of the rate system while the Department of Public Health (DPH) issues Refuse permits, enforces public health standards and adjudicates billing and service disputes.

The California Integrated Waste Management Board oversees diversion efforts by municipalities and enforces AB 939 – the Integrated Waste Management Act – passed in 1989, which set a 50% recycling goal for California. SF Environment is the city department charged with meeting these state diversion goals and it provides program development and performance oversight of Norcal. Without direct command and control, SF Environment has developed a close working relationship with Norcal to advance the City's resource recovery goals.

In February 2003, the San Francisco Board of Supervisors adopted a goal of diverting 75% of waste from the landfill by 2010 and achieving "zero waste" by 2020. Strategies to achieve these goals include development and expansion of new programs through improvements to the recycling and market infrastructures, as well as education, outreach and legislative policy actions to help in product lifecycle redesign for reuse, recycling and composting.

Solid Waste Actions to Reduce Emissions

Recommended renewable energy actions are grouped into six categories, listed in table 3.5. Estimated CO_2 reduction has been estimated by category. Specific actions are described below.

Existing Actions

SF Environment, in partnership with Norcal and its subsidiaries, including the City's exclusive permitted haulers (Sunset Scavenger and Golden Gate Disposal & Recycling) as well as other organizations, has developed and is implementing innovative city-wide recycling and composting programs in the residential and commercial sectors of San Francisco. These programs resulted in San Francisco achieving a 52% landfill diversion rate in 2001 and with maximum expansion will help San Francisco to achieve its 75% diversion goal. These programs are being recognized as valuable models that many communities are striving to emulate.

Among these new programs, San Francisco is implementing the first large rollout of food and other

Table 3.5 Summary of Solid Waste Actions and Estimated CO_2 Reductions

Solid Waste Action Categories	Estimated CO_2 Reduction (tons)
A. Increase Residential Recycling and Composting	70,000
B. Increase Commercial Recycling and Composting	109,000
C. Expand Construction and Demolition Debris Recycling	57,000
D. Support Alternate Collection Methods for Recyclable Materials	66,000
E. Promote Source Reduction, Reuse and Other Waste Reduction[95]	–
F. Expand Municipal Programs[96]	–
Total	**302,000**

organics collection and composting in a large U.S city. Started as a commercial produce pilot in 1996, food collection has expanded citywide to include all food scraps (including post-consumer and meat), food soiled paper, waxed cardboard, wood crates and landscape trimmings from all types of generators, including markets, restaurants, cafes, juice bars, florists, hotels, schools and universities. After nearly three years of pilot programs, a new 3-cart collection program, called the "Fantastic 3", began in February 2000 for households and small businesses. This program replaced the previous separate open blue bin recycling and trash collections that had no organics collection.

Proposed Actions

The proposed actions described in this section are all expansions of existing actions.

A. Increase Residential Recycling and Composting

Estimated CO_2 Reduction: 70,000 tons

- **Expand Recycling and Composting Programs**

  Fantastic 3 is San Francisco's residential and small business recycling and composting collection program serving single-family homes, apartments, and small businesses that are integral to residential neighborhoods. Recyclables and refuse are collected by dual compartment, semiautomatic, compacting collection trucks. Compostables are collected using semiautomatic, side loading, single-compartment, compacting trucks.

  Through the *Fantastic 3* program, residents and small businesses receive three color-coded wheeled 32 gallon carts – blue for commingled recyclables, including all paper, cardboard, bottles, and cans; green for

[95] Not quantified, unknown materials breakdown.
[96] Municipal waste reduction is included in the commercial recycling and composting program totals.

all compostable food scraps, yard trimmings, wooden crates, animal bedding, and soiled paper; and black for any remaining refuse. Residents also receive a 2-gallon kitchen pail to help them separate and collect food scraps.

Further expansion of recycling and composting programs to multifamily apartment buildings and increasing participation through outreach, adding new materials and adopting mandatory policies, will divert an estimated 223,252 tons/year of residential recycling and compost by 2012. This total includes separate program tonnages of 154,471 tons of recyclables and 68,781 tons of organic material.

Fantastic 3 Program

Fantastic 3 is San Francisco's residential and small business recycling and composting collection program serving single-family homes, apartments, and small businesses. In the Fantastic 3 program, residents and small businesses receive three color-coded wheeled 32 gallon carts: **green** for all compostable food scraps, yard trimmings, wooden crates, animal bedding, and soiled paper; **blue** for "comingled" recyclables, including all paper, cardboard, bottles, and cans; and **black** for any remaining refuse. Residents also receive a 2-gallon kitchen pail to help them separate and collect food scraps.

B. Increase Commercial Recycling and Composting

Estimated CO_2 Reduction: 109,000 tons

- **Expand Commercial Recycling**

San Francisco should continue to expand its commercial recycling programs, which include source-separated collection, bagged co-collection (in which loose paper and other recyclables are separated from bagged refuse) and re-routing (where trucks collect from generators rich in recyclables separately). The commercial programs accept all types of paper, cardboard, glass, metal and plastic. Commercial accounts with wood, light metals, film plastic and other common industrial materials are processed at the new Pier 96 Materials Recovery Facility (MRF).

The addition of this advanced sorting and processing operation at Pier 96, along with increased outreach, adding new materials to recycle and adopting mandatory polices will result in substantial increases in diversion of commercial recyclable material from the landfill. By 2012, this program will be recovering 186,026 tons of recyclables per year.

- **Expand Commercial Composting**

Commercial composting programs have expanded dramatically in the past two years. With the commercial source-separated organics program, most businesses in the program have been able to reduce their trash volume and service significantly, diverting 50% or more of their waste through composting and recycling. A number of restaurants have exceeded 90% diversion. With maximum expansion of commercial organics

collection through outreach, requiring use of compostable products, and adopting mandatory policies, the projection for 2012 is that 79,275 tons of compostable material will be diverted per year.

C. Expand Construction and Demolition Debris Recycling

Estimated CO_2 Reduction: 57,000 tons

Construction and Demolition (C&D) waste represents a significant portion of the total waste stream in San Francisco – up to 20% depending on which materials are included. Several companies provide service, including Norcal Waste Systems, Specialty Crushing, and Waste Resource Technology. The total C&D material diverted annually as a result of these expanded programs combined is estimated to be 493,056 tons debris by 2012.

Norcal Waste Systems C&D. Norcal has a construction and demolition debris recycling program in which roll-off bins are used to collect concrete, wood, metal, and other materials from industrial, construction, and demolition sites. Norcal's new construction and demolition debris sorting facility began operations in July 2003 and will triple Norcal's current capacity. The old temporary sorting line is now used to improve diversion at the public disposal and recycling area. These improvements are projected to increase construction and demolition debris recycling to 142,335 tons debris diverted per year by 2012.

Specialty Crushing C&D. Specialty Crushing performs specialized recovery of inert materials, primarily concrete, asphalt, rock and brick. Specialty has expanded their operations to include more materials and make new products, such as Envirocrete – a trademarked non-structural concrete suitable for all sidewalk, curb ramp and street use made from brick, dredge spoils and other recovered inerts. Through the addition of new processing capacity and the development of markets for new and existing products, Specialty plans to expand the amount of C&D materials it processes each year – and by 2012 the amount projected for diversion is 286,959 tons per year.

Other C&D. In San Francisco and the greater Bay Area, dozens of companies process some portion of the C&D waste stream. Collectively, this set of processors is growing in number and processing capacity. The growth in this service area is due in part to the recent development of C&D ordinances in Bay Area jurisdictions requiring minimum recovery rates from C&D projects. Total estimated waste diverted in 2012 from this program will be 63,762 tons debris per year.

D. Support Alternate Collection Methods for Recyclable Materials

Estimated CO_2 Reduction: 66,000 tons

- **Increase Metals Recycling**

  Metals have routinely been recovered from the waste stream for many years. San Francisco does not measure all the metals recovered, only the new increment beyond what was traditionally recovered prior

to 1990. New processing equipment for debris box loads is being built and new programs to recover electronic waste will provide a significant increase in the amount of metals recovered. In 2001, San Francisco recovered 19,345 tons and it is projected that 30,028 tons of metals will be recovered annually by 2012. This is in addition to increased metal recovery from the C&D waste stream.

- **Support Community Drop-off, Buy-back and Collection**
  There are a number of recycling programs which do not fall under Norcal's programs or other processing programs. These include donations at community recycling centers, the buy-back of California Redemption Value (CRV) beverage containers, and numerous collection programs operated by non-profit organizations or independent companies. A total if 37,307 tons of waste was diverted in 2001 – a figure that is projected to remain stable through 2012.

- **Support Recovery by Material Handlers**
  This area includes activity by independent recyclers such as paper dealers, re-use centers like Goodwill for furniture and textiles, and electronic waste reuse and recycling. These operators were responsible for diverting 92,074 tons in 2001 and this figure is projected to remain steady through 2012. New programs are being developed in this area and subsequent projections will very likely see increases for some materials in this group.

E. Promote Source Reduction, Reuse and Other Waste Reduction

Efforts to reduce the use of materials through reuse, substitution, re-designed products and processes have been identified, are growing and all fall into this category. Examples include: reuse of pallets and lumber in multiple shipping and construction applications; refilling toner cartridges, replacement of printed newsletters and reports by electronic versions; road base specifications that include tires, glass, brick and other previously discarded materials; and processing waste glass and ceramic into landscape, artistic, or building materials and products.

Waste audits frequently reveal creative diversion activities and new techniques. In 2001, 65,620 tons were identified as being diverted through these methods. By 2012, 70,362 tons will be diverted annually.

F. Expand Municipal Programs

- **Continue Sludge/Alternative Daily Cover Program**
  The City currently diverts the solid leftover from sewage treatment to landfills and agricultural sites. The material is then applied to agricultural land or used at the landfill for daily cover called Alternative Daily Cover (ADC), erosion control or other engineered uses—all regarded as diversion activities by the California Integrated Waste Management Board. In 2001 the City diverted 96,010 tons of sludge to use in this manner, a level projected to remain constant through 2012.

- **Expand Recycling in City Facilities**
  San Francisco has a goal to set a resource conservation example to residents and businesses through its own practices. The key element of this effort is the Resource Conservation Ordinance (RCO).

  The City adopted the first RCO a decade ago to reduce waste and increase purchasing of recycled products by City departments. The original RCO was completely amended in 2000 to further improve resource conservation practices and states that it is the goal of the City and every department to maximize purchases of recycled products and divert from disposal as much solid waste as possible.

  The RCO sets minimum recovered material content requirements for the purchase of building insulation products, paper and paper products, motor oil, tires and other products. Purchasing requirements are important to support markets for recovered materials. Examples of minimum requirements are:

  - Copier, printing and writing paper – 30% post-consumer content;
  - Paper towels – 40% post-consumer content; and
  - Motor oil – 25% re-refined oil content.

The RCO establishes a framework to assist departments in minimizing waste disposal. First, it requires each department to submit and distribute a Compliance Letter committing the department to the RCO goals and designating at least one person responsible for compliance. Second, a Departmental Waste Assessment (DWA) documenting all waste diverted and disposed must be submitted. Third, each department is to submit a Resource Conservation Plan (RCP) outlining how it will achieve RCO goals. Lastly, each department submits an Annual Recycling Survey (ARS) reporting solid waste diversion.

The RCO requires that the SF Environment submit this Annual Report to the Board of Supervisors summarizing department implementation and listing departments failing to conform. The information contained in this report came from the above submittals, site visits and other communications with departments.

Materials Recovered

Table 3.6 shows the breakdown of materials recovered from City facilities by material category — C&D debris, organics and recyclables. C&D refers to construction and demolition debris such as wood, concrete, asphalt, brick, tile, dirt, metal, and salvaged fixtures. Organics consists of logs, plant trimmings, food scraps, grease, soil, manure and sludge. Recyclables include paper, cardboard, bottles and cans, window glass and pallets.

The City has embarked on an aggressive campaign to reduce waste and increase diversion in all city departments and facilities. One goal is the central management and coordination of all garbage and resource conservation services. Another goal is significant savings on the cost of garbage and recycling services. Tons of material diverted are expected to increase significantly as well.

Table 3.6 Materials Recovered from City Facilities 2001

Material	C&D	Organics	Recyclables
Tons	21,867	16,855	2,916

Processing Facility Improvements

Commingled recyclables from the Fantastic 3 program and the commercial recycling programs are taken to a new recyclables processing facility at Pier 96, which began full-time operation in January 2003. This facility is the largest recycling processing center on the West Coast, employing state of the art separation systems, with a daily capacity of 2,100 tons and initial overall diversion of 75% that SF Environment and Norcal hope to increase up to 85% over time.

Source-separated organics loads from residential and commercial programs are taken directly to the transfer station, loaded into trailers, and then hauled to Norcal's Jepsen Prairie Organics Composting Facility in Vacaville. The material is composted for two months using an enclosed, aerated Ag-Bag composting system, windrow-turned and cured for a month, and then screened. The finished compost is marketed to landscaping and agriculture users, including organic farmers and vineyards. Some of the compost is used by farmers who market their produce to the same restaurants and markets in San Francisco that generate the organic material that Norcal collects.

Substantial new capacity for processing Construction and Demolition materials has been built by Norcal. Norcal's existing C&D facility has been enclosed and a second sort line added and new conveyance and processing systems integrated. This project will increase the existing capacity by 200-300%, and improve recovery rates. The facility began operations in July 2003 with a capacity to sort more than 300 tons per day.

Specialty Crushing has proposed adding a sorting line that will allow acceptance of heavily inert loads with minor contaminants such as brick, metal and wood. In conjunction with the sorting capability, Specialty intends to automate batching of new mixes that include previously discarded materials for use in road base, sidewalk and curb work. Those materials include brick, dredge spoils and mixed ceramic glass. Approval of this new facility is under consideration at the Port of San Francisco and operation is expected to be on line in 2005.

San Francisco already has several mechanisms in place to facilitate work towards our greenhouse gas reduction goal. Many of the efforts now underway to reduce vehicle emissions, increase energy efficiency and renewable energy, and increase recycling can provide an impetus to move the City in the right direction. Our challenge is to expand and increase the capacity of these actions, and to link them under the common goal of climate protection. Significant investments will be required if we are to meet our goal. Chapter 4 provides a list of recommended next steps to implement these actions.

Chapter 4

An Implementation Strategy for the Near Term

4.1 Introduction

Chapter 3 described the actions that will be necessary to meet San Francisco's greenhouse gas reduction goal of approximately 2.5 million tons of CO_2 per year by the year 2012. These actions surpass the pace of efforts now planned in the areas of transportation, energy efficiency, renewable energy and solid waste. Implementing the *Climate Action Plan* will, therefore, require increased, coordinated efforts in all of these areas. If San Francisco is to reach its reduction target by the year 2012, it is imperative that over the next 1-3 years the City:

- Accelerates and expands existing programs in all areas—transportation, energy efficiency, renewable energy, and solid waste.
- Develops the infrastructure to support new programs.
- Secures resources to implement actions.
- Sets up tracking mechanisms and indicators to measure progress.

The City should set up a process to support City departments and private entities to integrate climate protection into their standard operating procedures. To be successful, this process must include participation of stakeholder groups and implementing agencies. As the coordinating agency, the Department of Environment (SF Environment) should:

- Establish a City interdepartmental working group and an external advisory group to implement the Plan.
- Establish and maintain a tracking system for quantifying CO_2 emissions and reductions.
- Collaborate with other cities through ICLEI's Cities for Climate Protection program.
- Increase outreach and education activities (such as publishing brochures on "simple things you can do" for climate protection).
- Seek grant funding from sources such as the U.S. Department of Energy, U.S. Environmental Protection Agency (EPA), and California Energy Commission (CEC).
- Document and report progress to decision makers and to the public.

Implementing the *Climate Action Plan* will require ongoing commitment. Other City departments such as San Francisco Public Utilities Commission (SFPUC), Muni and the Planning Department should allocate resources to implement the actions under their areas of expertise and jurisdiction, and to support participation in the interdepartmental working group. Working groups should guide the process by periodically reevaluating action priorities, target levels, and monitoring progress of emission reductions programs. The groups should report back to the Board of Supervisors annually with findings and recommendations.

4.2 Next Steps for the Near Term 2005-2007

This section outlines the recommended steps to implement the Climate Action Plan in the next three years and the likely implementing agencies, funding sources, and progress indicators. More detailed descriptions of the actions are found in Chapter 3.

Transportation

The transportation sector accounts for approximately 50 percent of San Francisco's CO_2 emissions. Reducing transportation emissions is a complex endeavor— host of policy, regulatory, and financial variables exist that influence the City's ability to achieve emissions reductions. Many actions that can result in large emissions reductions are controlled by federal entities, such as Congress, and the Federal Transportation Administration or by regional administrative agencies like the Metropolitan Transportation Commission (MTC). It is necessary therefore, to pursue a wide range of actions that can be supported in San Francisco, while recognizing that they may also require policy changes in the larger regional and national transportation sectors.

A. Public Transit

One major approach to reducing transportation sector emissions is to reduce vehicle trips by encouraging a shift from privately owned vehicles to public transit. In order for public transit to provide a viable and attractive transportation option, local and regional services must provide efficient and reliable service to as many locations as possible. The "Transit First" policy has already been officially adopted in San Francisco. The next steps for improving transit will need to be coordinated between all the responsible agencies, City departments and the regional transportation entities.

Next Steps:

- Expand local transit service.
- Dedicate more funding for Muni capital improvements, fulfilling the vision outlined in Muni's long range planning document, A Vision for Rapid Transit in San Francisco.
- Expand and improve regional service and interconnections.
- Develop a regional transit pass system.
- Improve Muni safety, customer service and user-friendliness.
- Increase marketing and promotion of public transit.
- Expand transportation impact fee assessment.

Implementing Agencies:
San Francisco agencies: Muni, Planning Department, SF Environment, Department of Parking and Traffic

Regional and other agencies: Metropolitan Transportation Agency, Metropolitan Transportation Commission, San Francisco Transportation Authority, BART, Caltrain, Golden Gate Transit, AC Transit, SamTrans, RIDES for Bay Area Commuters, San Francisco Water Transit Authority, Federal Transportation Authority

Funding Sources:
Proposition B Sales Tax Reauthorization, San Francisco Transportation Authority, Metropolitan Transportation Commission, Federal Transportation Authority, CEMAQ, U.S. Congress

Progress Indicator:
Increase in the percentage of transit trips

B. Ridesharing

Encouraging carpooling and vanpooling will help to reduce the number of vehicle miles traveled by private cars and thereby reduce emissions. Many incentives for ridesharing exist in the Bay Area, such as High Occupancy Vehicle (HOV) lanes, preferential parking policies, and free passage across area toll bridges. RIDES for Bay Area Commuters also provides free ridematching services. However, most commuters still do not take advantage of these incentives, either because they do not know the incentives exist or they consider ridesharing to be bothersome. Further incentives to encourage ridesharing and increased outreach to potential carpool/vanpool participants will encourage others to switch.

Next Steps:
- Designate more HOV lanes in the region.
- Expand carpool and vanpool designated parking at both municipal and private parking facilities.
- Require that all proposed large developments and existing public and private parking facilities in the City provide preferential parking for carpools and vanpools.
- Implement school ridesharing programs to reduce traffic around area schools.
- Increase marketing and promotion of ridesharing.

Implementing Agencies:
San Francisco agencies: Planning Department, SF Environment, Department of Parking and Traffic, San Francisco Unified School District

Regional and other agencies: Metropolitan Transportation Commission, San Francisco Transportation Authority, RIDES for Bay Area Commuters, Caltrans

Funding Sources:
San Francisco Transportation Authority, Metropolitan Transportation Commission, Federal Transportation

Authority, Caltrans, Bay Area Air Quality Management District

Progress Indicators:

- Increase in the number of miles of HOV lanes
- Increase in the percentage of carpool and vanpool trips
- Increase in the number of carpool and vanpool ridematches for San Francisco completed by RIDES for Bay Area Commuters
- Increase in the number of carpool/vanpool parking spaces at municipal and private parking lots
- High level of participation in school ridesharing program

C. Bicycling and Walking

San Francisco is well suited for bicycling and walking, and the city has a robust bicycle and pedestrian advocacy community that lobbies the City, State, and federal agencies to improve bicycle and pedestrian access. The lead City departments working on these issues—Parking and Traffic, Planning, and SF Environment—need to work more closely to further encourage the use of bicycle and pedestrian modes of transportation. A variety of measures, especially those that support safety and convenience, are essential to shift people from polluting motorized vehicles and toward the use of bicycles and sidewalks.

Next Steps:

- Finish the bicycle network by continuing to increase the number of bicycle lanes, routes, and paths.
- Continue to improve safe access and passage on pedestrian walkways.
- Improve bicycle access to transit.
- Continue to improve and expand bicycle parking facilities.
- Increase workplace shower facilities for bicyclists.
- Increase marketing and promotion of bicycling.

Implementing Agencies:

San Francisco agencies: Planning Department, SF Environment, Department of Parking and Traffic, San Francisco Transportation Authority, Muni

Regional and other agencies: Metropolitan Transportation Commission, Bay Area Air Quality Management District, RIDES for Bay Area Commuters, regional transit operators

Funding Sources:

San Francisco Transportation Authority, Bay Area Air Quality Management District, Metropolitan Transportation Commission, Federal Transportation Authority

Progress Indicators:

- Increase in the percentage of bicycle and walking trips
- Increase in the number of miles in the bicycle network

D. Employer-Based Programs

Employer-based strategies can be an effective way to reduce vehicle trips because a large percentage of trips are work-related and workers typically travel to the same place at about the same time every day, making it easier to find a practical substitute to driving. Employers are motivated to provide incentives for their workers as part of their overall benefits package to help attract and retain workers, and because of the increased worker productivity achieved through reduced commute time and related stress. Employer-based programs can include commuter tax benefits, parking cash-out, guaranteed ride home programs, shuttle to transit hubs, on-site services, telecommuting, and compressed work weeks.

Next Steps:

- Implement mandatory employer trip-reduction requirements.
- Conduct general marketing and promotion of commuter services to stimulate employee demand for employer services.
- Expand employer commute assistance and outreach to assist employers in establishing and maintaining programs.
- Implement a countywide guaranteed ride home program to support the choice to use alternative modes of transportation to commute to work.
- Increase promotion of alternative modes to the 33,000 City and County employees and provide additional services and incentives.

Implementing Agencies:

San Francisco agencies: SF Environment, San Francisco Transportation Authority, San Francisco Board of Supervisors

Regional and other agencies: RIDES for Bay Area Commuters, Metropolitan Transportation Commission, Bay Area Air Quality Management District, private sector employers and business organizations

Funding Sources:

San Francisco Transportation Authority, Bay Area Air Quality Management District, Metropolitan Transportation Commission, U.S. EPA

Progress Indicators:

- Increase in the percentage of all alternative modes combined for commute trips
- Increase in the number of employers required to provide trip reduction programs and incentives
- Increase in the number of employer contacts made by RIDES or other outreach staff
- High level of participation in a county-wide guaranteed ride home program
- Increase in the percentage of City employees using alternative modes for their commute

E. Discourage Driving

Another way to encourage a shift to alternative modes is to simply make driving more difficult or expensive. This can be accomplished through restrictions, as well as setting price signals. These types of strategies can be extremely effective, but also controversial. San Francisco already has experience with some conventional strategies, including bridge tolls, parking fees, and residential parking permits. Some potential strategies require implementation on the state or regional level, such as gas taxes or increasing vehicle license fees.

Next Steps:

- Investigate congestion pricing on bridges or introduce cordon (controlled access) tolls for entrance into designated areas of the City.
- Lower minimum parking requirements or switch to parking maximums for all new developments.
- Reduce parking in areas well served by transit.
- Restrict the number of parking permits issued to the number of on-street spaces and consider charging market rates.
- Scale parking permit fees according to the number of vehicles in the household and/or vehicle size or emissions.

Implementing Agencies:

San Francisco Board of Supervisors, San Francisco Planning Department, San Francisco Department of Parking and Traffic

Funding Sources:

Department budgets, Metropolitan Transportation Commission, Bay Area Air Quality Management District

Progress Indicators:

- Decrease in traffic counts on area roadways
- Decrease in parking ratios in new developments
- Decrease in parking in areas well served by transit
- Decrease in the number of parking permits issued in the City

F. Clean Air Vehicles and Fleet Efficiency

Clean air vehicle and fleet efficiency strategies target the efficiency of the vehicles themselves, rather than trying to induce a shift to alternative modes. Improving Corporate Average Fuel Efficiency (CAFE) standards is one of the most direct and effective ways to reduce vehicle emissions. Others include switching to alternative fuels, installing emissions controls, and using advanced vehicle technologies such as electric batteries or fuel cells. Many of these strategies require action on the state and federal level to set policies, designate funding, and create incentives; however, some actions can be taken locally to support these efforts.

Next Steps:

- Lobby for increased CAFE standards.
- Support state policies such as the LEV/ZEV sales mandate development of a greenhouse gas emission standard for all passenger vehicles and light duty trucks, and tiered registration fees based on vehicle size or emissions rather than cost.
- Introduce tiered parking rates based on vehicle size in privately owned parking facilities and City operated garages.
- Promote bridge toll and HOV lane waivers for AFVs.
- Lobby regional agencies to open clean vehicle grants for private sector uses so that public entities can implement projects targeting private sector fleets in their communities.
- Support the expansion of City Car Share to increase the accessibility and availability of this service throughout the City.
- Continue implementing San Francisco's Environment Code, Chapter 4, purchasing AFVs for the City fleet and developing AFV fueling infrastructure in the community, facilitating conversion of private sector fleets, rightsizing and downsizing the City's fleet, and creating carsharing vehicle pools.
- Replace old and highly polluting Muni buses with cleaner technologies.
- Develop a plan to encourage the county's residents to purchase AFVs.
- Participate in fuel cell vehicle demonstration projects.

Implementing Agencies:

San Francisco agencies: Department of Administrative Services (City fleet operator), SF Environment, Board of Supervisors, Department of Parking and Traffic

Other agencies: California State Legislature, California Air Resources Board (CARB), Bay Area Air Quality Management District, Department of Motor Vehicles (DMV), private sector fleet operators

Funding Sources:

San Francisco Transportation Authority, Bay Area Air Quality Management District, Metropolitan Transportation Commission, U.S. EPA

Progress Indicators:

- Increase in average vehicle fuel efficiency (reported annually by EPA)
- Creation of a state-wide greenhouse gas emissions standard
- Decrease in the number of large and/or inefficient vehicles registered in San Francisco
- Increase in the number of small, efficient, and/or alternative fuel vehicles registered
- Increase in the use of City Car Share vehicles
- Increase in the number/percentage of clean vehicles in the City fleet
- Increase in the percentage of clean air Muni vehicles
- Increase in the number of alternative fueling stations in the City with public access
- Increase in the number of private fleets implementing clean vehicle technology
- Implementation of fuel cell vehicle demonstration projects

Energy Efficiency

The energy sector accounts for approximately 50 percent of San Francisco's CO_2 emissions. Actions to improve energy efficiency in buildings include incentives, direct installation and technical assistance programs aimed at each of the major building sectors – residential, commercial, and municipal; education and outreach programs aimed at building users, operators, designers and builders; and legislation, codes and standards which support energy efficient design and practices.

A. Incentives, Direct Installation and Technical Assistance

Demand side management programs such as incentives, direct installation and technical assistance help utility customers install energy efficient equipment and to design and operate their homes, businesses and facilities more efficiently. These programs can include rebates, financing, energy surveys, design, engineering, expedited approval processes, project management assistance, and turnkey energy retrofit projects. Programs are available to each of the three major market sectors: residential, commercial, and municipal.

Residential Buildings

Public Goods Charge (PGC) funded multifamily and single-family residential demand side management programs should be continued and expanded.

Next Steps:

- Continue implementation of SF Environment/PG&E Peak Energy Pilot (PEP) commercial programs.
- Develop agreements with organizations representing tenants, apartment owners, property managers, homeowners, and developers.
- Conduct bulk purchasing programs and trade-in events.
- Implement energy audit and retrofit programs for multi-family buildings with high energy use.
- Train contractors to test and retrofit residential buildings to improve program effectiveness.
- Obtain energy and peak load data to measure and evaluate progress.
- Establish a position in the Planning and Building Inspection departments for a specialist who will be responsible for providing advice and guidance on energy efficiency design, technologies, and incentives for new construction and remodeling projects submitted for permits.

Implementing Agencies:

PG&E, Department of Environment (SF Environment), Planning Department, Department of Building Inspection

Funding Sources:
Utility ratepayers (through Public Goods Charges), California Energy Commission (CEC), U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA)

Progress Indicators:
- Decreased demand (kilowatts) and energy use (kilowatt-hours, therms)
- Increased program participation rates

Commercial Buildings

Public Goods Charge (PGC) funded commercial demand side management programs should be continued and expanded. These programs should be customized for the San Francisco building stock.

Next Steps:
- Continue implementation of SF Environment/PG&E Peak Energy Pilot (PEP) commercial programs.
- Develop agreements with local business organizations.
- Identify high-energy use buildings and businesses.
- Increase training of building operations and maintenance staff.
- Design and implement efficiency retrofit programs that include turnkey services.
- Promote peak load reduction and peak pricing tariffs.
- Obtain energy and peak load data to measure and evaluate progress.

Implementing Agencies:
PG&E, SF Environment

Funding Sources:
Utility ratepayers (through Public Goods Charges), CEC, DOE, EPA

Progress Indicators:
- Decreased demand (kilowatts) and energy use (kilowatt-hours, therms)
- Increased program participation rates

Municipal Buildings

The San Francisco Public Utilities Commission (SFPUC) implements projects in the public sector for Hetch Hetchy customers, which include City buildings and facilities such as fire stations, police stations, libraries, hospitals, sewage treatment facilities, convention centers, recreation centers, and San Francisco International Airport. Municipal energy efficiency and demand reduction programs should be continued and expanded.

Next Steps:

- Design and implement comprehensive departmental energy efficiency programs at Muni, the Port, the Airport, SFPUC and other departments.
- Design and implement peak load management and demand response program in City facilities.
- Develop energy design review services for City departments.
- Integrate energy efficient equipment into City purchasing contracts.
- Provide energy efficiency training for building maintenance staff and conservation education for employees.
- Obtain energy use and peak load data to measure and evaluate progress.

Implementing Agency:
SFPUC

Funding Sources:
Hetch Hetchy Water and Power, departmental cost sharing, grants from state and federal agencies

Progress Indicators:
- Decreased demand (kilowatts) and energy use (kilowatt-hours, therms)
- Increased program participation rates
- Number of staff trained
- Energy efficiency is integrated into standard operating procedures

B. Education and Outreach

Raising awareness about the benefits of energy efficiency, available programs, and energy efficient practices will enable residents, students, workers, and building owners to take action. Working with other agencies, the City can develop an energy efficiency education campaign to reach the general public, public and private school students, as well as building management and construction professionals.

Next Steps:
- Set goals for public outreach to businesses and the community.
- Provide a single point of contact for information on programs (e.g. website/hotline).
- Establish a volunteer corps, and develop public education materials.
- Develop energy curricula for use in classrooms.
- Develop agreements with business and community organizations for the preparation and distribution of articles, mailings, and for energy information presentations.
- Develop agreements with local media to cover energy related events.
- Develop agreements with City departments to include energy messages in City mailings, in public facilities and on vehicles, and through normal City inspections.
- Identify local examples and prepare case studies of successful energy efficiency education actions.
- Develop an agreement with PG&E's Pacific Energy Center to coordinate training for building management and construction professionals.

Implementing Agencies:
SF Environment, SF Unified School District, PG&E/Pacific Energy Center

Funding Sources:
Utility ratepayers, California Energy Commission, U.S. Department of Energy, U.S. EPA

Progress Indicators:
- Number of Website hits and hotline contacts
- Number of participants trained

C. Legislation, Codes and Standards

Effective local legislation can reduce local energy use. The City can adopt codes and standards to improve the efficiency of existing residential, commercial and municipal buildings, and can require new construction to be more energy efficient than the current state standards.

Next Steps:
- Develop energy guidelines for an amendment to the Rent Stabilization Act to allow landlords to pass through to tenants the cost of reasonable energy efficiency or renewable energy investments.
- Amend the Residential Energy Conservation Ordinance (RECO) to increase the efficiency of existing housing.
- Reinstate the City's Commercial Energy Conservation Ordinance (CECO).
- Develop new requirements for energy efficient operations and maintenance practices in large commercial properties including requirements for the installation of efficient lighting system demand management controls.
- Develop ordinances to require improved efficiency in new multi-family construction and existing housing.
- Enforce the Green Building Ordinance requiring energy efficient equipment, building commissioning, and LEED green building certification in municipal facilities.

Implementing Agencies:
SF Environment, SFPUC, City Attorney

Funding Sources:
City and state funds and other grants

Progress Indicators:
- Enforcement reports show high level of compliance
- Energy usage reports show decreased demand (kilowatts) and energy use (kilowatt-hours, therms)
- Number of buildings obtaining LEED silver certification

Renewable Energy

Replacing fossil fuel energy with clean renewable energy resources such as solar, wind and biomass reduces local greenhouse gas emissions. San Francisco has voiced strong support for renewable energy through the City's Sustainability Plan, the Electricity Resource Plan, and the passage of ballot measures authorizing debt financing of renewable energy projects and energy efficiency measures.

Developing both large and small-scale renewable energy projects requires: assessing resource potential and costs, identifying appropriate sites, developing financing mechanisms, and developing business, labor and consumer demand and support.

A. Renewable Energy Projects

Solar Energy

Maximizing the development of solar energy in San Francisco will require a coordinated effort to facilitate installation of solar photovoltaic systems on commercial, residential and municipal facilities in the City. To this end, SFPUC and SF Environment are jointly implementing the Generation Solar Program.

Next Steps:

- Identify high value sites for solar projects (e.g. roofs with proper orientation).
- Create transparency in specifications and prices for solar electric technology.
- Catalogue and publicize financing options for consumers.
- Assist in matching solar early adopters with qualified installers.
- Provide training for solar installation and appropriate linkages with labor organizations.
- Reduce city permit fees and streamline permit process.
- Encourage studies of benefits and costs to local electricity distribution system of large-scale distributed generation installations.
- Troubleshoot grid interconnection process with PG&E.
- Develop a business plan to enable Hetch Hetchy power operation to issue solar revenue bonds.
- Facilitate access to customer incentives and low-interest financing.

Implementing Agencies:
SFPUC, SF Environment

Funding Sources:
SFPUC, debt financing authorized through Proposition B and H, private financing, grants and loans from state and federal agencies

Progress Indicators:

- Increased energy generated by renewable resources (kilowatt-hours)
- Increased number of solar projects installed

Wind Energy

Develop and install wind projects within and outside of San Francisco.

Next Steps:

- Continue to monitor the wind resources within San Francisco and on City-owned property outside the City limits (e.g. Hunters Point Shipyard, Crystal Springs).
- Develop and apply models to quantify the value of energy storage capabilities of the hydroelectric system for adding value to intermittent renewable energy generation such as wind.
- Develop an RFP for 50 megawatts of wind generation to supplement Hetch Hetchy power after the expiration of the Calpine contract.
- Research small-scale wind generators appropriate for urban use.
- Research feasibility of a pilot offshore wind generation capability.
- Investigate benefits of entering into a power purchase contract for new wind generation to take advantage of project tax benefits and reduce city risk.

Implementing Agencies:
SFPUC and SF Environment

Funding Sources:
Financing from Proposition B or H revenue bonds
Financing through a project developer supported by a power purchase contract
Federal production tax credits
State and federal grant funds

Progress Indicators:

- Installed capacity (kilowatts) and energy production (kilowatt-hours)
- Number of sites monitored

Biomass Energy

Sewage treatment biogas can be collected for use in combustion generators to generate electricity.

Next Steps:

- Assess new opportunities for expanding biogas generation at existing City wastewater treatment facilities.
- Identify opportunities for gasification of biomass waste materials for use in modular generation technologies such as fuel cells.

Implementing Agency:
SFPUC

Funding Sources:
SFPUC, Proposition B & H revenue bonds, State and federal grant funds

Progress Indicator:
- Installed capacity (kilowatts) and energy production (kilowatt-hours)

B. Emerging Technologies

Emerging new renewable technologies include hydrogen, fuel cells, tidal current and offshore wave energy generation. The City should assess the resource potential and feasibility for these technologies in San Francisco, and develop partnerships with appropriate agencies to implement demonstration projects.

Hydrogen Fuel Cells

Next Steps:
- Site and install 2 proton exchange membrane fuel cells obtained as part of a grant award from the Department of Energy.
- Implement an "energy station" hybrid fuel cell demonstration project to provide hydrogen for stationary and vehicle fuel cells.
- Develop hydrogen educational materials for schools.
- Develop network of City staff to champion hydrogen projects.
- Present workshop for policymakers.

Implementing Agencies:
SFPUC, SF Environment

Progress Indicators:
- Completed demonstration projects
- Number of classrooms with educational materials

Tidal Power

Next steps
- Initiate feasibility study on electricity generation from the current flow through San Francisco Bay.
- Create an intra-agency action team to steer a pilot project.
- Develop the pilot project.
- Report on findings.
- Conduct community education and outreach.

Implementing Agency:
SF Environment

Funding Sources:
Grants from state and federal agencies (e.g. CEC, DOE) and foundations
Project financing with manufacturer or developer

Progress Indicators:
- Feasibility study findings and recommendations
- Completed demonstration project

C. Green Power Purchasing

Existing renewables currently make up approximately 11% of the state power grid. Strategies for increasing this percentage are to create a market for renewable resources and create requirements for the development of those resources. The City should support opportunities for City residents, businesses, and municipal facilities to purchase electricity generated from renewable energy resources – "green power".

Next Steps:
- Evaluate community choice aggregation for a citywide power purchasing pool, as approved under Assembly Bill 117.
- Support accelerated implementation of the state's Renewable Portfolio Standard.
- Support legislation that would allow solar generation on city facilities that export power to the grid to be compensated for those power exports.

Implementing Agency:
SFPUC

Funding Sources:
SFPUC

Progress Indicator:
- Megawatt-hours of renewable energy purchased

Solid Waste

Recycling has the dual benefits of reducing landfill and reducing greenhouse gas emissions. Expansion of citywide recycling and composting programs in the residential and commercial sectors, increased construction and demolition waste recycling, and increased source reduction and recycling in municipal buildings will move San Francisco towards achieving its 75% landfill diversion goal as well as its greenhouse gas emissions reduction goals.

A. Residential Recycling and Composting

Increasing diversion of residential waste from the landfill will require expanding residential recycling programs, including all types of paper, cardboard, glass, metal and plastic containers, wood, film plastic and other common household materials. The City should increase outreach, serve apartment buildings, add new materials to recycle and adopt mandatory polices which will result in substantial increases in diversion of residential recyclable material.

Next Steps:

- Expand recycling and composting services for the City's apartment buildings, particularly for the 133,000 units in buildings that house 6 units or more.
- Develop equivalent collection services for downtown areas.
- Increase participation through expanded outreach.
- Add new materials to residential diversion programs.
- Adopt policies for mandatory participation.
- Develop waste diversion strategies and programs with the City's Environmental Justice Program to better serve SF Housing Authority and other low-income housing.
- Promote building owner/manager and resident participation in waste diversion programs.

Implementing Agencies:
SF Environment, Norcal Waste Systems, Inc.

Funding Sources:
Garbage Ratepayers, California Department of Conservation

Progress Indicator:

- Tons of waste diverted from landfill

B. Commercial Recycling and Composting

Recyclable material diversion can be greatly increased by expand commercial recycling programs, including all types of paper, cardboard, glass, metal, plastic, wood, light metals, film plastic and other common industrial materials. Similarly, compostable material diversion can be increased by expanding commercial organics collection and composting programs through outreach, by requiring use of compostable products and by adopting mandatory policies. Continuing and expanding these programs will result in substantial increases in diversion of commercial recyclable material from the landfill.

Next Steps:

- Complete commercial recycling and composting collection programs rollout per garbage rate plan.
- Target generators, conduct waste audits, provide training and other assistance, and collaborate with associations (e.g., BOMA, restaurant and hotel associations), service providers, unions and others to increase diversion.
- Expand outreach, including promote participation in waste diversion programs by building owners/managers and employees.
- Monitor new organics processing, Pier 96 commercial recycling lines and Tunnel Avenue construction and demolition debris lines to ensure they are being used to their fullest capacity.
- Develop markets, add materials eligible for recycling and composting collection, and promote buying recycled.
- Integrate environmental justice considerations into commercial waste diversion program plans.
- Provide incentives (such as tiered rates, awards programs) for increased participation.
- Research and recommend legislation to increase diversion.

Implementing Agencies:
SF Environment, Norcal Waste Systems, Inc.

Funding Sources:
Garbage Ratepayers, California Department of Conservation

Progress Indicator:

- Tons of waste diverted from landfill

C. Construction and Demolition Debris Recycling

Construction and Demolition (C&D) debris represents a significant portion of the waste stream in San Francisco, up to 20% depending on materials included. Increasing C&D diversion will therefore have a great impact on overall solid waste reduction.

Next Steps:

- Complete Norcal's new Materials Recovery Facility and monitor operations to expand capacity for

C&D diversion.
- Expand outreach, including promote participation in waste diversion programs by building owners/managers and contractors.
- Develop new markets for C&D waste (e.g. sheetrock).
- Develop policies for mandatory participation (e.g. C&D debris recycling ordinance).

Implementing Agencies:
SF Environment, Norcal Waste Systems Inc., Specialty Crushing

Funding Sources:
Building owners and contractors

Progress Indicator:
- Tons of waste diverted from landfill

D. Alternate Collection Methods

A number of recycling programs do not fall under Norcal's programs or other processing programs. These include donations at community recycling centers, buy-back of California Redemption Value (CRV) beverage containers, and numerous collection programs operated by non-profit organizations or independent companies such as paper dealers; re-use centers like Goodwill for furniture and textiles; and electronic waste reuse and recycling. Developing new programs in this area that will result in increases in diversion of materials in this group.

Next Steps:
- Provide technical assistance and financial support (e.g., grants and contracts) to organizations to increase waste prevention, reuse, recycling and composting diversion.
- Expand outreach to support these programs.

Implementing Agencies:
SF Environment, Norcal Waste Systems, Inc., private recyclers (e.g., Circosta Iron and Metals) and non-profit recyclers (e.g., San Francisco Community Recyclers)

Funding Sources:
Garbage Ratepayers, California Department of Conservation

Progress Indicator:
- Tons of waste diverted from landfill

E. Source Reduction, Reuse and Other Waste Prevention

Encourage producers to be responsible for the waste associated with the products they manufacture and distribute – during production, packaging and at the end of the product's life. Increase the recyclability or compostability of selected product types and secure producer participation and/or funding to collect and divert them from landfill.

Next Steps:

- Increase waste audits as a step to increasing waste prevention.
- Work with other cities, counties and stakeholders to enact State electronics producer responsibility legislation.
- Identify additional reusable, recyclable and compostable products with recycled content, direct purchases to such alternatives, and evaluate buying recycled progress.
- Research and recommend local packaging producer responsibility legislation.
- Increase outreach (e.g. brochures, media campaigns, grants) and assistance to businesses and purchasers on purchasing and using recycled and/or recyclable/compostable products.
- Research and promote using products that require less materials (e.g. double sided copying).

Implementing Agencies:
SF Environment, Norcal Waste Systems, Inc. and other organizations (e.g., and San Francisco League of Urban Gardeners)

Funding Sources:
Garbage Ratepayers, California Department of Conservation, California Integrated Waste Management Board

Progress Indicator:

- Increased tons of waste diverted from landfill

F. Municipal Programs

By minimizing purchase of products made from virgin materials and maximize those that are recyclable or compostable, City government diversion can be increased from an estimated 40% to more than 50% by 2005.

Next Steps:

- Update City department database, conduct waste audits at each location, provide training and other assistance, collaborate with service providers, unions and others, and evaluate Resource Conservation Ordinance compliance.
- Strengthen Resource Conservation Ordinance to increase City departments' diversion programs and purchases of recycled content products (e.g. post consumer content paper) and compostables (e.g. food service products).

- Provide technical assistance (e.g. training for city staff to participate in programs).

Implementing Agencies:
SF Environment, Norcal Waste Systems, Inc.

Funding Sources:
Garbage Ratepayers, California Department of Conservation

Progress Indicator:
- Increased tons of waste diverted from landfill

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- Windmills: National Renewable Energy Laboratory
- Composting: Larry Strong, Norcal Waste Systems, Inc.

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- Page ES-7 - Windmills: National Renewable Energy Laboratory
- Page ES-8 - Composting: Larry Strong, Norcal Waste Systems, Inc.

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- Page 1-7 - "Hurricane Elena, Gulf of Mexico": Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center
- Page 1-9 - Figure 1.5 Global Sea Level Rise Scenarios: IPCC, 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. Van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA
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- Page 1-11 - Figure 1.7 Effect of a 1 Meter Sea Level Rise on San Francisco Bay: Gleick, Peter H. and Maurer, Edwin P., Pacific Institute for Studies in Development, Environment and Security, and Stockholm Environmental Institute. 1990.
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- Page 1-17 - Pacifica cliffs: Federal Emergency Management Agency, Andrea Booher, 1998-03-09.

Chapter 2

- Page 2-17 - Figure 2.13 Greenhouse Gas Sources and Sinks Associated with the Material Life Cycle: Solid Waste Management and Greenhouse Gases, A Life-Cycle Assessment of Emissions and Sinks, U.S. EPA, EPA 530-R-02-006, May 2002, 2nd Edition.

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- Page 3-9 - Police officer on bicycle: San Francisco Department of the Environment
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Appendix A

CO_2 Reduction Estimates Assumptions

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions
Transportation		
A. Increase the Use of Public Transit as an Alternative to Driving	87,000	2% reduction in both San Francisco and intraregional auto and light truck Vehicle Miles Traveled (VMT) due to increased use of transit. Represents: 1) Approx. 26 million more annual person-trips made by transit rather than auto/light truck in SF, or a 11% increase in current Muni ridership; and 2) Approx. 6.6 million more annual intraregional person-trips made by transit than by auto/light truck.
B. Increase the Use of Ridesharing as an Alternative to Single Occupancy Driving	42,000	5% reduction in intraregional VMT for work trips made by auto and light truck. Represents: Approx. 8.2 million annual auto/light truck trips shift to rideshare trips. In terms of a commute to work five days per week, this represents approx. 16,800 people switching from Single Occupancy Vehicles (SOVs) to ridesharing for their daily commute.
C. Increase Bicycling and Walking as an Alternative to Driving	10,000	5% increase in total bicycle and pedestrian trips in SF. Represents: 9.4 million new annual bicycle and pedestrian trips in SF, with 4.7 million (50%) new bicycle and pedestrian trips replacing SOV trips (the remaining 50% replace transit trips). Note: These are one-way trips. Round trips would be 4.7 million total new annual bike/ped trips and 2.4 million new bike/ped trips replacing SOVs.

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions
Transportation		
D. Support Trip Reduction Through Employer-Based Programs	28,000	2% reduction in VMT for intraregional auto/light truck work trips and 1% reduction in VMT for auto/light truck work trips in SF, due to commuters switching to alternative modes. <u>Represents</u>: 3.3 million one-way annual intraregional vehicle trips (1.6 million round-trips) and 3.2 million one-way annual vehicle trips in SF (1.6 million round trips). In daily trips, this is 9,000 daily one-way intraregional trips reduced (4,500 round-trips) and 9,000 daily one-way SF trips reduced (4,400 round-trips).
E. Discourage Driving	155,000 Congestion Pricing: 111,000 Other Disincentives: 44,000	10% reduction in SF auto/light truck VMT for work trips, due to congestion pricing discouraging driving; 1% reduction in both SF and intraregional auto/light truck VMT for all other disincentive measures discouraging driving. <u>Represents</u>: 1) Congestion pricing: 16.4 million one-way annual vehicle trips reduced (8.2 million round-trips). In daily trips this is 45,000 daily one-way intraregional vehicle trips reduced (22,000 daily intraregional round-trips reduced). *Current annual one-way trips are 350 million (956,000 per day).* 2) Other measures: 3.3 million one-way intraregional vehicle trips reduced (1.6 million round-trips) and 13.0 million one-way SF vehicle trips reduced (6.5 million round-trips). In daily trips this is 9,000 daily one-way intraregional trips reduced (4,500 daily intraregional round trips reduced) and 36,000 daily one-way SF vehicle trips reduced (18,000 daily SF round-trips reduced).

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions
Transportation		
F. Increase the Use of Clean Air Vehicles and Improve Fleet Efficiency	641,000 CAFÉ Standards: 555,000 Other Clean Air Vehicle Measures: 86,000	Increase in CAFÉ standard of 5 mpg for autos and light trucks combined. Improvement in average fuel efficiency due to all other clean air vehicle measures: 2% increase in average mpg for autos/light trucks combined. <u>Represents</u>: Current CAFÉ Standards are 27.5 mpg autos and 20.7 mpg light trucks, for an average of 23.59 mpg. Assumes an increase of 5 mpg to 28.59 mpg in 2005. By 2012, this new standard would be affecting approximately one-third of the autos/light trucks on the road. Current average auto/light truck fuel efficiency = 19.82 mpg. Average auto/light truck fuel efficiency with 2% improvement = 20.22 mpg

Average trip length, intraregional trips: 12.3 miles
Average trip length, SF trips: 3.0 miles
Conversion Factors (from *Cities for Climate Protection™ (CCP) U.S. Greenhouse Gas Emissions* software):

Gasoline	1.04×10^{-2} tons eCO_2 per gallon
Diesel	1.05×10^{-2} tons eCO_2 per gallon

See ICLEI CCP U.S. Greenhouse Gas Emissions Software Excerpts, "Transportation Emissions Primer".

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions [1]
Energy Efficiency		
A. Increase Incentives, Direct Installation and Technical Assistance	Residential Buildings: 222,000 Commercial Buildings: 433,000 Municipal Buildings: 45,000	Residential: Expanded efficiency programs: 59.5 gigawatt-hours [2] (GWh), 24.6 million therms; Lighting: 75.5 GWh; Commercial: Building tune-ups: 41.9 GWh, 0.7 million therms; Targeted incentives: 199 GWh, 13 million therms; Large Account energy management services: 228 GWh, 1.7 million therms; Turnkey retrofit services: 165 GWh, 1.3 million therms. Municipal: Estimated savings potential for selected lighting and HVAC efficiency measures in the top 25 energy-using City departments. 58 GWh, 2.5 milion kWh
B. Expand Outreach and Education	36,000	28.4 GWh, 3.4 million therms
C. Strengthen Legislation, Codes and Standards	65,000	123 GWh, 0.2 million therms

[1] Assumptions of savings potential and participation rates for residential and commercial energy efficiency measures and impacts of outreach and legislation by Brown Vence & Associates based on CEC end use data, PG&E PGC-funded program data, and technical potential data from *California Statewide Commercial Sector Energy Efficiency Potential Study,* Xenergy, Inc. July 9, 2002.

[2] 1 gigawatt-hour (GWh) = 1 million kilowatt-hours (kWh)

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions
Renewable Energy		
A. Develop Renewable Energy Projects	Solar Energy: 35,000 Wind Energy: 239,000 Biomass Energy: 44,000	San Francisco meets 2012 Electricity Resource Plan [3] goals. 68 GWh per year solar generation. 460 GWh per year wind generation. 84 GWh per year biomass generation.
B. Conduct Pilot Projects for Emerging Technologies	N/A	Research and development projects. No CO_2 reduction assumed.
C. Support and Develop Green Power Purchasing	230,000	25% of San Francisco's imported electricity comes from renewable sources. 3,409 GWh x .25 = 852 Gwh total green goal – 3,409 GWh x .12 = 409 Gwh baseline green = 443 GWh of new renewable power in 2012.

Conversion Factors:
Natural gas: 6.16×10^{-3} tons eCO_2 per therm [4].
CO_2 Electricity Coefficient: 1.52×10^{-1} tons eCO_2 per million BTU, 520 tons eCO_2 per GWh.
The CO_2 electricity emissions coefficient is not a physical constant and contains many variables. Electricity is generated from a number of primary energy sources. Some are large sources of CO_2 emissions (e.g., coal combustion) while others result in virtually no CO_2 emissions (e.g., hydro). The mix of generation resources used to meet loads can vary by time of day and by season. Also, electricity is transported over long distances by complex transmission and distribution systems, so the generation of power often occurs far from the point at which that energy is consumed.

For the purposes of this report, an *average* emissions factor (electricity coefficient)[5] for San Francisco was estimated and applied to both baseline emissions and estimated CO_2 emissions reductions resulting from the recommended actions. A more accurate way to estimate the impact of electricity reduction actions may be to use a *marginal* emissions factor- one that reflects the likely generation source/type being affected by energy efficiency and renewable actions. The California Energy Commission is reviewing greenhouse gas emissions protocols for the State. City staff will continue to monitor the progress and results of these studies.

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[3] *Electricity Resource Plan: Choosing San Francisco's Energy Future*. December 2002.

[4] *Cities for Climate Protection™ U.S. Greenhouse Gas Emissions* software.

[5] California coefficient (1.64×10^{-1} tons eCO_2 per million BTU) from *Cities for Climate Protection™ U.S. Greenhouse Gas Emissions* software, adjusted to reflect San Francisco's power mix. See ICLEI CCP U.S. Greenhouse Gas Emissions Software Excerpts, "Electricity Coefficients"

CO_2 Reduction Estimates Assumptions

Action Category	Estimated CO_2 Reduction (tons)	Assumptions
Solid Waste		
A. Increase Residential Recycling and Composting	70,000	154,471 tons recyclables diverted 68,781 tons compostables diverted
B. Increase Commercial Recycling and Composting	109,000	186,025 tons recyclables diverted 79,275 tons compostables diverted
C. Expand Construction and Demolition Debris Recycling	57,000	493,054 tons construction and demolition waste diverted
D. Support Alternative Collection Methods for Recyclable Materials	66,000	159,409 tons waste diverted
E. Promote Source Reduction, Reuse, and Other Waste Reduction	N/A	Unknown materials breakdown. Savings not estimated
F. Expand Municipal Programs	N/A	CO_2 reduction estimates included under category B. above, Increase Commercial Recycling and Composting.

75% average diversion rate

Landfill Methane Recovery Factor:
1990 75%
2012 95%

Waste Coefficients: See ICLEI Cities for Climate Protection™ U.S. Greenhouse Gas Emissions Software Excerpts, "Waste Sector Primer and Coefficients."

Transportation Emissions Primer

The quantification framework for the transportation sector of the Community Analysis and Community Measures modules in this software is based on a simple equation for describing the impact of a particular measure or strategy. The following equation separates the VMT component (number of trips, length of trips, number of people per vehicle) from the vehicle fuel efficiency (miles per US gallon) and fuel (emissions/unit of fuel) components. For any particular vehicle type:

CO_2 Emissions	=	Vehicle Miles Traveled	X	CO_2 Emissions per Vehicle Mile
CO_2	=	(VMT)	X	(CO_2/VMT)

The two terms in this equation -- VMT and CO2/VMT -- break down further. First, there is the VMT term, which tracks the three determinants of VMT for any particular mode:
Vehicle Miles Traveled = (Person-Trips/Persons per vehicle) X Trip Length (km)
The term in brackets represents vehicle-trips. The difference between the number of individual person-trips and the number of vehicle-trips depends on how many people there are in the vehicle. The vehicle occupancy factor (persons per vehicle) is critical and is the main reason why transit and carpooling are such effective ways of reducing emissions per passenger mile of travel.

The second factor -- CO_2/VMT -- also breaks down to separate factors describing the fuel efficiency of the vehicle and the CO_2 intensity of the fuel being used:
CO_2 per VMT = Fuel Efficiency (i.e. miles per US gallon) X Emissions per Unit of Fuel (the fuel type factor)
Combining these factors leads to the five factor formula for transportation emissions:
CO_2 Emissions = (A/B) X C X D X E, where

A is the number of person trips made using the vehicle type

B is the number of people per vehicle (occupancy factor)
C is the trip length
D is the fuel consumption (in L/100km)
E is the CO_2 emissions per unit of fuel (i.e. the fuel type factor)

Each one of these factors is determined by a number of other factors (technological, behavioral, structural, etc.), and even these simple factors are not independent. A switch from automobile to diesel transit bus that changes the values of A for cars and buses, for example, usually means D and E go up (bad) but B goes up even more (good). People are more likely to walk or bicycle for short trips (C affects A). For cars, we know that fuel consumption per vehicle mile is higher for short trips (cold start effect) so that when C for cars goes down (good), D goes up (bad).

Any measure for reducing greenhouse gas emissions in the transportation sector can be completely characterized by filling in before or after values for each of the five factors in this formula, and that is the basis for the design of the Transportation Measures Calculator in this software.

Electricity Coefficients

In the U.S. edition of the CCP software, default coefficients are provided that relate emissions of carbon dioxide to kilowatt-hours of electricity end use on at state-by-state and year-by-year basis. Earlier editions of the software used the coefficients that are included with the Department of Energy's Reporting Guidelines for the Section 1605(b) greenhouse gas emissions reporting system (Voluntary Reporting of Greenhouse Gases, Instructions for Form EIA-1605). However, those coefficients do not reflect interstate and international flows of electricity, and these factors are important in developing an end use based emission factor for electricity.

The default coefficients provided here are based on the Energy Information Administration (DOE) database, but use a slightly different method than the one used for the 1605(b) reporting guidelines. The coefficients provided are based on an average annual kilowatt-hour method and are based on annual carbon dioxide emissions from power production, adjusted for net interstate flows. Details of the method and data sources are as follows.

The Numerator (carbon dioxide emissions from power generation)
For each state, carbon dioxide emissions from electricity production are computed based on data from the Energy Information Administration, U.S. Department of Energy's State Energy Data Report, 1997. The State Energy Data Report provides state-by-state estimates of energy inputs at electric utilities by fuel, in natural units and trillion Btu. In order to determine total emissions from electricity production for each state, the amount of coal, natural gas and petroleum utilized are multiplied by their respective carbon dioxide emission coefficients.

For coal-fired power, average carbon dioxide emissions (in pounds per million Btu of coal) for electric utilities can be found in the State Energy Data Report. For each year from 1990 through 1997, the total coal consumed for electric power production in each state was multiplied by the average emissions factor for utility coal in that state to determine total coal-related emissions. The emission factor for each state is an average for all coals consumed in that state. The coals consumed are bituminous coal and lignite for all states except Pennsylvania, where anthracite is also used for electric power production.

Natural gas and both heavy (residual) fuel oil and light (distillate) fuel oil are used by electric utilities in many states. For the purposes of this analysis, an average emissions coefficient was multiplied by electric utility consumption for each petroleum fuel. The emission coefficients for petroleum and natural gas were found in the Energy Information Administration's 1999 Voluntary Reporting of Greenhouse Gases, Instructions for Form EIA-1605, Appendix B. Consistent with the EIA's guidelines and the Cities for Climate Protection protocol, hydroelectric, nuclear, geothermal and biomass generation are considered to have zero emissions of anthropogenic carbon dioxide. (Electricity generation from wood and wood waste is negligible in all states, and is therefore not included in the calculation of state carbon dioxide emissions factors.)

Once electricity production from each fuel has been multiplied by its respective coefficient, total emissions from electricity generation are calculated for each state.

The Denominator (total end use electricity)
Gross end use consumption (including flows to other states) is computed by summing state electric utility net generation and net international imports, then subtracting transmission and distribution losses. Net international electricity imports are all assumed to have been generated at hydroelectric plants, and therefore have zero carbon dioxide emissions factors. Total state carbon dioxide emissions from electric power production are then divided by gross end-use electricity consumption to arrive at a carbon dioxide emissions coefficient expressed in tons per million Btu.

The Adjustment for Inter-State Power Flow
The above coefficient includes both the emissions and the kilowatt-hours associated with net flows of electricity to other states, thus ensuring that a state coefficient will not be inflated due to emissions associated with electricity exports. In circumstances where a state is a net importer of interstate flows of electricity, its electricity emissions coefficient is calculated by creating a weighted average of its state emissions coefficient and a U.S. average electricity emissions coefficient. The weighting is based on the proportion of total end-use electricity consumption originating from state-generated electricity, and from net interstate imports. A U.S. average is used for net interstate imports because the origin of interstate electricity flows is not known. The U.S. average emissions coefficient was calculated using the same method as that described above for individual states, except that net interstate flows of electricity are not relevant. Data on electric utility generation, transmission and distribution losses, international and interstate flows of electricity was taken from the State Energy Data Report.

Criteria Emission Coefficients
The emission coefficients for criteria pollutants resulting from electricity were based on data compiled by the Environmental Protection Agency. Here, the EPA (2000) estimated emissions of NOx, CO and VOC using a 'bottom up' approach for a number of general fuel categories, including coal, fuel oil, natural gas, wood, and other fuels. Here, we were interested in three fuel types specifically; coal, fuel oil, and natural gas, as U.S. energy balances showed that it is these three primary fossil fuels that are used for electricity generation in the United States. The EPA (2000) supplied both total fuel consumptions for the utility sector, and the final emissions of the criteria air pollutants NOx, CO, and VOC.

Here, the following equation was used to establish final emissions:

Ep,s = As * Efp,s * (1-Cp,/100)

where

As= total fuel consumption
E = emissions
P = pollutant
S = source category
EF = emission factor
C = percent control efficiency

The method used by the EPA (2000) considered emission controls, which differs from the IPCC defaults, which do not consider emission controls. Using the data from the above calculations, we used the following equation to calculate the final emission coefficients for NOx, CO and NMVOC to be used for all fuels:

Ef/Cf
where
Ef = final total emissions from source category
Cf = final total consumption by source category

We used the resulting coefficient factors for the criteria pollutants for coal, natural gas, and fuel oil, in conjunction with the energy consumption statistics for electricity production found in the State Energy Data Report.

The CO_2 Coefficients

The attached table lists the default coefficients used in the Cities for Climate Protection Greenhouse Gas Emissions Software to represent the carbon dioxide emissions from the end use of electricity. These coefficients are based on total carbon dioxide emissions from electricity production in the state (adjusted for net interstate flows), divided by the annual end use consumption of kilowatt-hours in the state.

Electricity CO_2 Emission Coefficients (all values in tons of CO_2 per million BTU)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Alabama	0.225	0.217	0.215	0.231	0.212	0.229	0.204	0.202	0.221	0.216
Alaska	0.203	0.205	0.197	0.179	0.143	0.174	0.179	0.164	0.186	0.194
Arizona	0.180	0.167	0.171	0.183	0.180	0.163	0.154	0.156	0.157	0.163
Arkansas	0.200	0.194	0.204	0.179	0.192	0.226	0.199	0.192	0.221	0.216
California	0.162	0.159	0.160	0.147	0.157	0.143	0.147	0.159	0.148	0.164
Colorado	0.327	0.320	0.326	0.319	0.319	0.319	0.333	0.312	0.317	0.313
Connecticut	0.099	0.142	0.098	0.061	0.072	0.080	0.190	0.237	0.190	0.110
DC	0.218	0.214	0.216	0.217	0.215	0.211	0.213	0.215	0.270	0.256
Delaware	0.325	0.322	0.317	0.299	0.279	0.267	0.272	0.269	0.221	0.216

Electricity CO_2 Emission Coefficients (all values in tons of CO_2 per million BTU)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Florida	0.234	0.238	0.231	0.229	0.223	0.218	0.224	0.228	0.225	0.221
Georgia	0.215	0.208	0.198	0.205	0.210	0.217	0.225	0.227	0.220	0.221
Hawaii	0.275	0.269	0.270	0.266	0.260	0.259	0.258	0.261	0.288	0.289
Idaho	0.133	0.132	0.162	0.132	0.154	0.123	0.102	0.094	0.111	0.115
Illinois	0.155	0.157	0.145	0.157	0.165	0.160	0.176	0.207	0.199	0.157
Indiana	0.330	0.329	0.327	0.328	0.328	0.332	0.334	0.344	0.331	0.331
Iowa	0.308	0.299	0.305	0.302	0.296	0.304	0.309	0.295	0.309	0.307
Kansas	0.279	0.292	0.268	0.282	0.277	0.273	0.287	0.285	0.264	0.277
Kentucky	0.301	0.301	0.299	0.306	0.306	0.301	0.301	0.305	0.304	0.311
Louisiana	0.202	0.206	0.220	0.210	0.213	0.206	0.212	0.212	0.212	0.215
Maine	0.063	0.041	0.063	0.056	0.020	0.109	0.029	0.151	0.023	0.009
Maryland	0.257	0.227	0.216	0.216	0.218	0.208	0.209	0.214	0.216	0.216
Massachusetts	0.225	0.227	0.225	0.225	0.212	0.221	0.216	0.222	0.209	0.208
Michigan	0.245	0.233	0.250	0.224	0.249	0.234	0.232	0.242	0.288	0.268
Minnesota	0.241	0.227	0.225	0.217	0.217	0.230	0.217	0.204	0.161	0.170
Mississippi	0.212	0.198	0.210	0.221	0.204	0.208	0.206	0.209	0.228	0.230
Missouri	0.281	0.276	0.283	0.269	0.279	0.280	0.302	0.302	0.290	0.292
Montana	0.212	0.206	0.244	0.217	0.242	0.243	0.166	0.187	0.220	0.211
Nebraska	0.218	0.216	0.205	0.239	0.239	0.233	0.215	0.221	0.237	0.217
Nevada	0.300	0.293	0.297	0.296	0.307	0.281	0.284	0.265	0.260	0.258
New Hampshire	0.148	0.109	0.097	0.095	0.116	0.094	0.080	0.116	0.086	0.084
New Jersey	0.164	0.158	0.169	0.162	0.166	0.181	0.210	0.200	0.159	0.154
New Mexico	0.320	0.314	0.317	0.318	0.309	0.318	0.314	0.318	0.313	0.317
New York	0.171	0.159	0.163	0.151	0.140	0.152	0.139	0.148	0.153	0.149
North Carolina	0.188	0.183	0.208	0.213	0.187	0.196	0.202	0.205	0.195	0.200
North Dakota	0.340	0.348	0.346	0.339	0.342	0.339	0.327	0.335	0.355	0.348
Ohio	0.284	0.278	0.277	0.287	0.281	0.273	0.287	0.277	0.279	0.275
Oklahoma	0.267	0.275	0.272	0.268	0.278	0.271	0.311	0.292	0.279	0.277
Oregon	0.012	0.025	0.033	0.051	0.073	0.027	0.039	0.020	0.040	0.033
Pennsylvania	0.202	0.203	0.195	0.200	0.187	0.191	0.190	0.193	0.202	0.178
Rhode Island	0.226	0.221	0.195	0.194	0.209	0.165	0.136	0.143	0.068	0.086
SouthCarolina	0.106	0.109	0.103	0.112	0.116	0.104	0.123	0.127	0.123	0.128
South Dakota	0.161	0.167	0.160	0.203	0.130	0.117	0.089	0.096	0.129	0.115
Tennessee	0.215	0.205	0.217	0.265	0.227	0.216	0.206	0.198	0.192	0.200
Texas	0.259	0.254	0.250	0.260	0.245	0.237	0.239	0.242	0.240	0.244
Utah	0.305	0.312	0.307	0.306	0.305	0.294	0.339	0.304	0.296	0.296
Vermont	0.002	0.003	0.003	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Virginia	0.183	0.186	0.187	0.193	0.184	0.182	0.186	0.190	0.208	0.207
Washington	0.026	0.027	0.065	0.070	0.067	0.022	0.026	0.022	0.034	0.027
West Virginia	0.300	0.303	0.304	0.306	0.304	0.300	0.294	0.302	0.300	0.303
Wisconsin	0.251	0.248	0.245	0.248	0.245	0.227	0.260	0.496	0.257	0.252
Wyoming	0.338	0.336	0.339	0.337	0.335	0.328	0.327	0.331	0.342	0.367

Waste Sector Primer and Coefficients

The factors in this software that are used to compute the greenhouse gas emissions from waste and the emission reductions from waste reduction and recycling measures, are based on U.S. EPA research. As of July 2001, these numbers are under review. As soon as a revised set of emission factors are released by the EPA, we will incorporate them in the software.

Early in the CCP campaign, it became apparent that local governments needed to be able to quantify not only the methane emissions from "waste-in-place" but also the greenhouse gas emissions that will eventually result from organic waste that is sent to landfill in the inventory year. This is the waste that is subject to three R programs and this is the largest lever many local governments have for reducing waste-related greenhouse gas emissions. We set about to develop algorithms, based on the modified Scholl Canyon method, for computing the methane emissions that would eventually result from organic waste sent to landfills in the inventory year and we embedded this "methane commitment" method in the CCP software. In these early editions, only methane emissions were counted, in both the Analysis and Measures modules. No account was taken of sequestration impacts at the landfill in the inventory (Analysis module) calculations and no account was taken of full cycle emission reductions from landfill diversion measures (three R's) in the Measures modules.

As research became available, we began to incorporate full cycle emission impacts in the Measures modules of the software. They were not and are still not included in the inventory (Analysis) modules as to do so would result in double counting of those emissions (the upstream emitters themselves will already have counted them). In the Measures modules, however, where the GHG impacts of waste recycling, reduction and composting measures are computed, it is both possible and desirable to attribute upstream emission reductions to the measures. There is no double counting because it is emission reductions rather than emissions that are being counted.

In 1998, the publication of the EPA's final report on the greenhouse gas implications of waste management strategies (U.S. Environmental Protection Agency, Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste – Final Report, Prepared for the U.S. Environmental Protection Agency under EPA Contract No. 68-W6-0029, September 1998), provided an opportunity for further revisions to CCP Greenhouse Gas Emissions software.

In the interests of consistency with the EPA, earlier and more sophisticated algorithms have been replaced with a simple algorithm that is consistent with the coefficients in the EPA report. In addition, for the first time the CCP software takes explicit account of the carbon sequestered in landfills, a revision which can have the effect of changing the results of the model's computations from positive to negative for total greenhouse gas emissions at landfills with high rates of methane recovery.

Essentially, GHG emissions and emission reductions from waste and waste diversion measures are now computed according to a simple equation:

[Equivalent CO_2 Emissions = (Quantity of Waste of Particular Type] * [(1-R)*A + B]

A is a coefficient, with units of tons of eCO_2 per ton of waste, that specifies the landfill methane emissions from the waste (or the avoided methane emissions in the case of waste diversion measures). This is the so-called "methane factor" in the Fuel and Waste Coefficients utility in this software.

B is a coefficient, with units of tons of eCO_2 per ton of waste that reflects the non-methane greenhouse gas emissions or emission reductions associated with the waste or waste measure (mainly CO_2 emissions but some other gases in the case of aluminum recycling for example). This is the so-called "non-methane factor" in the Fuel and Waste Coefficient utility in this software. **R is the rate of landfill gas recovery to be applied**. In the CCP campaign we ask that all inventories by computed using the landfill gas recovery rate that was already extant in the base year of the local action plan and that any landfill gas recovery introduced subsequent to the base year be entered as a Measure in the appropriate module. Thus, target year inventories in our business-as-usual forecasts are computed with the base year landfill gas recovery factor. A separate value of R can be specified to be used when computing the impact of waste reduction measures, thus avoiding double counting any methane that has already been recovered as part of a landfill gas recovery measure implemented since the base year of the plan. The methane recovery factors are set in the Methane Factors item on the Settings Menu in the software.

In the case of the Analysis module, B has been set to zero in all previous versions of the CCP software, but now values of B have been entered to reflect the EPA conclusions on the extent of carbon sequestration in landfills. These new values of B (see Table A) are negative for the organic waste types tracked in the Analysis modules (paper products, food scraps, plant debris, and wood/textiles), reflecting the fact that they are tracking the sequestration of carbon in the landfill (i.e. a "negative" source, or sink). Because the A coefficient is generally larger than the B coefficient, landfills will continue to be characterized as net sources of greenhouse gas emissions in the CCP software unless the value of R (methane recovery) is high enough to reduce the impact of methane emissions below that of carbon sequestration.

In the Measures module, the B factor is used to quantify the upstream greenhouse gas emission reductions that result when various waste types are reduced, recycled or composted. These are generally the energy-related carbon dioxide emissions that are avoided from the enormous energy savings that accrue when the use of energy intensive materials is either reduced or when virgin raw materials (e.g. wood pulp) can be replaced with recycled materials (e.g. recycled paper) in the manufacturing of these materials. These upstream effects occur with all materials, not just organic materials. In fact, some of the largest upstream GHG emission impacts are associated with the reduction or recycling of inorganic materials such as aluminum. The B factors that are shown in the table below reflect the emission impacts relative to landfilling, which is the reference

technology throughout the Waste sectors of the CCP software. As such, they already incorporate the moderating impact of the carbon sequestration at the landfill.

It is important to note how much larger the B factors are for the waste diversion measures than for the inventory waste types. The upstream emission reductions from three R measures are large compared to all the landfill impacts. This is why waste reduction and recycling measures continue to be by far the most effective strategies for reducing the greenhouse gas impacts from waste.

The final column in Table A indicates the net emissions or emission reductions, in tons of eCO_2 per ton of waste, at landfills where 90% of methane is recovered. In the top half of the table, corresponding to the quantification of emissions from landfilled waste, we can see that the net coefficient becomes fairly strongly negative for paper products, plant debris, textiles and wood waste. The carbon sequestration factor is dominating because most of the methane is being recovered. Landfills with high rates of methane recovery will operate as net sinks under these conditions.

On the other hand, a glance at the final column for the bottom part of the table that shows the net impact of recycling and reducing various waste types, it is evident that even after allowing for the sequestration impact and high rates of methane recovery, waste reduction and recycling measures are still much more preferable to landfills in terms of the overall impact on greenhouse gas emissions. The only possible exceptions to this occur for municipal solid waste incineration and composting of plant debris. In the case of the MSW incineration, this is because the net effect of diverting mixed waste from landfill in order to burn it is that the sequestration benefits are totally foregone and the avoided methane emissions are insufficient to offset that loss. Because plant debris has a relatively low methane generation rate in landfills and a relatively high carbon sequestration coefficient, the net effect on greenhouse gas emissions of diverting it from landfill is that a relatively small amount of methane emissions are avoided and a relatively large amount of eCO_2 is released that would have been sequestered.

This is not an argument against composting, which has many benefits independent of its greenhouse gas impacts. Furthermore, the only reason that the coefficient comes out negative is because we have taken landfills as the reference practice and in this reference practice some eCO_2 gets sequestered that would otherwise have been released to the atmosphere as part of the natural carbon cycle. In this sense, the negative coefficient for centralized composting is somewhat misleading, as the eCO_2 released from the compost would have been released in nature in any other reference scenario except landfilling.

With respect to municipal waste incineration, caution should also be used here in attaching too much significance to the negative net coefficient, partly for the same reasons described above for composting and partly because with incineration there may be other offsetting emission benefits. For example, if the incinerator is used to produce electricity, which displaces coal-fired or oil-fired electricity generation, the net greenhouse gas impact can be and in many locations is highly favorable.

The default values for the A and B coefficients being used in this edition of the software are shown in Table A below.

Note that for the waste measures, the B coefficients vary not only by waste type but also by measure type (i.e. reduction vs. recycling). This is because the upstream energy reductions are different (usually greater) for waste reduction measures than for waste recycling measures. The coefficients in the table do not include the energy use by waste collection trucks – in the CCP software, the fuel use of the community's vehicle fleet, including the garbage and recycling trucks, is reported elsewhere. In any event, on a per ton of waste basis, it is relatively insignificant.

The methane related coefficients (the A factors) are all based on an assumption of zero methane recovery at the landfill. In the CCP software, methane recovery factors (R in the equation above) are entered separately and are not incorporated in coefficients. The utilization of recovered landfill gas for various purposes, such as electricity generation, is also treated elsewhere in the CCP software (as a fuel switching measure) and the coefficients in Table A do not reflect any assumptions about landfill gas applications.

Finally, the coefficients for MSW recycling do not contain any credit for ferrous metal recovery. Cities are encouraged to identify and report this explicitly when it is practiced in their community.

TABLE A. Waste Coefficients for CCP Software

	A	**B**	**Net coefficient when R=0**	**Net coefficient when R=0.9**
Analysis Modules – Waste Types				
Positive Represent a Source, Negative a Sink				
Paper Products	1.75	-0.75	1.00	-0.58
Food Waste	1.00	-0.07	0.93	0.03
Plant Debris	0.57	-0.69	-0.12	-0.63
Wood/Textiles	0.51	-0.69	-0.18	-0.64
All Other Waste (inorganic)	0.00	0.00	0.00	0.00

Measures Modules – Waste Type/Measure Type Combinations

Positive represents a reduction relative to landfill, negative a net increase

	A	B	Net when R=0	Net when R=0.9
Mixed MSW – Recycling	0.82	0.50	1.32	0.58
Mixed MSW – Reduced	0.82	0.53	1.35	0.61
Newsprint-Recycling	0.77	1.66	2.43	1.74
Cardboard – Recycling	1.61	1.59	3.20	1.75
Office Paper – Recycling	3.61	2.59	6.20	2.95
Alum. Cans – Recycling	0.00	12.91	12.91	12.91
Steel Cans – Recycling	0.00	1.91	1.91	1.91
Plastic – Recycling	0.00	1.64	1.64	1.64
Wood – Recycling	0.51	0.00	0.51	0.05
Food Waste Composting	1.00	-0.07	0.93	0.03
Plant Debris Composting	0.57	-0.69	-0.12	-0.63
MSW – Incineration	0.82	-0.43	0.39	-0.35
Newsprint – Reduced	0.77	1.82	2.59	1.90
Cardboard – Reduced	1.61	1.86	3.47	2.02
Office Paper – Reduced	3.61	3.27	6.20	2.95
Alum. Cans – Reduced	0.00	9.93	9.93	9.93
Steel Cans – Reduced	0.00	2.78	2.78	2.78
Plastic – Reduced	0.00	2.75	2.75	2.75
Mix Office Paper-Recycled	1.93	2.11	4.04	2.30
Household Paper-Recycled	1.62	1.43	3.05	1.59
Gen. Mix Paper-Recycled	1.75	1.47	3.22	1.65
Glass – Recycling	0.00	0.26	0.26	0.26
Glass – Reduced	0.00	0.47	0.47	0.47
Mixed Recyclables	1.34	1.90	3.24	2.03

Appendix B

U.S. Mayor's Statement on Global Warming, 2003

U.S. MAYORS' STATEMENT ON GLOBAL WARMING 2003

Mayors from across the U.S. are concerned about the impacts of global warming on our communities. Many of us are actively pursuing reductions at the municipal level, but know it will take leadership at the national level to slow the rate of global warming. We urge the Federal Government to focus attention and policy efforts on this critical issue.

Global warming poses significant threats to communities across the country. We are already feeling impacts in the form of heat waves, shrinking water supplies and snow pack, increased rates of asthma, floods and storms, and coastal erosion.

The scientific community is very clear in its warning -- we must act now to significantly reduce greenhouse gas emissions below current levels or we will quickly reach a point at which global warming can not be reversed. This issue requires an effective response from the U.S. Federal Government.

Many local governments across the country have made it a policy priority to reduce greenhouse gas emissions. As mayors, we know that actions that promote energy conservation and efficiency, sustainable transportation (such as expanded mass transit, alternative fuel vehicles, and bike and pedestrian safety amenities) and reduce solid waste also reduce greenhouse gas and criteria pollutants emissions and bring a host of benefits to our communities. These actions reduce financial waste for local governments, businesses and citizens; they make our communities more livable; they increase spending and economic investment in our communities; and they increase the quality of life for current and future generations.

In addition to these benefits, two other reasons have recently emerged that put reducing greenhouse gas emissions at the top of the policy priority list. The first is energy security. Switching to cleaner energy sources, practicing conservation and maximizing energy efficiency will ease U.S. dependence on foreign fossil fuel-based energy, and at the same time improve local air quality and public health.

The second driver is the simple fact that the people in our communities are calling on us as elected leaders to address global warming. A public mandate is emerging in cities and towns across the country calling for governments at all levels to protect the global climate.

As Mayors responsible for the well being of our communities, we urge the federal government to maintain, enhance and implement new domestic policies and programs that work with local communities to reduce global warming pollution.

U.S. MAYORS' STATEMENT ON GLOBAL WARMING 2003

First Signatories
Mayor James Garner, US Conference of Mayors President, Hempstead NY;
Mayor Vera Katz, Portland OR;
Mayor RT Ryback, Minneapolis MN;
Mayor Ed Garza, San Antonio TX;
Mayor Dick Murphy, San Diego CA.

National League of Cities
Mayor John DeStefano, NLC President, New Haven CT
Mayor Karen Anderson, NLC immediate past President, Minnetonka, MN

US Conference of Mayors Leadership
Mayor Thomas Menino, USCM immediate past President, Boston, MA
Mayor Donald Plusquellic, USCM vice-president, Akron, OH

US Conference of Mayors Executive Committee
Mayor Beverly O'Neill, Chair, USCM Advisory Board, Long Beach, CA
Mayor Jerry E. Abramson, USCM Past President, Louisville Metro, KY
Mayor Joseph P. Riley, Jr. USCM Past President, Charleston, SC
Mayor Patrick Henry Hays, North Little Rock, AR
Mayor Sharpe James, Newark, NJ
Mayor Scott L. King, Gary, IN
Mayor Dannel P. Malloy, Stamford, CT
Mayor Arlene Mulder, Arlington Heights, IL
Mayor Meyera E. Oberndorf, Virginia Beach, VA
Mayor Douglas Palmer, Trenton, NJ
Mayor David W. Smith, Newark, CA

US Conference of Mayors Advisory Board
Mayor Irma L. Anderson, Richmond, CA
Mayor Lee P. Brown, Houston, TX
Mayor Willie L. Brown, Jr., San Francisco, CA
Mayor Martin J. Chavez, Albuquerque, NM
Mayor Peter A. Clavelle, Burlington, VT
Mayor Shirley Franklin, Atlanta, GA
Mayor Oscar B. Goodman, Las Vegas, NV
Mayor Harvey Johnson, Jr., Jackson, MS
Mayor Elizabeth B. Kautz, Burnsville, MN
Mayor Laura Miller, Dallas, TX
Mayor Greg Nickels, Seattle, WA
Mayor Judith Valles, San Bernardino, CA
Mayor Shelia Young, San Leandro, CA

Donald Plusquellic, Akron OH
Beverly Johnson, Alameda CA
Martin Chavez, Albuquerque NM
Mary Hammand-Roland, Apple Valley MN
Bob Ornelas, Arcata CA
Arlene Mulder, Arlington Heights IL
Charles Worley, Asheville NC
Alan DeBoer, Ashland OR
Helen Klanderud, Aspen CO
Shirley Franklin, Atlanta GA
Gus Garcia, Austin TX
Joseph Doria Jr., Bayonne NJ
Michael Hurley, Belfast ME
Mark Asmundson, Bellingham WA
Tom Bates, Berkeley CA
Thomas Menino, Boston MA
William R. Toor, Boulder, CO
Joseph Scarpelli, Brick NJ
John Fabrizi, Bridgeport CT
John Yunits, Brockton MA
Anthony Masiello, Buffalo NY
Stacey Murphy, Burbank CA
Peter Clavelle, Burlington VT
Elizabeth Kautz, Burnsville MN
Michael Sullivan, Cambridge MA
Rocky Randels, Cape Canaveral FL
Michael Nelson, Carrboro NC
Kevin Foy, Chapell Hill, NC
Joseph P. Riley, Jr., Charleston SC
William Ward, Chesapeake VA
Ivan Fende, Chocolay Charter MI
Stephen Padilla, Chula Vista CA
Mike Nixon, Cloverdale CA
Helen Berg, Corvallis OR
Janet Kurvers, Cotati CA
Keith Villere, Covington LA
Laura Miller, Dallas TX
James Jadwin, Dayton MN
Jeff Perlman, Delray Beach FL
Euline Brock, Denton TX
Gary Doty, Duluth MN
William V. Bell, Durham NC
Robert Bowser, East Orange NJ
Patsy Jo Hillard, East Point GA
Daniel Harshman, Edinburg VA
Lorraine Morton, Evanston IL
David L. Ganz, Fair Lawn NJ
Dan Coody, Fayetteville AR
Mike Moncrief, Fort Worth TX
Thomas Bussing, Gainesville FL
Thomas Longo, Garfield Heights OH
Scott King, Gary IN
Joy Cooper, Hallandale Fl
Carl Amento, Hamden CT
Stephen Reed, Harrisburg PA
Roberta Cooper, Hayward CA
Leah Gold, Healdsburg CA
James Garner, Hempstead NY
Mara Giulianti, Hollywood FL
Jeremy Harris, Honolulu HI
Lee Brown, Houston TX
Frank Petrone, Huntington, NY
Roosevelt F. Dorn, Inglewood CA
Alan J. Cohen, Ithaca NY
Harvey Johnson, Jackson MS
Alberto Santos, Kearny NJ
Michael Blastos, Keene NH
James Weekley, Key West FL
Filemon Esquivel, Jr., Kingsville TX
Don Wright, LaConner WA
John D. Medinger, La Crosse WI
Robert Blais, Lake George Village NY
Oscar Goodman, Las Vegas NV
Jim Daley, Little Rock AR
Beverly O'Neill, Long Beach CA
Jerry E. Abramson, Louisville KY
Dave Cieslewicz, Madison WI
Ken Kearsley, Malibu CA
Jeff Kagermeier, Mankato MN
Victor de Luca, Maplewood NJ
Ralph W. Conner, Maywood IL
Michael McGlynn, Medford MA
Chuck Oberlie, Michigan City IN
John Norquist, Milwaukee WI
R.T. Rybak, Minneapolis MN
Karen Anderson, Minnetonka MN
Mike Kadas, Missoula MT
Louise Wilson, Montgomery NJ
Dennis Kennedy, Morgan Hill CA
Carol Wilcox, Morris MN
Bryan K Knedler, Mount Rainier MD
Ernest Davis, Mount Vernon NY
Skye Richendrfer, Mount Vernon WA
John DeStefano, New Haven CT
C. Ray Nagin, New Orleans LA
David Smith, Newark CA
Sharpe James, Newark NJ
David Cohen, Newton MA
Irene Elia, Niagara Falls NY
Gary Frankel, North Lauderdale FL
Patrick Hays, North Little Rock AR
Patricia Cohen, Oak Harbor WA
Jerry Brown, Oakland CA
Stan Biles, Olympia WA
Mike Fahey, Omaha NE
Dena Mossar, Palo Alto CA
Davic Glass, Petaluma CA
Tom Pico, Pleasanton CA
Jonathn Sharkey, Port Hueneme CA
Jim Cloutier, Portland ME
Vera Katz, Portland OR
David Cicilline, Providece RI
Rosemarie Ives, Redmond WA
Grace Vargas, Rialto CA
Irma Anderson, Richmond CA
Ardell Brede, Rochester MN
Walter Hoerman, Rochester NH
William Johnson, Rochester NY
Armando Flores, Rohnert Park CA
Heather Fargo, Sacramento CA
Rocky Anderson, Salt Lake City UT
Peter Kilkus, San Anselmo CA
Ed Garza, San Antonio TX
Judith Valles, San Bernardino CA
Dick Murphy, San Diego CA
Willie Brown, San Francisco CA
Ron Gonzales, San José CA
Sheila Young, San Leandro CA
Robert Habingreither, San Marcos TX
Marty Blum, Santa Barbara CA
Emily Reilly, Santa Cruz CA
Richard Bloom, Santa Monica CA
Sharon Wright, Santa Rosa CA
Ken Klotz, Saratoga Springs NY
Greg Nickels, Seattle WA
Craig Litwin, Sebastopol CA
Dorothy Kelly Gay, Somerville MA
John Powers, Spokane WA
Dannel P. Malloy, Stamford CT
Julia Miller, Sunnyvale CA
Matthew Driscoll, Syracuse NY
Bill Baarsma, Tacoma WA
Kathy Porter, Takoma Park MD
John Marks, Tallahassee FL
Jack Ford, Toledo OH
Dan Walker, Torrance CA
Douglas Palmer, Trenton NJ
Ray Di Guilio, Ventura CA
Carolyn Gentilini, Virginia MN
Meyera Oberndorf, Virginia Beach VA
Michael Jarjura, Waterbury CT
Theresa Estness, Wauwatosa WI
Jeff Prang, West Hollywood CA
John Madden, Williamstown MA
Michael Paulhus, Windham CT
Gerald Bach, Wisconsin Rapids WI

Appendix C

San Francisco Board of Supervisors Resolution, 2002

AS AMENDED IN COMMITTEE
2/21/02

FILE NO. 020158 RESOLUTION NO. 158-02

[Reducing Greenhouse Gas Emissions.]

Resolution supporting efforts to curb global warming, adopting greenhouse gas emissions reduction goals for the City and County of San Francisco in excess of the targeted goals of the Kyoto Protocol, and calling for continued actions towards achieving these goals.

WHEREAS, The world's leading climate scientists have documented a clear global warming trend and the unmistakable impact of human activities on that trend; and

WHEREAS, Global warming of the magnitude now predicted by the scientific community will cause extremely costly disruption of human and natural systems throughout the world; and

WHEREAS, Climate change is the most critical threat to the sustainability of our planet and the health of millions of people is at risk from smog, rising heat, increased disease, more frequent extreme weather events and rising sea levels; and

WHEREAS, Over the next 50-100 years, sea levels around the world could rise one meter; and

WHEREAS, To prevent flooding of the Airports in San Francisco and Oakland; Treasure Island; Mission Bay Development; the Giants new ballpark; parts of Interstate 80 and Highway 101; railroad tracks; sewage treatment plants; marinas; and harbors would require vast investments in dikes, pumping stations or other infrastructure; and

WHEREAS, The International Panel on Climate Change has determined that stabilizing concentrations of greenhouse gases in the atmosphere will require emission reductions in excess of 60% of current emissions, and the Kyoto Protocol is a modest first step in the direction of those reductions;

WHEREAS, Achieving greenhouse gas emission reductions required to protect the climate is of overriding importance not just to the community of nations but to the City and County of San Francisco, which relies heavily on the stability of the climate for our water and power supplies; and

WHEREAS, President George H. W. Bush signed the United Nations Framework Convention on Climate Change in 1992, which includes the commitment on the part of the United States to seek the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;" and

WHEREAS, The current administration in Washington, D.C. has demonstrated an alarming unwillingness to play a leadership role in climate protection; and

WHEREAS, President George W. Bush rejected the Kyoto Protocol on global warming outright, while in Bonn 178 countries, not including the United States, reached agreement on the Kyoto Protocol in July, 2001, and

WHEREAS, Local actions can help to pave the way for national leadership, by providing working models of greenhouse gas reduction initiatives that reinforce other high-priority policy objectives; and

WHEREAS, Over 370 cities across the United States and around the world are inventorying greenhouse gas emissions and adopting reduction targets as part of the International Council for Local Environmental Initiatives' Cities for Climate Protection program; and

WHEREAS, 16 cities from around the world have agreed in the Toronto Declaration to send a communiqué to the Conference of the Parties meeting in Morocco in November 2001 declaring their intention to achieve much higher levels of greenhouse gas reduction than those called for in the Kyoto Protocol; and

WHEREAS, Many of the critical components of a local action plan for climate protection are already in place or under development in the City and County of San Francisco, including the Green Building Program, the Resource Conservation Ordinance, the Environmentally Preferable Purchasing Program, the Clean Air Program, the Urban Forestry Council, the Sustainability Plan, and others; and

WHEREAS, fossil fueled electrical generators are among the largest contributors of greenhouse gas emissions adding to global warming; and

WHEREAS, the Board of Supervisors along with a large majority of San Franciscans supported Propositions B and H in November 2001 which will create the largest renewable energy programs in the country; and

WHEREAS, Greenhouse gas reduction activities contribute substantially to the achievement of many of the City's highest priority goals, including but not limited to: energy security and cost reduction; affordable housing; mobility and, transportation choices; solid waste reduction and recycling; reliable, affordable water supply; urban and rural forest protection; sustainable economic development; and clean air; and

WHEREAS, The City and County of San Francisco's existing energy, solid waste, and transportation and air quality initiatives – all designed and implemented to meet established City priorities – are expected to reduce greenhouse gas emissions while delivering tangible local economic and environmental benefits; and

WHEREAS, On a municipal level, reducing greenhouse gas emissions to the target established by the Kyoto Protocol or beyond would demonstrate that the goals of the international treaty are realistic and can be met; now, therefore, be it

RESOLVED, That the Board of Supervisors of the City and County of San Francisco establishes the long-range goal of reducing San Francisco's greenhouse gas emissions; and, be it

FURTHER RESOLVED, That the Board of Supervisors of the City and County of San Francisco directs the Department of the Environment as lead agency, to work with the Public Utilities Commission, and other appropriate City agencies to complete and coordinate the analysis and planning of a Local Action Plan targeting greenhouse gas emission reduction activities, so that:

a. By April 30, 2002, these agencies will complete and deliver an inventory of 1990 and 2000 greenhouse gas emissions, including as a first step, defining the scope of activities and geographic boundaries to be included in the inventory. The completed inventory should include:

i. an accounting of greenhouse gas emissions associated with City activities for the baseline years

ii. an accounting of greenhouse gas emissions within the City and County of San Francisco, but not associated with City operations;

iii. a projection of future emissions through the year 2012.

b. By June 30, 2002, these agencies will present to the Board of Supervisors a proposed plan for the City's role in achieving a greenhouse gas emissions reduction target of 20% below 1990 levels by the year 2012. The Plan will also present other scenarios, such as one describing what actions would be necessary to reverse global warming, according to the United Nations Intergovernmental Panel on Climate Change (IPCC) . The plan should include but not be limited to:

i. reductions, the approximate costs and benefits of those alternatives, and the estimated time and resources required to implement them;

ii. recommended combinations of measures to meet an emission reduction target of 20% below 1990 levels by 2012, and United Nations IPCC set scientific targets above this target that would constitute a proper scientific response to the global warming crisis;

iii. an assessment of which of those alternatives require actions that lie outside the City's control and what the City can do to influence those responsible for such actions;

iv. an assessment of the time and resources required for continuing coordination of the plan and to assure its successful implementation; and, be it

FURTHER RESOLVED, That the Board of Supervisors of the City and County of San Francisco do actively support the Kyoto Protocol, and call upon national leaders to do so as well; and, be it

FURTHER RESOLVED, That the Board of Supervisors of the City and County of San Francisco join the cities that have signed the Toronto Declaration in calling for strong national leadership and pledging to promote cooperation toward the ultimate goal of stabilizing greenhouse gas concentrations in the atmosphere; and, be it

FURTHER RESOLVED, That the Mayor and Board of Supervisors of the City and County of San Francisco commit to continue to achieve steady progress in reducing greenhouse gas emissions throughout the period covered by the Kyoto Protocol and beyond.

City and County of San Francisco

Tails

Resolution

City Hall
1 Dr. Carlton B. Goodlett Place
San Francisco, CA 94102-4689

File Number: 020158 **Date Passed:**

Resolution supporting efforts to curb global warming, adopting greenhouse gas emissions reduction goals for the City and County of San Francisco in excess of the targeted goals of the Kyoto Protocol, and calling for continued actions towards achieving these goals.

March 4, 2002 Board of Supervisors — ADOPTED

Ayes: 11 - Ammiano, Daly, Gonzalez, Hall, Leno, Maxwell, McGoldrick, Newsom, Peskin, Sandoval, Yee

File No. 020158

I hereby certify that the foregoing Resolution was ADOPTED on March 4, 2002 by the Board of Supervisors of the City and County of San Francisco.

Gloria L. Young
Clerk of the Board

3/15/02
Date Approved

Mayor Willie L. Brown Jr.