



BENICIA CLIMATE ACTION PLAN



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Acronyms Used Throughout Document

AB	Assembly Bill
BART	Bay Area Rapid Transit
BEST	Benicia Energy Solutions for Tomorrow
BRT	Bus rapid transit
CARB	California Air Resources Board
CCA	Community Choice Aggregation
CCAP	Center for Clean Air Policy
CEC	California Energy Commission
CCP	Cities for Climate Protection
CFL	Compact fluorescent light
CH ₄	Methane
CNG	Compressed natural gas
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO ₂ EMT	Carbon dioxide equivalent in metric tons
CPUC	California Public Utilities Commission
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse gas
HFC	Hydrofluorocarbons
HVAC	Heating, ventilating, and air conditioning
ICLEI	International Council of Local Environmental Initiatives, renamed to “ICLEI – Local Governments for Sustainability”
ICS	Irrigation control system
IPCC	Intergovernmental Panel on Climate Change
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
LGSEC	Local Government Sustainable Energy Coalition
LID	Low impact development
N ₂ O	Nitrous oxide
O ₃	Ozone
PCB	Polychlorinated biphenyls
PG&E	Pacific Gas & Electric
PM	Particulate matter
PPM	Parts per million
RECs	Renewable energy certificates
SGIP	Self Generation Incentive Program
SB	Senate Bill
TDM	Transportation demand management
TOD	Transit oriented development
UNFCCC	United Nations Framework Convention on Climate Change
USGBC	U.S. Green Building Council
VIP	Valero Improvement Program
VMT	Vehicle miles traveled
VTA	Santa Clara Valley Transportation Authority

Global Warming Potential and CO₂EMT

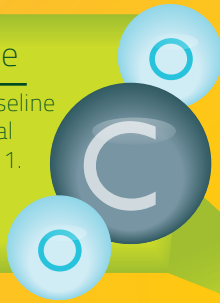
Various types of GHGs absorb different amounts of heat; therefore, a common reference gas, CO₂, is used to relate the amount of heat absorbed with the amount of gas emitted, commonly referred to as “CO₂ equivalent,” or, CO₂E. CO₂E is calculated by multiplying the amount of GHGs emitted by its global warming potential. For example, carbon dioxide has a global warming potential of one. By contrast, methane (CH₄) has a global warming potential of 21, meaning its global warming effect is 21 times greater than carbon dioxide on a molecule per molecule basis. A graphic depiction is located on page iv. In this report CO₂ equivalent is measured in metric tonnes (CO₂EMT).

What is a Carbon Dioxide Equivalent Metric Tonne?

Carbon Dioxide Equivalency is a conversion method used to express the global warming potential (GWP) of multiple greenhouse gases using a consistent unit of measurement, carbon dioxide equivalent metric tonnes (CO₂EMT). The measurement is expressed in terms of the amount of carbon dioxide (CO₂) that would have the same GWP as the mixture. For example, methane is twenty-five times more potent than carbon dioxide, giving it a GWP of 25, expressed as 25 CO₂EMT.

CO₂- Carbon Dioxide

Since CO₂ is used as the baseline measurement, it has a global warming potential (GWP) of 1. CO₂ concentrations have increased by 36% since the industrial revolution.



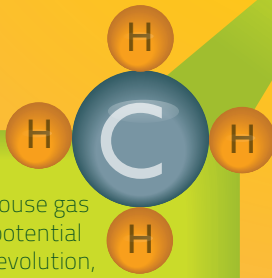
NO₂ - Nitrous oxide

Nitrous oxide has a global warming potential of 298. Nitrous oxide concentrations have increased 15% since the industrial revolution.



CH₄-Methane

Methane is a major greenhouse gas and has a global warming potential of 25. Since the industrial revolution, the abundance of methane in the Earth's atmosphere has increased from 700 parts per billion (ppb) to 1745 ppb.



other

Other Gases

Other gases known as 'minor' gases are also included in CO₂EMT. While they may be low in concentration, these 'minor' gases can still have a large impact on global warming. For example, the minor gas fluoroform, a byproduct of Teflon, has a GWP of 14,800.

CO₂EMT

Greenhouse Gas	Formula	1998 Level	Increase since 1750	GWP	1 tonne is equivalent to
Carbon Dioxide	CO ₂	365ppm	87ppm	1	1 CO ₂ EMT
Methane	CH ₄	1,745ppb	1,045ppb	25	25 CO ₂ EMT
Nitrous oxide	CH ₄	314ppb	44ppb	298	298 CO ₂ EMT
Carbon tetrafluoride	CF ₄	80ppt	40ppt	6,500	6,500 CO ₂ EMT
Hexafluoroethane	C ₂ F ₆	3 ppt	3ppt	9,200	9,200 CO ₂ EMT
Sulfur hexafluoride	SF ₆	4.2ppt	4.2ppt	22,800	22,800 CO ₂ EMT
Fluoroform	CHF ₃	14ppt	14ppt	14,800	14,800 CO ₂ EMT
Tetrafluoroethane	C ₂ H ₂ F ₄	7.5ppt	7.5ppt	1,430	1,430 CO ₂ EMT
Difluoroethane	C ₂ H ₄ F ₂	0.5ppt	0.5ppt	120	120 CO ₂ EMT

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Introduction

The City of Benicia is joining an increasing number of California communities in developing plans to address climate change at a local level. Although climate change is a global problem, city leaders in the U.S. and abroad are increasingly recognizing that it will directly affect their constituents and pose risks to public health, safety, and welfare. It is also at the local level that many strategies to both adapt to the changing climate and combat its progression are best enacted. In 2007, Benicia's City Council adopted a resolution to act on climate change and officially join ICLEI - Local Governments for Sustainability's Cities for Climate Protection Campaign. This plan sets forth a series of actions Benicia can take to reduce its contribution to global climate change by lowering its greenhouse gas emissions.

PURPOSE, SCOPE, AND ORGANIZATION OF THE CLIMATE ACTION PLAN

Purpose

The Climate Action Plan is based on the premise that local governments and the communities they represent are uniquely capable of addressing many of the major sources of the emissions within their jurisdictions that contribute to global warming. The purpose of the Climate Action Plan is to provide objectives and strategies that guide the development and implementation of actions that cut Benicia's greenhouse gas emissions (GHG) to meet its goal of reducing GHG emissions to 2005 levels by 2010 and reducing GHG emissions to 10 percent below 2000 levels by 2020.

Scope

This Plan covers objectives and strategies for the reduction of greenhouse gas emissions from municipal and community-wide activities within the City. It addresses the major sources of emissions in Benicia and sets forth objectives and strategies in eight focus areas that the City and community can implement to achieve greenhouse gas reductions: education and public

outreach, energy production, transportation and land use, buildings, industrial and commercial, water and wastewater, solid waste, and parks and open space. In addition, it provides an estimated range of GHG emission reductions associated with each objective and a relative set of percentages for each strategy, based on levels of adoption and implementation (see Layout Guide on page 17).

Organization

The Climate Action Plan is organized into the following chapters:

Introduction – provides an overview of the ICLEI five step process that is being followed to reduce greenhouse gas emissions. This chapter summarizes the first two steps (Inventory and Targets), which were completed in September 2008, and describes the planning process for developing the Climate Action Plan (step three).

Climate Change Science + Policy – summarizes the changes that are taking place in the Earth's atmosphere as a result of human activity and describes the effects they will have locally. This chapter also describes legislation and policies being implemented at international, national, State, and local levels to combat climate change.

Emission Reduction Measures – organizes objectives and strategies to reduce locally generated emissions in each of the eight focus areas. An implementation phasing sequence and indicators to track progress are identified in the summary matrix (page 83) for each objective.

Conclusion – compares emission reduction measures to the adopted City and Community targets.

Strategy Summary Table — available as a standalone document on the Climate Action Plan website. It is administered by the Community Sustainability Commission and will be regularly updated with performance measures/indicators, phasing, etc for each strategy.

CLIMATE ACTION PLANNING PROCESS

Strategy

In 2007, the Benicia City Council took its first steps to combat climate change by adopting Resolution No. 07-126 authorizing membership in ICLEI and their Cities for Climate Protection Campaign. The City chose to follow ICLEI's Five Milestones Process for Climate Protection:

1. Conduct a baseline emissions inventory and forecast
2. Adopt an emissions reduction target for the forecast year
3. Develop a climate action plan
4. Implement plan policies and measures
5. Monitor and verify results

The City has achieved the first three steps of the Five Milestones process. The City has begun the final two steps commenced after City Council's adoption of the Climate Action Plan. The following section is a summary of the first two steps and a description of the planning process for the Climate Action Plan.

Process

Step 1: Baseline Emissions Inventory and Forecast

The purpose of an emissions inventory is to identify and categorize the major sources and quantities of greenhouse gas emissions produced by the city's residents, businesses and municipal operations. Benicia's Emissions Inventory was completed by City staff in September 2008, using the Clean Air Climate Protection (CACP) software provided by ICLEI; on September 16, 2008 the City Council accepted the inventory and established reduction targets by adopting Resolution No. 08-103.

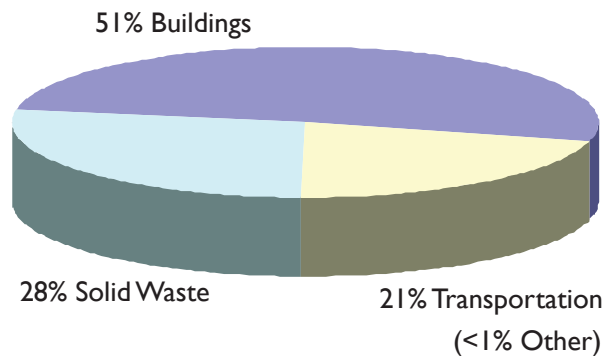
The City Government's Greenhouse Gas Emissions Inventory Report provides emissions data for the baseline year, 2000 (the earliest year for which sufficient data is available), and an interim year, 2005. The data provides a framework on which to base objectives and strategies that specifically address Benicia's sources of emissions. These measures are presented in Chapter 3. The inventory also serves as a reference against which to measure the progress towards reducing greenhouse gas emissions over time.

The Emissions Inventory Report contains two sets of data, which represent an inventory for City operations and a separate inventory for the Community's emissions as a whole. The Community emissions include City operations. Both inventories evaluate a range of focus areas. The inventory does not include emissions from port operations; air, water and rail travel; or, regional commuter traffic. Existing greenhouse gas modeling software available to local governments is not sophisticated enough to include regional commute patterns; however, policy decisions should consider potential implications on regional commute traffic. Future inventories should include data as it becomes accessible.

City Government Inventory

The City operations inventory examined greenhouse gas emissions attributed to the City Government in the sectors of Buildings, Vehicle Fleet, Commute, Streetlights, Water/Sewage Systems, Waste, and Other Activities (paint shop, generators, etc.) (Figure 1.1). In 2000, the City's total emissions were 9,202 carbon dioxide equivalent metric tonnes (CO₂E_{MT}). Buildings were responsible for the largest percentage of greenhouse gases at 51 percent followed by waste at 28 percent.

2000 City Government Emissions

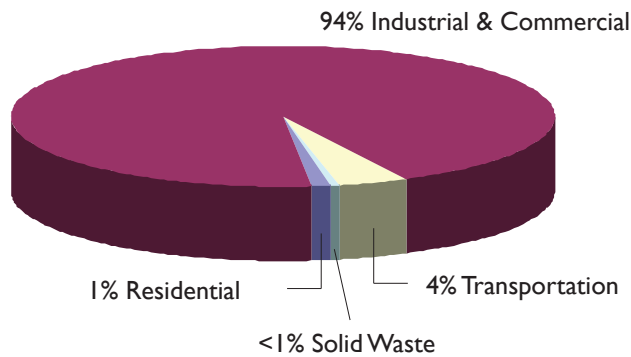


Source: City of Benicia (2008)

Community Inventory

The Community emissions inventory was organized into Transportation, Waste, Residential, and Commercial/Industrial sectors and also includes City Government emissions. In 2000, the Community's total emissions were 4 million tonnes. By 2005, emissions increased 5.6 percent to 4.25 million tonnes. The largest emitter in both 2000 and 2005 was Commercial/Industrial/Other (businesses), which included the Valero refinery, at more than 94 percent (Figure 1.2).

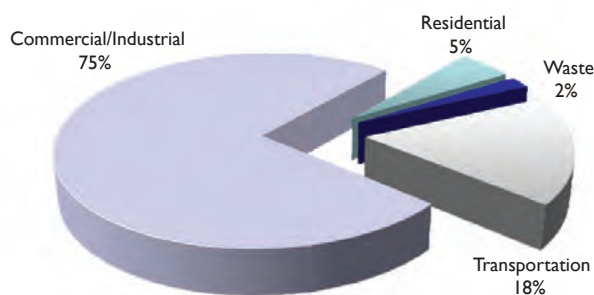
2000 Community Emissions



Source: City of Benicia (2008)

The chart below shows the Community's emissions, excluding the two largest emitters, Valero Refinery and the Port of Benicia. When these emitters have been disaggregated from the data, it is evident that Benicia's emissions are still largely dominated by the industrial sector with transportation taking another significant portion. These have been omitted for argument's sake in order to demonstrate that even without the City's two largest industrial stakeholders, the City's industrial base still has a profound impact on our emissions, identifying a large opportunity area for emission reductions, through means of sustainable economic development. This graph is also a good indication of the emission sources that the City has the ability to directly influence based on permitting and infrastructure authority.

2005 Community Emissions Excluding Valero and the Port of Benicia



Source: City of Benicia (2008)

Benicia's disproportionate percentage of commercial/industrial related emissions must be taken seriously, however, they should not be used to dwarf the importance of behavioral change of residents.

Business as Usual Forecast

Under a forecasted business as usual scenario, the community wide emissions in 2010 will increase by 9 percent from 2005 to 4.6 million tonnes. By 2020 emissions are forecasted to increase by 21 percent to 5.1 million tonnes. For City Government operations, business as usual would result in 8,300 tonnes of emissions in 2010 and 9,400 tonnes in 2020.

Step 2: Adopt Emissions Reduction Target for the Forecast Year

Emissions reduction targets are a vital component of greenhouse gas reduction efforts. According to the Cities for Climate Protection Campaign (2008), the reduction target is essential to both foster political will and to create a framework that guides planning and implementation.

A target provides a goal toward which the Community can strive to meet, and against which progress can be measured.

Benicia's inventory estimates and forecasts led to reduction goals for both the City and the Community emissions. On September 16, 2008, the Benicia City Council accepted the Greenhouse Gas Emissions Inventory Report and adopted the greenhouse gas reduction targets for City operations and the community as a whole, as follows:

City Government operations

- Reduce GHG emissions to 25 percent below 2000 levels by 2010
- Reduce GHG emissions to 33 percent below 2000 levels by 2020

Community-wide

- Reduce GHG emissions to maintain 2005 levels by 2010
- Reduce GHG emissions to 10 percent below 2000 levels by 2020

The targets are consistent with Assembly Bill 32 (AB 32)¹, and in some cases, the Kyoto Protocol.²

1) Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006, is a California law that established a timetable to move California closer to the greenhouse gas emissions goals established by the Kyoto Protocol.

2) The Kyoto Protocol is an international protocol that sets binding targets for its signatories to reduce greenhouse gas emissions in industrialized nations. The Kyoto Protocol was not ratified by the United States, but was used as a source of inspiration for AB 32.

Step Three: Develop a Local Climate Action Plan

The City partnered with the Cal Poly, San Luis Obispo City and Regional Planning department to carry out the third step of the Five Milestones process—development of a Climate Action Plan. The Plan was developed in three phases. Cal Poly was responsible for Phase One and Two and City staff for Phase Three.

- Phase 1: Background research, including an audit of existing policies and programs that support or potentially conflict with the City Government's emissions reduction goals; a review of existing climate change policy plans to assess strategies used by other jurisdictions to lower greenhouse gas emissions; and, public workshops to gather community input
- Phase 2: Preliminary Draft of Climate Action Plan – Identify specific emission reduction objectives and strategies, develop indicators to track progress, and provide policy recommendations for implementation.
- Phase 3: Final Draft of Climate Action Plan – Staff edited Cal Poly's preliminary draft and added emission reduction range percentages for each strategy.

The visioning workshops established a foundation for community involvement and encouraged public participation in the creation of the Draft Climate Action Plan. Building and maintaining feedback mechanisms, such as the interactive website, provided a valuable vehicle for broadening the public outreach and ensuring that the community's views are reflected in the Climate Action Plan.

PUBLIC OUTREACH

Public outreach yields valuable information from individuals most knowledgeable about the community - its residents. Community engagement provided a forum for citizens to share ideas regarding ways that Benicia can adapt to climate change and reduce greenhouse gas emissions.

The Cal Poly team conducted numerous community outreach events with local stakeholders. The consulting team facilitated two visioning workshops, one at Benicia High School to engage the teenage population, and a second at the Senior Center that targeted all community stakeholders. An interactive web site provided an additional opportunity for residents to participate in the Plan preparation process. The website enabled the community to participate in a survey, offer suggestions, and learn about climate protection planning in other communities. Targeted interviews were conducted with stakeholders to gather information about operations and current actions undertaken by various public and private entities. The Cal Poly Consulting Team presented their findings at a March 2009 Planning Commission meeting.

WHAT DATA WENT INTO THE EMISSIONS INVENTORY?

COMMUNITY EMISSIONS

* Includes City government emissions



Vehicle Miles Traveled (VMT)

255,064 Thousand VMT
158,346 CO2EMT in 2005

This data is measured in Vehicle Miles Traveled (VMT). It includes estimates of all trips on public roadways within the City, including I-680, I-780, City streets, roads within the Benicia State Recreation Area, vehicle trips on Port of Benicia property and Allied Waste Services' mileage associated with garbage and recycling.



Electricity and Natural Gas

234,747,060 kWh
162,571,423 terms
717,458 CO2EMT in 2005

Data for electricity (kWh) and natural gas (therms) use provided by PG&E. Contains all residential, commercial, and industrial PG&E use that was not from direct access accounts, such as Valero.



Solid Waste

28,194 tons of solid waste
21,998 CO2EMT in 2005

This data includes all Benicia's residential and commercial/ industrial waste picked up and hauled by franchise holder Allied Waste Services, the City's refuse hauler in both years, as well as an estimate of the Benicia Unified School District's waste.



Large Stationary Emitters

Over 800,000 CO2EMT in 2005

Benicia has two large industrial businesses, the Valero Refinery and the Port of Benicia. The 2005 data for Valero is a non-certified estimate; only data from 2006 forward have been certified by a third party.

What is not Included in the City Government Emissions Inventory?

- Employee and contractor travel on City business outside of City limits or in private vehicles
- Supply chains of purchased products

CITY GOVERNMENT EMISSIONS

* City government emissions are included in the total Community emissions



Municipal Vehicle Fleet

69,440 gallons of gasoline
12,640 gallons of diesel
2,333 CO2EMT in 2005

Municipal vehicle fleet data includes all city vehicles including Benicia Breeze Buses. Since more detailed data was available, actual fuel consumption numbers were used rather than VMT estimates.



Employee Commute

2,050 Thousand VMT
876 CO2EMT in 2005

A six-mile round trip commute was assumed for employees who live within Benicia. Commutes for both full-time employees, at an estimated five round trips per week, and part-time employees, at an estimated three round trips per week, were calculated for 47 weeks per year.



Electricity and Natural Gas

10,889,738 kWh
251,616 terms
3,187 CO2EMT in 2005

Electricity (kWh) and natural gas (therms) use data were used to calculate the emissions from City buildings, streetlights, traffic signals, and water and wastewater systems.



Solid Waste

3,556 tons of solid waste
2,483 CO2EMT in 2005

For waste, only wastewater sludge (sludge, a.k.a. biosolids, is residual material left over after processing) is included in Benicia's inventory, because municipal solid waste data was not available as a stand-alone account.

What is not Included in the Community Emissions Inventory?

- Rail transportation
- Marine transportation
- Air transportation overhead
- Underground activities, like pipelines through the City
- Port cargo handling and
- Valero's PG&E usage
- Activities near but not within the City limits (reserve fleet, Syar facility, etc)
- Activities by citizens beyond City limits, although the impact of driving the community's waste to landfills outside the City limits was included

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Climate Change Science & Policy

UNDERSTANDING CLIMATE CHANGE

Scientists have been working for decades to track the increase of greenhouse gases in the Earth's atmosphere and the subsequent rise of temperatures. Due to anthropogenic (human) activity, the planet is warming more quickly than it would under natural conditions; the primary precipitant is the burning of fossil fuels.

In 2001, the United Nations' Intergovernmental Panel on Climate Change (IPCC),³ a scientific body tasked to evaluate the risks of climate change, began assessing pre-existing scientific literature in order to understand the current and future situation of the Earth. In doing so, they found:

“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.”

“Most of the observed increase in global average temperatures since the mid-20th Century is very likely due to the observed increase in [human-caused] greenhouse gas concentrations.”

- IPCC 2007, p. 2 & p. 5

Climate Change v. Global Warming

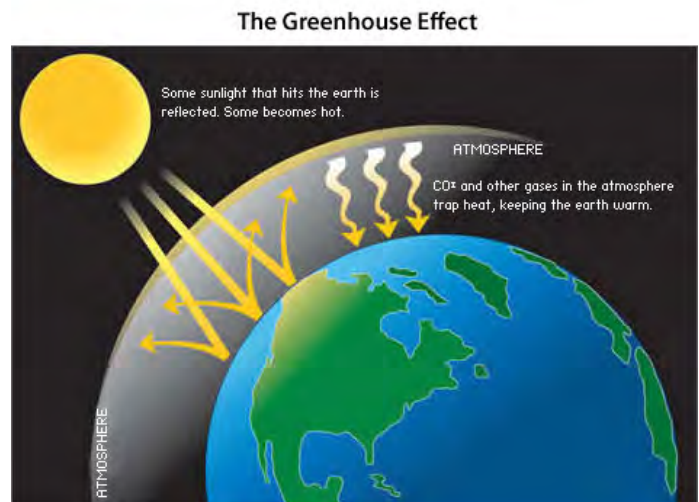
Global Warming – an overall warming of the planet, based on average temperature over the entire surface, which can contribute to changes in global climate patterns.

Climate Change – changes in regional climate characteristics, including temperature, humidity, rainfall, wind, and severe weather events.

HOW GREENHOUSE GASES WORK TO RAISE TEMPERATURES

Although greenhouse gases—including carbon dioxide, methane, nitrous oxide, and fluorinated gases—make up less than one percent of total atmospheric gases, they exert powerful influence over global temperatures. The greenhouse gases absorb the Sun's heat as it radiates back from the Earth's surface toward space, trapping that heat in the atmosphere (see Figure 2.1).

Over the past 650,000 years, the concentration of greenhouse gases gave the Earth a balanced climate that fostered bountiful ecosystems and eventually civilization. Greenhouse gas concentrations fluctuated with the natural cycle of ice ages, but were never higher than 300 parts per million (ppm).⁴



Source: US Department of Energy State Energy Program's newsletter, Conservation Update.

3) The IPCC is an international scientific body established by the World Meteorological Organization and the United Nations Environmental Programme to report on the implementation of the United Nations Framework Convention on Climate Change. The group compiled existing data and research to establish a scientific consensus on various aspects of climate change. The results were published in a series of 4 reports over a 20 year period.

4) IPCC, 2007 (http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm)

Over the last century and a half, industrialization changed the balance. Since the start of pre-industrial times (1700s), atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have climbed by over 36 percent, 148 percent, and 18 percent, respectively⁵. Humans have caused this increase mostly by burning fossil fuels, such as coal, oil, and gas. Burning fossil fuels in cars, power plants, industry, and homes raises the level of carbon dioxide in the atmosphere. This accounts for two thirds of human-caused greenhouse gas emissions. The remaining third is primarily caused by deforestation, decomposition of organic matter within landfills, and industrial processing.

Scientists project the global temperature will continue to rise — the question is how much. In 2007, the IPCC developed a range of future “business as usual” scenarios, which indicated that greenhouse gas concentrations could reach 600 to 1,000 ppm by the end of this century, resulting in global temperature increases of 3.6 to 10.4 degrees Fahrenheit.

EFFECTS OF CLIMATE CHANGE

Climate change has the potential to impact environmental resources through changes in air temperatures and precipitation patterns. As the average temperature of the Earth increases, weather is affected. Rainfall patterns change. Droughts and flashfloods are likely to become more frequent and intense. Mountain snowcaps will continue to shrink. Climate change and the resulting rise in sea level are likely to threaten buildings, roads, underground infrastructure, and power lines. Agricultural patterns will change as crops and productivity shift along with the climate. These physical changes will impact public health, economics, biogeography, and ecology. We can expect to see worsening air quality, an increase in the number of weather-related tragedies, and possible increases in infectious disease. Higher temperatures contribute to increased smog, which is damaging to plants, animals, and humans. Climate change increases fire hazards and makes forests more susceptible to pests and diseases.

The degree of impact will vary by region and with the ability of different societal and environmental systems to adapt⁶ (IPCC, 2007). According to the California Energy Commission⁷ (2006), some of the primary effects of climate change in California may include more extreme heat days per year and changes in precipitation patterns. These have the potential to produce secondary impacts on snow pack, sea level, health, agriculture and food supply, forests, and ecosystems and biodiversity. Below is a summary of potential effects that could be experienced in California as a result of climate change.

Higher Temperatures

California’s climate is expected to become considerably warmer during this century. The degree to which this occurs depends on the growth of contributory human activities, such as the burning of fossil fuels. The State of California Climate Action Team (CAT) 2009 Biennial Report⁸ projects that in the first 30 years of the 21st century, temperature increases are likely to range from about 0.5 to 2 °C (0.9 to 3.6 °F) and by the last 30 years of the 21st century, temperature increases may range from about 1.5 to 5.8 °C (2.7 to 10.5 °F). The projection for the first 30 years is lower largely because warming over the next few decades will be affected largely by past emissions.

Historically, extreme warm temperatures in California have mostly occurred in July and August, but as greenhouse gases increase and the climate changes, the occurrence of these events will likely extend from June to September⁹. All of the California Environmental Protection Agency’s Climate Action Team’s (CAT) 2009 simulations indicate that extremely hot daytime and nighttime temperatures (heat waves) will increase in frequency, magnitude, and duration from the historical period; this has serious implications for emergency response and electricity demand in the state.

5) U.S. Environmental Protection Agency, (2009) 2009 U.S. Greenhouse Gas Inventory Report.

6) IPCC, 2007 (http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm)

7) California Energy Commission. (2007). California Energy Commission Climate Change Portal.

8) CAT, 2009 (<http://www.climatechange.ca.gov/publications/cat/>)

9) Ibid.

Precipitation

Most of California is characterized by a Mediterranean precipitation pattern, with most of the annual precipitation falling between November and March. The CAT projections indicate that California's Mediterranean precipitation pattern is expected to continue, with cool and wet winters and hot dry summers. The model-driven climate simulations indicate a high degree of variability from year to year in annual precipitation. While it will retain its overall character, models of the California climate also project increased vulnerability to drought by mid-21st century. Even if precipitation levels were to remain unchanged over the 21st century, the higher temperatures would increase evaporative water loss and thus produce overall drier conditions. Additional reductions in precipitation would exacerbate the challenges associated with increased evaporative water loss.

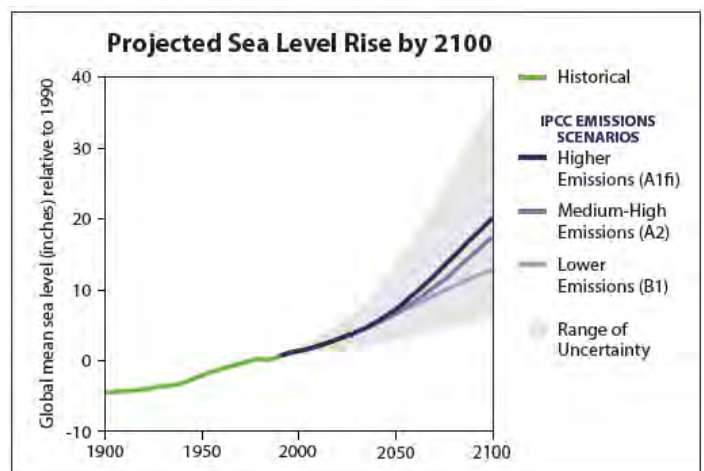
Loss in Snow Pack

One area of considerable concern is the effect of climate change on California's water supply. During the winter, high in the Sierra Nevadas, snow accumulates in a deep pack, preserving much of California's water supply for the hot, dry summer. If winter temperatures are warmer, more precipitation will fall as rain, decreasing the size of the snowpack. Less spring runoff from a smaller snowpack will reduce the amount of water available for hydroelectric power production and agricultural irrigation. Evidence of this problem already exists. Throughout the 20th century, annual April to July spring runoff in the Sierra Nevada has been decreasing, with water runoff declining by about ten percent over the last 100 years.

Sea Level Rise

A rise in sea level is already occurring in California, with a 3 to 8 inch rise in the last century. As sea level continues to rise, there will be an increased rate of extreme high sea level events. These events can occur when high tides coincide with winter storms and can be exacerbated by El Niño occurrences. Sea levels at the California coast often rise substantially during El Niño winters, when the Eastern Pacific Ocean is warmer than usual and westerly wind patterns are strengthened. This can lead to severe consequences for the large populations living along California's coast, including flooding of low-lying property, loss of coastal wetlands, erosion of cliffs and beaches, saltwater contamination of drinking water, and damage to roads, bridges and underground infrastructure.

The San Francisco Bay Conservation and Development Commission (BCDC) has projected that sea level in the San Francisco Bay will rise another 16 inches (1.3 ft) by mid-century and 55 inches (4.5 ft) by 2100 (see image next page). A rise in sea level may have a significant impact on our built environment including underground infrastructure, shoreline development, and structures built on fill materials. Fill materials are materials used to artificially raise the level of the ground near bodies of water, such as in Benicia's Downtown Historic District. In addition, the Benicia Industrial Park is particularly vulnerable to such impacts due to its shoreline location. BCDC identified ports as being one of the most vulnerable sets of infrastructure in the region¹⁰. Damage to Bay Area ports as a result of a rise in sea level is expected to have a large impact on the regional economy.





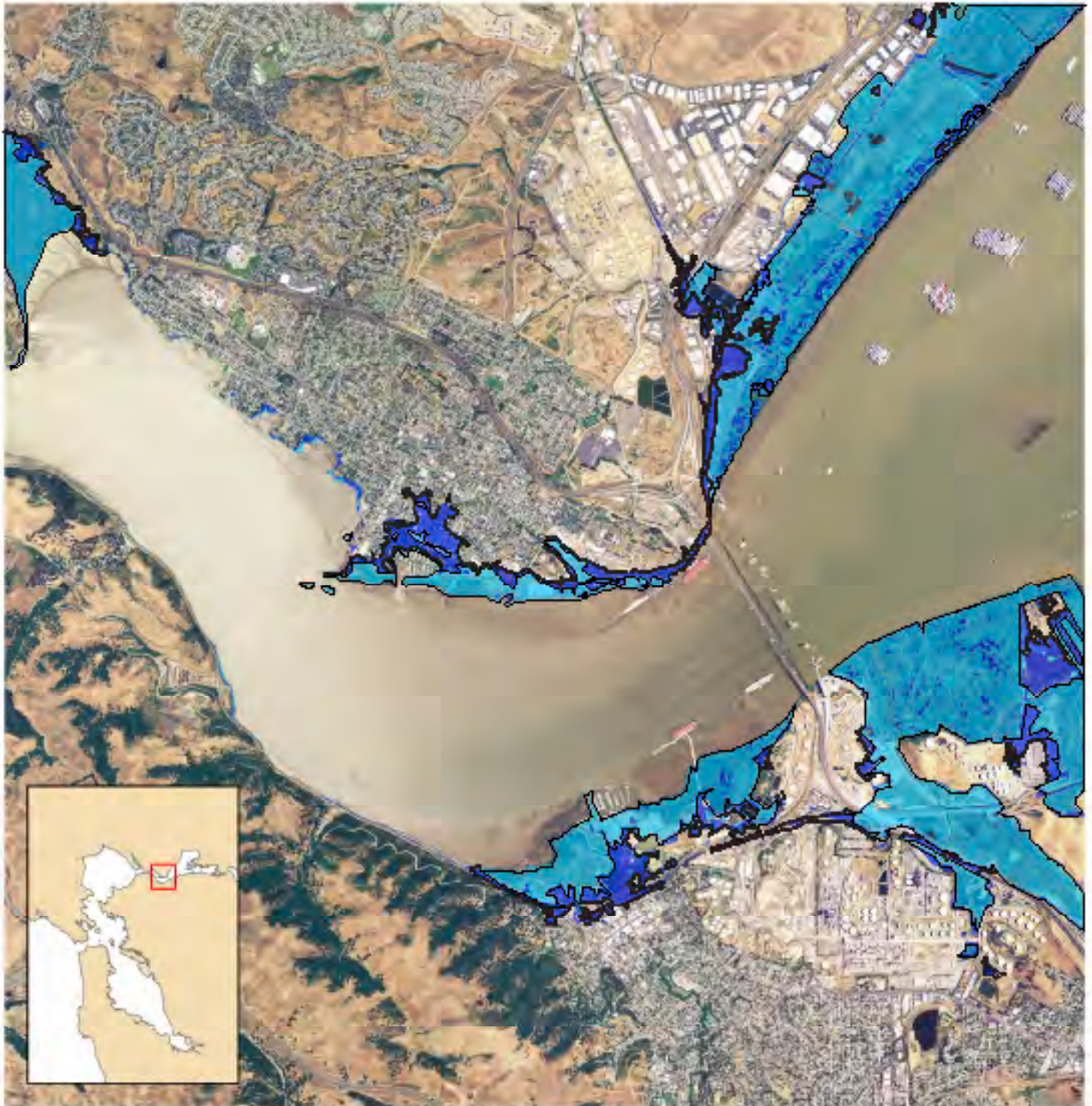
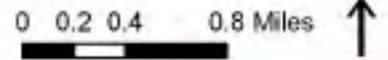
Source: California Climate Change Center.

¹⁰ San Francisco Bay Conservation and Development Commission, (2009). Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline. (http://www.bcdc.ca.gov/planning/climate_change/climate_change.shtml)



Carquinez Strait Shoreline Areas Vulnerable To Sea Level Rise

-  Area vulnerable to an approximate 55 - inch sea level rise
-  Area vulnerable to an approximate 16 - inch sea level rise



NOTE: Inundation data from Knowles, 2008. Additional salt pond elevation data by Siegel and Bachand, 2002. Inundation data does not account for existing levees or other shoreline protection. Aerial imagery is NAIP 2005 data.

Air Quality

Higher temperatures also increase harmful air pollutants -- more fuel evaporates, engines work harder, and demands for electric power increase. High temperatures, strong sunlight, and a stable air mass are ideal for formation of ground-level ozone, the most health-damaging constituent of smog. As the temperature rises and air quality diminishes, heat related health problems also increase. Drier conditions increase the potential for large wildfires, which further worsen air quality.

Public Health

According to the California Climate Change Report Center's July 2006 report, *Our Changing Climate: assessing the Risks to California*, warmer temperatures and changes in precipitation have serious public health implications¹¹. Research suggests that the most serious effects will be related to increased frequency of extreme conditions such as longer, more intense heat waves. Severe heat accompanied by drier conditions and poor air quality could increase the number of heat-related deaths, illnesses and asthma attacks throughout the state. Currently, Solano County has the highest childhood asthma rate, with nearly a quarter (23.6%) of its population between the ages of 5 and 17 having been diagnosed as asthmatic. Within the county, the Vallejo/Benicia area has the highest asthma-related hospitalization rate for 0-4 year olds¹². Changes in global climate also cause disease-carrying vectors, such as mosquitoes, to thrive in new areas. In addition to mosquitoes, warmer and wetter temperatures will provide prime breeding grounds for ticks, mites, rodents, and the diseases that these vectors carry. Other factors that influence the probability and magnitude of public health disasters such as pandemics are population density, housing type (detached single family residential, apartment buildings, etc.); and, sewage and waste management. The State of California is also working to establish strategies to address the potential impacts of climate change on public health.¹³

Agriculture

California has a \$30 billion agricultural industry that produces half of the United States' fruits and vegetables. Higher CO₂ levels can stimulate plant production and increase plant water-use efficiency. However, if temperatures rise and drier conditions prevail, water demand will increase, crop-yield may be threatened by a less reliable water supply, and greater ozone pollution could render plants more susceptible to pest and disease outbreaks. Temperature increases may change the time of year that certain crops, such as wine grapes, bloom or ripen, and thus affect their quality¹⁴ (California Climate Change Center, 2006). In addition, high temperatures are known to stress dairy cows, resulting in reduced milk production, which is a three billion dollar industry in California.

Ecosystems and Wildlife

California is one of the most climatically and biologically diverse areas in the world, supporting thousands of plant and animal species. Climate change is expected to intensify the threat to ecosystems by increasing the risk of wildfire and altering the distribution and character of natural vegetation and wildlife. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent. Sea level will dramatically increase along most of the U.S. coastline. Rising temperatures could have major impacts on plants and animals, including: 1) timing of ecological events; 2) geographic range; 3) species' composition within their respective communities; and, 4) ecosystem processes such as carbon cycling and storage¹⁵.

11) California Energy Commission (2006). *Our Changing Climate: assessing the Risks to California*. (<http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF>)

12) Solano County, (2009) Solano County Public Health - Asthma Education.

13) California Energy Commission (2009). *Public Health Adaptation Strategies* (<http://www.climatechange.ca.gov/adaptation/publichealth/index.html>)

14) California Energy Commission. (2006) *Our Changing Climate: Assessing the Risks to California*

15) Parmesan C. (2006) Ecological and evolutionary responses to recent climate change. *Annu. Rev. Ecol. Evol. Syst.* 37:637–69. and Parmesan, C. and H. Galbraith (2004) Observed Impacts of Global Climate Change in the US.

POLICY AND LEGISLATION

As a result of the overwhelming evidence that climate change is a real and increasing challenge, governments have created policies at international, Federal, State, and local levels to reduce greenhouse gases.

International Mandates for Climate Protection

Over a decade ago, most countries joined an international treaty - the United Nations Framework Convention on Climate Change (UNFCCC)¹⁶ - to begin considering what could be done to reduce global warming and to cope with inevitable temperature increases. More recently, a number of nations approved an addition to the treaty, the Kyoto Protocol.

The Kyoto Protocol sets binding targets for its signatories to reduce greenhouse gas emissions in industrialized nations. These reductions amount to an average of five percent below 1990 levels over the five year period from 2008 to 2012. The agreement was not ratified by the United States, but was one of the inspirations for California's State law, Assembly Bill 32 - The Global Warming Solutions Act of 2006, and the U.S. Mayors Climate Protection Agreement, which includes over 900 mayors who have pledged their cities to meet or beat the Kyoto Protocol's standard by 2012. Benicia Mayor Elizabeth Patterson signed the agreement in 2008.

Federal Mandates for Climate Protection

There is no federal mandate for greenhouse gas emission reporting or reduction in the United States. However, in April 2007, the U.S. Supreme Court ruled that the U.S. EPA has not only the authority, but also the obligation, to regulate greenhouse gases as "serious and well recognized" pollutants.¹⁷ In April 2009, the EPA released a 133-page endangerment finding noting that, "...Greenhouse gases that are responsible for [climate change] endanger public health and welfare in the meaning of the Clean Air Act." The eventual judgment from the EPA may open the door for regulation of greenhouse gas emissions via the provisions of the Clean Air Act.

State Mandates for Climate Protection

In 2005, California Governor Arnold Schwarzenegger signed Executive Order S-3-05, setting a goal of reducing emissions to 1990 levels by 2020 and 80 percent below 1990 levels by 2050. In response to the Executive Order, the California EPA created the Climate Action Team, which, in March 2006, published the first Climate Action Team Report. The 2006 CAT Report identifies a recommended list of strategies that the State could pursue to reduce greenhouse gas emissions. These strategies would be implemented by various state agencies, within their existing authority, to meet the Governor's targets. The strategies include, but are not limited to the reduction of passenger cars and light duty truck emissions, the reduction of idling times for diesel trucks, an overhaul of shipping technology/infrastructure, increased use of alternative fuels, increased recycling, and landfill methane capture.

In September 2006, the California State Legislature adopted Assembly Bill 32, the Global Warming Solutions Act of 2006, as an implementation strategy for the Governor's Executive Order. The law directs the California Air Resources Board (CARB) to adopt regulations to require the reporting and verification of statewide GHG emissions and to monitor and enforce compliance with the program. It conforms to Executive Order S-3-05 by requiring the reduction Statewide of greenhouse gas emissions to 1990 levels by 2020 (which represents reducing emissions by approximately 30 percent from emissions levels projected for 2020).

Since 2007, the California State Attorney General's office has been urging cities and counties to address emissions from new construction as part of the review process under the California Environmental Quality Act (CEQA). In 2007, the State Attorney General sued San Bernardino County for failing to consider greenhouse gas emissions in its proposed general plan update. The case was settled and the County agreed to develop a greenhouse gas emissions reduction plan. Additionally, in January 2008, the Sierra Club filed a lawsuit to block the City of Stockton's General Plan, claiming that it failed to address the amount of greenhouse gases the plan would emit into an already heavily polluted San Joaquin Valley. The Attorney General's Office subsequently entered into negotiations with Stockton, citing concerns about the General Plan and the need to evaluate greenhouse gas reduction impacts under CEQA. The Attorney General reached a settlement agreement with the City and the

¹⁶) The UNFCCC is a United Nations treaty that aims to stabilize greenhouse gas emissions and mitigate climate change

¹⁷) Massachusetts v. Environmental Protection Agency (EPA), No. 05-1120

Sierra Club in September 2008, under which the City will adopt a Climate Action Plan designed to reduce sprawl and increase infill development, promote public transit, and increase the number of energy-efficient buildings.

In October 2008, California continued its climate leadership by adopting the country's first comprehensive land use planning law to tackle related greenhouse gas emissions. Senate Bill 375, supports the implementation of AB 32 and signals a fundamental shift in community design. The three goals of SB 375 are to:

1. Use the regional transportation planning process to help achieve AB 32 goals.
2. Use CEQA streamlining as an incentive to encourage transit-oriented residential projects that help achieve AB 32 goals.
3. Coordinate the regional housing needs allocation process with the regional transportation planning process, providing monetary incentives for sustainable development.

Related State Legislation

The State of California has passed the following legislation aimed at combating climate change and promoting economic sustainable development:

- Senate Bill 1771 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.
- Assembly Bill 1493 (2002) requires the California Air Resources Board (CARB) 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 1078 (2002) establishes a Renewable Portfolio Standard requiring electricity providers to increase purchases of renewable energy resources by 1 percent per year until they have attained a portfolio of 20 percent renewable resources.

- Senate Bill 1368 (2006) requires the CEC and the California Public Utilities Commission to set a global warming emissions standard for electricity used in California — regardless of whether it is generated in-state or purchased from other states.
- California Solar Initiative Program (2006) is a comprehensive \$2.8 billion program that provides incentives toward residential and commercial solar development over 11 years.
- Senate Bill 97 (2007) directs the Governor's Office of Planning and Research to develop CEQA guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions."
- Assembly Bill 811 (2008) authorizes cities and counties in California to designate districts within which willing property owners could enter into contractual assessments to finance the installation of renewable energy generation, as well as energy efficiency improvements, that are permanently fixed to the property owner's residential, commercial, industrial or other real property. These financing arrangements would allow property owners to finance renewable energy generation and energy efficiency improvements through low-interest loans that would be repaid as an item on the property owner's property tax bill.

LOCAL ACTION

In addition to California State law, there have been three significant events that have influenced climate protection planning in Benicia:

- I. Valero Improvement Project Settlement Agreement: In 2002/2003 as a condition of the Valero Improvement Project, the City of Benicia and the Valero Refinery worked jointly to develop a project that would supply up to 2 million gallons per day of recycled water from the City's wastewater treatment plant for use by the refinery. Valero committed to financially support the water reuse project in the approximate amount of up to \$15 million. In 2006, the cost projections for the project were up to \$40 million, which was significantly beyond the financial commitment made by Valero to support its development. In 2007, at the direction of the City Council, the water reuse project was put on hold pending securing funding in the approximate amount of \$40 million. In 2008, Valero applied to amend the permits for the Valero Improvement Project. In doing so, a settlement agreement was reached between

Valero Refinery, City of Benicia, and the Good Neighbor Steering Committee (GNSC). GNSC is an unincorporated association of Benicia residents and business owners who are concerned about potential environmental impacts of Benicia refinery operations generally and the VIP and its amendments specifically. The terms of the \$14 million settlement agreement were incorporated into the conditions of approval for the amended project. Within the \$14 million, \$10 million was allocated for water conservation type projects over five years (\$2 million/year) and \$600,000 for implementation of the Climate Action Plan over three years (\$200,000/year). The remaining funds were allocated for watershed and buffer land acquisition, establishment of a City tree program, and energy efficiency projects at the Benicia Unified School District. The majority of the funds will be administered by the City Council based upon the recommendations of the Community Sustainability Commission. As of late 2009, the GNSC and Valero Refinery were drafting modifications that would effectively expand the water conservation allocation to also include energy efficiency.

2. Community Sustainability Commission: The City Council established the Community Sustainability Commission (CSC) in September 2009 with the charge of making recommendations on implementation of the Climate Action Plan and allocation of VIP water conservation and Climate Action Plan settlement funds.
3. Comprehensive Renewable Energy RFP: In May 2009, the City issued a request for proposals (RFP) for projects and programs that would transition the City from non-renewable energy sources to renewable energy sources at little or no cost to the City. This includes the potential development of a wind and/or solar micro-utility on City-owned parcels north of Lake Herman Road, solar photovoltaic (PV) and/or solar thermal collection installations at City facilities, establishment of an AB 811/Clean Energy Municipal Finance program similar to Berkeley FIRST, energy efficiency retrofits at City facilities, and communitywide energy audits and retrofits. In September 2009, the City Council approved the first contracts for a renewable energy project manager and a subsidized residential energy audit program.

Emissions Reduction Focus Areas

The Climate Action Plan includes focus areas that identify the measures needed to achieve Benicia's 2010 and 2020 emissions reduction targets:

- Public Education and Outreach
- Energy Production
- Transportation and Land Use
- Buildings
- Industrial and Commercial
- Water and Wastewater
- Solid Waste
- Parks and Open Space

A series of objectives with supporting strategies are identified in each focus area. For each strategy, suggested implementation actions are identified. Implementation timelines and indicators to track progress have been identified for each objective and are located in the summary matrix (pp 83). Implementation timelines are broken down into three phases:

- Near-term (2009-2011)
- Mid-term (2012-2015)
- Long-term (2016-2020)

These periods mirror those identified in AB 32, making the Plan consistent with the State timelines for implementation. Indicators to track progress are identified for each strategy in the summary matrix.

Public Education and Outreach has been included as the first focus area because it is considered integral to the successful implementation of objectives and strategies in the other seven focus areas. Given its broad reach and qualitative nature, emission reductions were not calculated for this focus area. Emission calculations were calculated for objectives in the other seven focus areas. In addition, reduction ranges are identified for each strategy within a given objective. The percentage range represents the emission reduction potential of a given strategy as it relates to its respective objective.

Energy efficiency is a critical component of this plan. Therefore, energy efficiency measures have been woven into all of the focus areas with the exception of Energy Production. The Energy Production focus area centers on renewable energy generation.

EMISSIONS REDUCTIONS

Calculating the emissions reductions for each objective requires making assumptions about the degree of implementation, future technology, and individual behavioral changes. The uncertainty associated with these assumptions makes it difficult to assign specific reduction totals to each objective. To address this uncertainty, a series of symbols and percentage ranges have been devised to represent the emission reductions associated with each objective and its strategies.

The specific implementation assumptions and estimated reduction totals are listed in the Appendix.

Plan Implementation & Integration

Three primary principles have been identified as critical to the future effectiveness of the Climate Action Plan. The first principle emphasizes the need for strong internal leadership, organizational capacity and interdepartmental integration. The second fulfills step five of ICLEI's Five Milestone Process, Monitoring and Verification via annual reporting. Principle three recognizes the importance of engaging industrial stakeholders to reduce emissions in the Benicia Industrial Park while adding value to existing and future businesses.

Principle I. Expand the Role of the Internal Green Team

The City of Benicia Green Team should be comprised of City staff assigned to infrastructure and facility management and maintenance, utility management, fleet maintenance and procurement, material and supply procurement, transit management, and, policy development and implementation. The group should develop internal policies and procedures (to present to senior City management for approval and implementation) as they relate to greenhouse gas reduction, green operations and forward-thinking climate protection planning. In addition, the group will provide staff support to the Community Sustainability Commission.

Principle 2. Annual GHG Reduction Monitoring Report

Annual GHG Monitoring Report – Monitoring and verification is step five of ICLEI’s Five Milestone process and is necessary to ensure that the plan is relevant and practical. Tracking strategy indicators/performance measures in order to implement adaptive management principles is the most effective approach. In doing so, strategies and standards may be modified or added in order to best meet the determined needs. The findings of the annual analysis should be presented to the Community Sustainability Commission and to the City Council.

Principle 3. GHG Reductions in Industrial and Commercial Sector

Reducing greenhouse gas emissions in the Industrial and Commercial sector is critically important given the significant emissions associated with the sector. The City must actively engage the business community to work together to develop strategies that add value to the businesses through efficiency and infrastructure, while reducing greenhouse gas emissions.

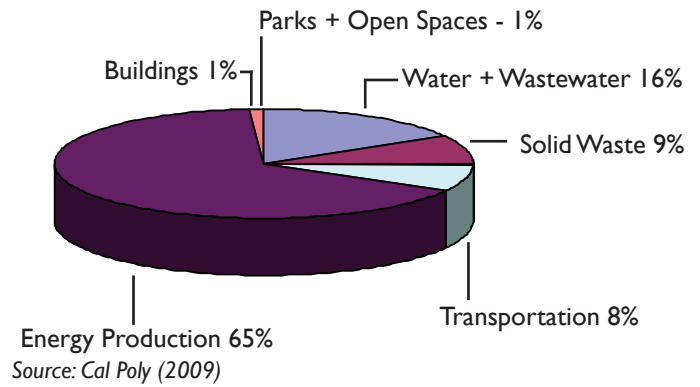
City staff has initiated preliminary discussions with the State of California Department of Conservation regarding the emerald cities partnership program. The program is a public-private partnership designed to achieve California’s resource conservation and environmental goals through technical assistance. The program has the potential to provide the business community with cost free technical resources.

EMISSION REDUCTION OVERVIEW

The following charts illustrate potential greenhouse gas emission reductions associated with relevant focus areas. 56 percent of City Government emission reductions and 43 percent of Community emission reductions are proposed to occur by implementing strategies in the Energy Production focus area.

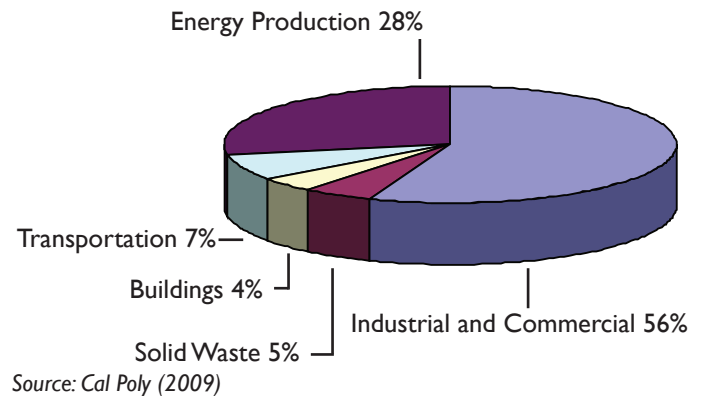
City Government Emission Reductions

The City Government chart excludes ‘Industrial and Commercial’ since it is not applicable to this category. In addition, emission reductions were not calculated for ‘Education and Outreach.’

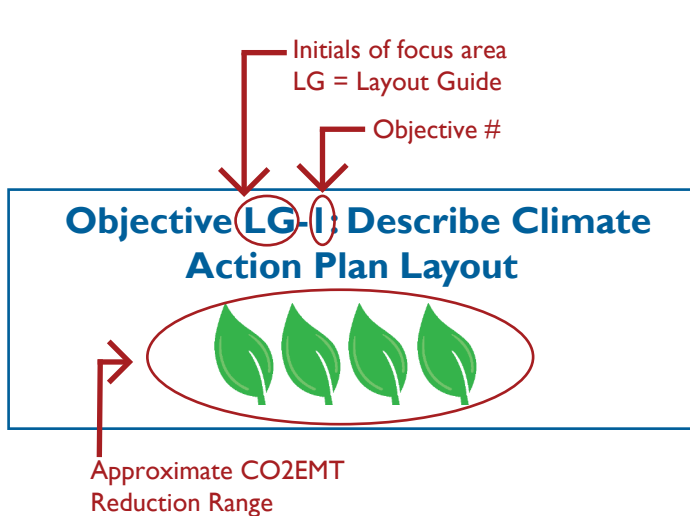


Community Emission Reductions

The Community emissions chart excludes ‘Water and Wastewater’ since they are functions of the City Government. Emission reductions were not calculated for ‘Education and Outreach.’



Focus Area Layout Guide



OBJECTIVES

Objectives establish the framework and targets necessary for each focus area to achieve the City’s 2010 and 2020 emission goals. Objectives are comprised of a set of strategies that serve as the implementation mechanisms.

Below each object title is a set of leaves that represent the range of carbon dioxide equivalent metric tonnes (CO2EMT) reductions that can be achieved if the objective is met (see diagram).

Each set of projected CO2EMT reductions assume phased implementation of all suggested strategies using conservative GHG estimates. These estimates are based on minimum levels of implementation, based on projections of consumer/resident habits, fiscal realities, and the local political climate. Aggressive implementation of particular strategies provides the flexibility to omit others, if so desired.

Existing Actions

The Existing Actions section describes the actions the City is currently undertaking that address the objective. Examples of Existing Actions include existing bus routes, existing community outreach projects, and energy efficient traffic signals that have been installed prior to the approval of the Climate Action Plan.



◆ Strategy LG-1.1 Example

Strategies are the specific sets of actions that the city can choose to implement to reach the objective.





Implementation Actions

- Implementation Actions lay out the steps the City may take to achieve the strategy.

CO2EMT Reduction Range

The reduction range for a strategy uses two targets – minimum and maximum levels of feasible implementation. It is very important to recognize that the stated range is within the context of each individual objective. The range can be a powerful tool to evaluate the relative impact that a given strategy is projected to have on the objective’s total reduction goal. Each objective reduction goal was established based on minimal implementation of each strategy. It is important to understand that the minimum ranges for each objective’s strategies may add up to over 100%, because of assumed overlap between strategies.

Significant assumptions are required when determining GHG value ranges at the strategy level. They are required to quantify otherwise qualitative issues such as behavioral change and rates of adoption. The assumptions are tailored to each individual strategy and are based on readily available data.

Symbol	Emissions Reduction (CO2EMT)
	< 1000
	1000 - 10,000
	10,000 - 50,000
	> 50,000

Strategy Icon Guide

Strategies with similar themes have been linked through the use of icons. Where applicable, icons are located below the strategy name and number. Many strategies have multiple icons indicating overlapping themes.



Public Outreach

Strategies with the public outreach icon require a comprehensive education or outreach program, to be effective. This may include workshops or distributing information on Benicia's climate action plan website.



Solar Energy

Strategies with the sun icon are related to solar energy generation strategies.



Wind Energy

Strategies with the windmill icon are related to wind energy generation strategies.



Transportation

Strategies with the bus icon are related to transportation.



Green Building

Strategies with the green building icon are related to green building practices, which have the potential to maximize efficiency of buildings, reduce energy costs, improve indoor air quality, and increase property values.



Energy Efficiency

Strategies with the light bulb icon are related to energy efficiency practices.



Water Conservation

Strategies with the water drop logo will help conserve water. Water conservation not only reduces our water usage, but also reduces CO₂ emissions by decreasing energy demand on pumps and lift stations used to convey the water.



Carbon Sequestration

Strategies with the Carbon Sequestration icon will help the City and Community reduce CO₂ emissions through carbon sequestration. Carbon sequestration is a greenhouse gas remediation technique that uses trees and other plant life to convert CO₂ into oxygen. A single mature tree can absorb 48 lbs. of CO₂ a year.



EDUCATION + PUBLIC OUTREACH

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Education + Public Outreach



INTRODUCTION

Education and outreach are critical components of climate protection planning because of the changes in citizen behavior and business practices that will be needed in order to meet the City’s emission reduction targets. The City can encourage behavior change through increased public awareness of the challenge and of potential solutions.

This chapter includes strategies that span more than one topic area. Likewise, proceeding chapters contain education and outreach programs tailored to their specific topics. Education and outreach strategies range from workshops and courses to community events and campaigns.

Objective EO-I: Increase Public Awareness and Education About Climate Change
 CO2EMT estimate not applicable

Existing Actions

The Benicia General Plan includes several programs for public education and outreach consistent with reducing greenhouse gas emissions. Programs include advertising for alternative modes of transportation and water conservation. The Urban Water Management Plan includes educational programs for water efficiency. These programs involve curriculum in elementary schools, observation of May as Water Awareness month, periodic bill inserts, conservation pamphlets, irrigation booklets, and as of 2008, a California Friendly Landscape Contest that promotes water efficient landscaping. Since 2006, the City has jointly hosted annual water wise landscaping seminars with the City of Vallejo. The seminars use the expertise of the Master Gardeners and California Native Plant Society to provide instruction on topics such as water wise design and irrigation.

The City periodically operates a booth at the Farmers Market to interact with the community on an as needed basis and is a great venue to promote greenhouse gas reduction initiatives. The City also provides a variety of water conservation giveaways at a monthly booth at the Farmers Market. Past giveaway items include low flow showerheads, hose timers, and landscape brochures.

◆ Strategy EO-I.1. Update and Maintain Sustainable Development Website



An interactive, informational website could be regularly maintained to include tools and resources about climate change science, food supply, green building technology, waste reductions, energy efficiency, and actions to reduce water and energy consumption. Information on rebates, incentives, and other funding sources could be made available to the public, as well as an online community forum.

Implementation Actions

- Incorporate an email alert system that automatically generates weekly or monthly updates for the public on recent website additions/news items;
- Maintain website.

Education + Public Outreach Objective Table	Emissions Reduction Type	Emissions Reduction
Objective EO-I: Increase Public Awareness and Education About Climate Change	Community & City	n/a



The Benicia Climate Action Plan website (2009).

◆ **Strategy EO-I.2. Sustainability Awards Programs**



Create an awards program administered by the Community Sustainability Commission to recognize outstanding achievements in the community for green building practices, waste diversion and reduction, energy and water conservation, and public outreach.

Implementation Action

- Establish a local awards program administered by the Community Sustainability Commission.

◆ **Strategy EO-I.3. Educational Workshops**



Conduct workshops to educate the community on ways to reduce greenhouse gas emissions, and the benefits associated with reducing emissions. Topics may include climate change science, renewable energy and energy efficiency; water efficient landscaping; community composting; food consumption, production and distribution; home and business weatherization, and alternative transportation.

Implementation Action

- Organize and host an educational workshop series, at least once per year, potentially associated with Earth Day in the Spring and International Climate Action Day in the Fall.

◆ **Strategy EO-I.4. Theme of the Month**



Promote different methods for reducing greenhouse gas emissions throughout the year. Themes should be integrated into the City website, quarterly Parks and Recreation Activity Guide, informational kiosks, and displays at City facilities such as City Hall, Benicia Public Library, and the future Community Center.

Example Themes:

- **Renewable Energy**
Partner with Pacific Gas and Electric (PG&E) to hold educational workshops about ways cities can reduce greenhouse gases related to energy production and distribution, including interactive workshops on potential community strategies.
- **Energy Efficiency**
Partner with local contractors to hold workshops and demonstrations about home and office weatherization techniques and other ways that reduce energy consumption within a home or office.
- **Locally Sourced Food**
Provide community resources that educate the public on the importance of locally grown food, low mercury fish, organic produce, and non-processed foods, among other things.

Implementation Actions

- Identify funding mechanism;
- Promote theme weeks or months with a City-sponsored education and outreach campaign;
- Further coordinate programming through City departments, including the Benicia Public Library and, Parks and Community Services. Coordinate with other organizations.



The City of Benicia celebrates International Day of Climate Action (2009).

◆ Strategy EO-1.5. Eco/Sustainable art exhibitions



Partner with the Benicia Main Street Program, Chamber of Commerce and local arts organizations such as Arts Benicia and Benicia Community Arts to sponsor an art exhibit with a climate change or sustainability theme. Such an exhibit would engage the local arts community and further increase awareness and education.

Implementation Action

- Partner with appropriate community groups to sponsor a local eco art exhibit.

◆ Strategy EO-1.6. Create a Center for Sustainability at a City Facility



A Center for Sustainability could provide a place where residents could take classes to learn about climate change, green building practices, water conservation improvements, and energy efficiency.

Implementation Actions

- Identify appropriate facility and funding source;
- Identify community programming needs;
- Establish a Center for Sustainability.



The Benicia Public Library could develop an extensive 'green' book collection and is well suited for informational kiosks (2008).

◆ Strategy EO-1.7. Increase “Green” Book Collection at Benicia Public Library



Providing educational resources to the community is one of the most important aspects of the Climate Action Plan. Developing a large green book collection at the Benicia Public Library is a cost effective approach to reach a substantial percentage of residents. Book topics may include principles and practices of sustainable development, water conservation, green building, renewable energy generation, and home energy efficiency.

Implementation Actions

- Secure funding for acquisition of “green” books;
- Purchase, or encourage donations of green book collection;
- Implement ongoing green book purchasing and donation program.

◆ Strategy EO-1.8. Informational Kiosks and Info Displays at City Facilities



Interactive kiosks and informational displays are effective communication tools that can be targeted to a variety of topics and age groups. Programming may include sustainable development, climate change, water conservation, green building, renewable energy and energy efficiency.

Implementation Actions

- Identify appropriate sites for kiosks and displays;
- Implement content;
- Secure funding and construct and place kiosks and displays.



Citizens discuss how to mitigate climate change at a community workshop (2008).

◆ **Strategy EO-I.9. Utilize Public Access Television**



Identify and develop appropriate content to be aired on Channel 27, Benicia’s public access television station.

Implementation Actions:

- Identify appropriate content;
- Coordinate with television station.

◆ **Strategy EO-I.10. Community Partnerships for Green Workforce Development**



Develop partnerships with community stakeholders such as the Benicia Unified School District, PG&E, and local labor groups to encourage green workforce development.

Implementation Actions

- Identify appropriate partnership opportunities;
- Initiate dialogue with stakeholder groups;
- Develop green workforce development programs.

◆ **Strategy EO-I.11. Emission Reduction Thermometer**



Design and construct a large-scale outdoor ‘thermometer’ to be installed at a highly visible city-owned location as a visual demonstration of City and community progress toward meeting the 2020 reduction targets.

Implementation Actions

- Design and construct GHG ‘thermometer’;
- Determine appropriate location and install accordingly;
- Tie into a larger education and outreach marketing campaign.

◆ **Strategy EO-I.12. Demonstration Gardens**



Work with Benicia Community Garden, the California Native Plant Society and other community groups to create community gardens that demonstrate the use of water efficient landscaping technologies and native drought tolerant plant species.

Implementation Action

- Coordinate with appropriate community groups to create demonstration gardens throughout the Community.

◆ **Strategy EO-I.13. Encourage BUSD to Educate K-12 Students on Climate Change and Ways to Reduce GHG Emissions**



The Benicia Unified School District (BUSD) can take a leadership role in climate change education by encouraging teachers to educate youth about actions to reduce greenhouse gas emissions. Schools can use a “learn by doing” approach, such as establishing an on-campus composting program, installing solar photovoltaics, or using rain barrels for water reclamation.

Implementation Action

- Engage the Benicia Unified School District on integrating climate change curriculum by 2012.

◆ Strategy EO-1.14. Green Science and Technology Fair



Encourage the Benicia Unified School District to partner with other school districts in Solano County and the Bay Area to hold a green science and technology fair to engage and educate youth about water conservation, energy efficiency, and renewable energy.

Implementation Actions

- Engage Benicia Unified School District on developing a green science and technology fair;
- Sponsor a green science and technology fair using VIP settlement funds.

◆ Strategy EO-1.15. Car-Free Challenge



Support the Bay Area Air Quality Management District's Spare the Air campaign by declaring one day a year as a "car free" day. This could encourage residents to use alternative modes of transportation and telecommute and can be incorporated into "Bike-to-Work" day.

Implementation Actions

- Adopt a resolution declaring a car-free day;
- Coordinate car-free day with existing programs and campaigns;
- Expand "car-free day" to a community-wide "car-free challenge," a City sponsored campaign that offers prizes and incentives to residents for using alternative modes of transportation;
- Sponsor regular "Bike Safety" events for children;
- Continue the "Safe Routes to School" program.

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ENERGY PRODUCTION

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Energy Production



The use of fossil fuels, including coal, oil, and gas, for energy production contributes significantly to greenhouse gas emissions. In Benicia, these traditional energy sources represent 51 percent of the City Government’s total emissions. Reductions in the emissions from energy production and consumption can be achieved by increasing the efficiency of traditional energy sources and increasing the overall share of renewable energy.

This focus was limited to energy production. Measures that focus on energy efficiency are included in subsequent focus areas.

Adaptation

Climate change could threaten the reliability of Benicia’s energy supply, increase energy demand and operational costs, and cause damage to energy infrastructure. Increasing temperatures and extreme heat will heighten electricity demand during peak hours.

Benicia receives its electricity and gas from Pacific Gas & Electric (PG&E); PG&E generates 17 percent of its electricity from hydropower, produced at Hetch-Hetchy Dam (Pacific Gas & Electric [PG&E]). Drought and a reduced snowpack could decrease power output at Hetch-Hetchy and other hydroelectric facilities. Flooding could damage pipelines and petroleum wells.

Long-term climate change could potentially alter Benicia’s available renewable energy supply. Daily wind patterns may be disrupted, and an expected increase in cloud cover over the Western United States may alter solar and wind energy potential in Benicia. However, even with the potential constraints, Benicia should continue to pursue moving from nonrenewable energy sources to renewable energy sources.

Co-Benefits of Energy Production Objectives

- Create jobs
- Reduce energy costs
- Streamline the regulatory process
- Foster and develop new markets

Energy Production Objective Table	Emissions Reduction Type	Emissions Reduction
Objective E-1: Increase Power Plant Efficiency 10% by 2020	Community & City	
Objective E-2: Increase Amount of Renewable Energy in Benicia	Community & City	
Objective E-3: Increase Amount of Solar Energy Production in Benicia	Community & City	
Objective E-4: Increase Amount of Wind Energy Production in Benicia to 15% by 2020	Community & City	
Objective E-5: Assess and Conduct a Feasibility Study for Use of Tidal and Geothermal Power by 2020	Community & City	n/a
Objective E-6: Conduct a Smart Grid Feasibility Study by 2020	Community & City	n/a

Did you know?



Pacific Gas and Electric (PG&E) provides power to the City of Benicia. PG&E's energy portfolio includes natural gas (47%), nuclear (23%), large hydro (17%), renewable (13%), coal (4%), and other sources (1%) (PG&E, 2007). Natural gas is less carbon intensive than coal or oil.

Objective E-2: Increase Amount of Renewable Energy in Benicia



TRADITIONAL ENERGY SOURCES

As a result of cost and accessibility, coal, oil, and gas have been the primary sources of raw material for energy production. The combustion of these resources is the leading cause of climate change, which is forcing us to rethink our use of these traditional fuel sources and look for more efficient means of energy.

Objective E-1: Increase Power Plant Efficiency 10% by 2020



◆ Strategy E-1.1. Join the Local Government Sustainable Energy Coalition (LGSEC)

The LGSEC is a branch of the Local Government Commission that represents local government interests at the State level. While the Coalition's focus is on larger municipalities, it has considerable influence that could benefit the City in terms of power plant efficiency and minimum renewable energy portfolio standards.

Implementation Action

- Pass a resolution and identify funding source to join the Local Government Sustainable Energy Coalition.

CO2EMT Reduction Range

- 100% of Objective E-1.

RENEWABLE ENERGY

Renewable energy is energy generated from naturally replenishing resources, such as sunlight, wind, tides, geothermal heat, and biomass. The use of renewable energy sources in place of fossil fuels substantially reduces greenhouse gas emissions. Solar, wind, biomass, geothermal, and tidal energy are all potential renewable energy sources for Benicia. Increasing Benicia's renewable energy generation requires coordination with PG&E and other third party entities, development of a variety of funding mechanisms, and collaboration with State and regional agencies.

Existing Actions

In 2008 and 2009, the City conducted feasibility studies on potential wind and solar power sources for the water and wastewater facilities and solar potential at the future Benicia Community Center. In 2009, the City received \$75,000 in Valero Improvement Project settlement funds to provide additional staff resources for sustainability initiatives, including renewable energy development. In May 2009, the City issued a comprehensive Renewable Energy Request for Proposals (RFP) to solicit ideas on transitioning the City from non-renewable to renewable energy sources, including potential development of a renewable energy micro-utility north of Lake Herman Road.

◆ Strategy E-2.1. Renewable Energy Project Manager



Hire or contract with a renewable energy project manager who is familiar with local, State, and federal energy policies. The manager would be responsible for developing energy efficiency and renewable energy technologies, educating City officials, community members, and City commissions; providing technical expertise; and, obtaining grants for the City to increase renewable energy production.

Implementation Actions

- Outline tasks and workload, and identify funding source for the Renewable Energy Project Manager;
- Hire or contract a Renewable Energy Project Manager.

CO2EMT Reduction Range

- Not Applicable.

◆ Strategy E-2.2. Property Assessed Clean Energy (PACE) Program



Similar to the BerkeleyFIRST program, a property assessed clean energy program enables private residential, commercial, and industrial property owners to install solar, wind and energy efficiency projects by financing the upfront capital through an additional property tax assessment. The capital cost is amortized over a fixed time period, typically 20 years, through an annual 'special assessment tax'. The debt burden stays with the property rather than the owner, if the property changes hands.

Implementation Actions

- Adopt a resolution to establish PACE program;
- Design the program and determine what kind of projects are eligible for funding and select funding mechanism (Statewide program, private firm, general fund, enterprise fund, bond issuance, etc.);
- Establish a voluntary tax assessment district, allowing interested property owners to 'opt-in' or join a Statewide Joint Powers Authority;
- Set up outreach channels, including a web portal;
- Roll out pilot program;
- Make necessary program improvements

CO2EMT Reduction Range

- 4%-5% of Objective E2.

◆ Strategy E-2.3. Renewable Energy For City Facilities



Transition City procured energy from non-renewable to renewable energy sources by implementing the following options:

Option 1: City-owned Generation Systems - Develop solar, wind, cogeneration, and biomass generation systems. Offset capital costs via PG&E's Self Generation Incentive Program (SGIP)¹⁸, which provides financial incentives for installations of new, qualifying wind or fuel cell self-generation equipment.

Option 2: Green Power Purchase Agreements - Enter into Power Purchase Agreements (PPAs) that license third party providers to build, own, and operate generating systems (solar, wind, biomass, or cogeneration) on City owned building roofs, parking structures, parking lots, or other land. The City would receive income from a lease agreement and would be able to purchase the energy produced at a fixed cost, at or below utility rates.

Green Power Purchasing Agreements are a way for the City to demonstrate its leadership and commitment to green power by using City roofs and land for power generation, with no upfront capital costs.

Option 3: Technical Assistance - Work with third party energy providers and State regulatory agencies to provide technical assistance to the public.

Implementation Action

- Solicit landowner participation and create landowner database.

CO2EMT Reduction Range

- 96%-100% of Objective E2 when combined with E-2.4.

18) Pacific Gas & Electric Company. (2009). Local Government Renewable Energy Self Generation Program (AB 2466). Retrieved March 9, 2009, from Web site: <http://www.pge.com/mybusiness/customerservice/nonpgeutility/generateownpower/ab2466/>

◆ **Strategy E-2.4. Renewable Energy Fund**



Develop a renewable energy fund to provide capital incentives for renewable energy technologies, and/or a revolving loan program.

Option 1: Cash incentives – Develop a cash incentive program for solar and wind generation systems.

Option 2: Revolving loan program – Create a revolving loan program to offer micro-loans for projects that are deemed appropriate by City established guidelines.

Implementation Actions

- Secure funding for cash incentive program;
- Develop program guidelines;
- Assess the feasibility of developing a revolving loan program. If feasible, develop program and define eligible projects;
- Secure funding for revolving loan program.

CO2EMT Reduction Range

- 96%-100% of Objective E2 when combined with E-2.3.

◆ **Strategy E-2.5. Citywide Renewable Energy Mapping and Database**



Develop a citywide database identifying existing and potential renewable energy sites, such as building rooftops, parking and vacant lots. This database could include wind, solar, and other sources citywide.

Implementation Actions

- Secure funding for renewable energy mapping;
- Consult with the CEC and EPA to create wind and solar feasibility maps that identify the renewable energy potential of individual parcels;
- Make database available to public.

CO2EMT Reduction Range

- Not Applicable.

◆ **Strategy E-2.6. Community Choice Aggregation Feasibility Assessment**



Community Choice Aggregation (CCA), created by State Assembly Bill 117, provides communities with the opportunity to ‘opt-out’ of power purchase agreements with traditional energy utilities, such as PG&E. Under a CCA arrangement, the utility continues to own, operate and maintain the transmission lines; however, cities are free to purchase or generate power from sources of their own choosing. Cities can either build their own green energy infrastructure, purchase energy from energy service providers, and/or partner with private firms to develop such infrastructure. A CCA agreement allows all customers within the established CCA district to ‘opt-in’ to the program, providing customers with the ability to obtain locally produced green energy.

The City should consider a CCA feasibility study and financial analysis to determine viability. Economies of scale may require Benicia to partner with another local agency or jurisdiction.

Implementation Actions

- Secure funding for feasibility study;
- Commission feasibility study;
- Consider partnership opportunities with Solano County municipalities and public agencies;
- Initiate conversation with senior management and decision makers in neighboring jurisdictions;
- Implement CCA program.

CO2EMT Reduction Range

- Not Applicable.

Objective E-3: Increase Amount of Solar Energy Production in Benicia



SOLAR ENERGY

The sun's energy can be harnessed for heat and electricity production. Electricity is generated by 'solar cells,' also known as photovoltaic (PV) panels, which convert solar energy from the sunlight into electricity. The use of PV technology can be developed into large-scale plants or small-scale localized energy production facilities. In each case, it is essential that property owners be educated on the need to secure panels and related equipment from theft.

Existing Actions

In 2002 and 2003, the City commissioned ICF Consulting to conduct energy audits on City facilities. The facilities included City Hall, the Corporation Yard, Fire Station 11, Fire Station 12, the Gymnasium, the Library, the Senior Center, James Lemos Swim Center, and the Youth Center. The energy audit identified City Hall and the Corporation Yard as potential sites for PV panel placement.

In 2008, the City commissioned the consulting firm HDR to conduct a solar analysis for select water and wastewater treatment facilities. HDR identified three potential sites for photovoltaic panel placement at the City's wastewater treatment plant (WWTP). HDR's findings indicate that the potential exists to develop a total of 481 kW of solar energy. This includes constructing PV installations at the WWTP, Park Road lift station, Benicia Industrial lift station, water treatment plant, P-1 pump station, and P-2 pump stations. In addition, the City commissioned a Photovoltaic Feasibility Report for the future Benicia Community Center. The report indicates that there is significant solar potential at the site. In May 2009, the City issued a comprehensive renewable energy RFP, which included solar generation at various City facilities.

◆ Strategy E-3.1. Encourage Parking Lot Solar Photovoltaic Arrays



Photovoltaic arrays can be placed on shade structures above parking lots, providing a large area for photovoltaic panels. Such projects could be developed at large parking lot sites belonging to Amports, Benicia High School, Valero, and the City.

Implementation Actions

- Conduct an assessment of parking lots within the city suitable for installation of photovoltaic arrays;
- Act as a facilitator between third party energy providers and parking lot owners to encourage installation of photovoltaic equipment;
- Develop marketing materials promoting benefits of parking lot solar PV arrays to property owners.

CO₂EMT Reduction Range

- 92%-100% of Objective E3.

◆ Strategy E-3.2. Solar Permitting Fee Waiver



Waive building permit fees for solar installations in order to reduce perceived financial barriers.

Implementation Actions

- Remove building permit fees for solar installation from fee schedule;
- Educate the public regarding the new program.

CO₂EMT Reduction Range

- This strategy supports E-3.3. All reductions for this strategy have been included in E-3.3.

◆ **Strategy E-3.3. Promote California Solar Initiative and Other Applicable Incentive Programs**



The California Solar Initiative (CSI) is a partnership between the State of California and California’s investor-owned utilities, such as PG&E, and is responsible for offering statewide solar rebates. The City can help promote this program and other similar programs by creating an education outreach campaign familiarizing Benicia citizens with existing rebates and incentives. The campaign may include presentations and workshops for homeowners, as well as web-based resources.

Implementation Actions

- Develop education outreach campaign, targetted to solar installation contractors, residents, and business owners for existing incentive programs, including the CSI;
- Integrate resources into the City’s regularly maintained sustainable development website.

CO2EMT Reduction Range

- 8%-10% of Objective E3.



PV panels can help the City produce its own power.

Objective E-4: Increase Amount of Wind Energy Production in Benicia to 15% of Citywide Usage by 2020



WIND ENERGY

Wind is the fastest growing segment of the energy market. The City of Benicia has incredible wind resources that present a considerable opportunity. This opportunity should be seized to the largest extent practicable. New vertical axis wind turbines should be included as potential alternatives to traditional horizontal axis turbines.

Existing Actions

In 2008, the City commissioned the consulting firm HDR to conduct a wind analysis for select water and wastewater treatment facilities. The study concluded that a 250 kW turbine at the water treatment plant could supply 37 percent of the plant’s annual electricity demand. In addition, the study found that two pump stations are potentially viable sites for wind turbines, although a detailed analysis of these sites was not included in the scope of this study.

◆ **Strategy E-4.1. Increase Wind Energy Generation within City Limits**



Encourage property owners to install vertical axis wind turbines by creating and adopting an overlay zone that streamlines the permit process of wind energy collection systems in particular zoning districts. Allowed height, size, and noise thresholds would be established through design guidelines, which would need to be developed in conjunction with the overlay district.

Implementation Actions

- Sponsor community workshops to educate the community about wind energy collection technology;
- Create and adopt an overlay zone that streamlines the permitting process of wind energy systems in designated areas deemed to be suitable for such use. Allowed height, size, and noise level would be established through design guidelines;

- Develop design guidelines specifying the allowed size, height, and maximum noise thresholds of wind collection systems in appropriate zoning designations.

CO2EMT Reduction Range

- 100% of Objective E4.



Horizontal-axis wind turbines are considered to be the best available technology for large-scale generation.

Objective E-5: Assess and Conduct a Feasibility Study for Use of Tidal and Geothermal Power by 2020

CO2EMT estimate not applicable

EMERGING RENEWABLE ENERGY SOURCES

As new renewable energy technologies are continually being developed, efficiency will increase, cost will decrease, and demonstrated effectiveness of renewable energies will promote wide spread use. Emerging renewable energy sources, such as biomass residue capture, methane gas capture, tidal power, and geothermal power may become more viable sources of energy for Benicia. Continued monitoring of research and development projects will ensure that Benicia is familiar with the latest technologies. Because the potential of using these technologies is uncertain, **emissions reductions were not estimated.**

Existing Actions

The wastewater treatment plant currently utilizes methane gas (aka biogas) generated from anaerobic digesters as the fuel source for boilers that heat the digesters. The anaerobic digesters produce enough methane gas to run the boilers over 97 percent of the time. Natural gas is used as an alternative fuel source when necessary.

◆ Strategy E-5.1. Investigate Tidal Power

Investigate the feasibility of forming a joint powers agreement for tidal power production. Coordination with other Bay Area municipalities and public agencies is necessary due to constraints associated with local water resources, including the narrow width and protected status of the Carquinez Strait.

Implementation Action

- Form a partnership with other municipalities and public agencies to explore the feasibility of a demonstration project.

CO2EMT Reduction Range

- Not Applicable.

◆ Strategy E-5.2: Geothermal Energy Procurement

Identify and assess viable sites for geothermal resources. Geothermal resources use heat from the earth to generate energy.

Implementation Actions

- Investigate local and regional sources of geothermal power;
- Determine feasibility of acquiring the rights to identified geothermal power sources.

CO2EMT Reduction Range

- Not Applicable.

Objective E-6: Conduct a Smart Grid Feasibility Study by 2020

CO2EMT estimate not applicable

GRID IMPROVEMENTS

Like most cities in the United States, Benicia has outdated power delivery infrastructure. Impacts associated with climate change could damage and over-load power lines. The grid is designed for one-way inputs from large-scale power providers making distributed generation very difficult, expensive and unreliable. With an increase in distributed energy generation, the power grid will need to be updated. Distributed generation is defined as any small scale electric generation that is located at or near the point of end use.

Existing Actions

The PG&E SmartMetering program provides customers with a two-way communication system that shows their gas and electricity consumption in real time. This raises consumer awareness, allows for a better assessment of demand for power production and reduces wasteful energy generation. PG&E plans to install SmartMeters for all account customers in Benicia starting in October 2009 and finishing by July 2010.

◆ Strategy E-6.1. Smart Grid Feasibility Study



Investigate the feasibility of building a smart grid infrastructure and identify partners such as PG&E. Smart grids allow for two-way electrical exchange, which is essential for distributed power production. The network provides feedback of real-time electricity consumption and production trends.

Implementation Actions

- Partner with PG&E to commission a feasibility study to identify necessary improvements, cost estimates, and the technical requirements of a smart grid retrofit;
- Secure local, State, and federal funding to install smart grid infrastructure.

CO2EMT Reduction Range

- Not Applicable.



TRANSPORTATION + LAND USE

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Transportation + Land Use



Transportation comprises nearly one-third of total U.S. emissions and close to 40 percent of California emissions (U.S. EPA, 2008). In Benicia, it is the second largest contributor of greenhouse gas emissions, representing a little over four percent of the community’s total emissions. Transportation related emissions are linked to the mode of transportation (vehicle, bicycle, etc.), trip length, number of trips, efficiency of vehicles, and from land use and development patterns.

Land use is closely related to transportation related greenhouse gas emissions. Sprawling development patterns foster dependence on motor vehicles and increases greenhouse gas emissions. In contrast, an integrated and connected street network increases the viability of alternative modes of transit, such as walking, biking, access to public transit; lowers automobile dependency; and reduces trip lengths, resulting in lower greenhouse gas emissions. Benicia has opportunities for infill development, which is key to achieving reductions in VMT.

Tracking transportation related emissions at a local level is challenging. Sources are widely distributed and determined by numerous transportation decisions made by community residents.

Additionally, many transportation policies, such as fuel efficiency and vehicle emissions standards, are enacted at the federal, state, and regional levels. However, the City can lower transportation related emissions by implementing strategies that decrease vehicle miles traveled (VMT), retrofitting the municipal fleet and local infrastructure, and implementing policies to reduce travel demand.

This chapter groups strategies into three major categories:

- Municipal Transportation
- Alternative Transportation
- Land Use

Transportation + Land Use Objective Table	Emissions Reduction Type	Emissions Reduction
Objective T-1: Reduce Municipal Fleet Related Emissions 20% by 2020	City	
Objective T-2: Reduce Municipal Transportation Infrastructure Related Emissions 50% by 2020	City	
Objective T-3: Increase Bicycle and Pedestrian Mode Share by 2020	Community	
Objective T-4: Increase Public Transit Ridership 10% by 2020	Community	
Objective T-5: Reduce Benicia Breeze Vehicle Emissions 50% by 2020	City	
Objective T-6: Increase the Use of Rail & Water Transportation	Community	
Objective T-7: Increase Carpooling to 15% of Mode Share by 2020	Community	
Objective T-8: Reduce Reliance on Conventional Automobile Travel	Community	
Objective T-9: Reduce VMT 1% by Increasing Compact Mixed-Use Development	Community	

Adaptation

As the sea level rises, erosion will occur more frequently with more severity, threatening low-lying coastal structures and transportation infrastructure. In addition, sea level rise may result in increased river flooding (Sacramento and San Joaquin waterways) and runoff due to its negative impact on the drainage rate of water. Roadways, trails, transit facilities, and structures along the Carquinez shoreline may need to be protected, realigned, elevated, or relocated. Extreme temperatures may damage roadways and transit facilities, resulting in increased maintenance.

Co-Benefits of Transportation Objectives

- Improved air quality
- Reduced traffic congestion
- Improved public health
- Reduced dependency on foreign oil
- Reduced expenditures on fuel
- More efficient utilization of existing infrastructure
- Increased community interaction

Objective T-I: Reduce Municipal Fleet Related Emissions 20% by 2020



MUNICIPAL TRANSPORTATION

This section addresses City government emissions from transportation and transportation infrastructure. In 2005, emissions from the vehicle fleet, employee commute, and streetlights accounted for approximately 34 percent of emissions from the City government's operations.¹⁹ Actions and strategies for reducing City government emissions include decreasing vehicle related emissions for the municipal fleet and emissions associated with transportation infrastructure.

¹⁹ City of Benicia. (2008). City of Benicia greenhouse gas emissions inventory report page 5.

²⁰ Ibid.

²¹ A NEV is defined by the United States Department of Transportation as an electric four-wheeled motor vehicle that weighs less than 3,000 pounds and has a maximum speed of 25 miles per hour.

Municipal Fleet

Emissions related to the municipal fleet account for approximately 18 percent of the City's total transportation related emissions.²⁰ The municipal fleet includes police and fire vehicles, parks and public works equipment and vehicles, and the Benicia Breeze public transit buses. Opportunities exist to reduce emissions within the fleet by purchasing cleaner operating vehicles, downsizing to more compact vehicles, where appropriate, and by identifying alternatives to vehicle travel.

Existing Actions

As of July 2009, the City of Benicia had seven hybrid vehicles (three Toyota Priuses and four Ford Escapes) in the fleet and had retrofitted 3 diesel municipal fleet vehicles out of 7 to meet State requirements. In 2009, the Valero Refinery purchased two new Toyota Prius hybrids for the City, which were converted to plug-in hybrids. By December 2010, City staff will retrofit the final three diesel fleet vehicles (out of seven) to meet state requirements. The City has plans to obtain additional fuel-efficient vehicles during the fiscal years 2009-2011. The City developed a Benicia Air Friendly Vehicle Policy for fiscal years 2009-2011. The objective is to replace two sedans, two light-duty pickup trucks and one off-road piece of construction equipment with vehicles that best fulfill the green fleet purpose of reducing air pollution and fuel consumption while maintaining vehicle function.

◆ Strategy T I. I. Establish Mandatory Criteria for New Fleet Vehicles



When purchasing new fleet vehicles, give priority to low emission and fuel-efficient vehicles, including plug-in-hybrid, electric, compressed natural gas, biodiesel, and neighborhood electric vehicles (NEV).²¹

Implementation Action

- Prepare low emission and fuel-efficient vehicle procurement standards.

CO₂EMT Reduction Range

- 100% of Objective T I.



Electric vehicle charging at City Hall (2008).

◆ **Strategy T-1.2. Municipal Bicycle Program**



Provide bicycles for City staff, police, and parking enforcement to use during work hours for site visits, city purposes and special events.

Implementation Actions

- Purchase bicycles for the City bicycle fleet;
- Purchase weather protected bicycle storage racks at municipal buildings and facilities.

CO2EMT Reduction Range

- Unknown Reductions.

Objective T-2: Reduce Municipal Transportation Infrastructure Related Emissions 50% by 2020



Infrastructure

The City provides and maintains transportation infrastructure, including streets, streetlights, and sidewalks. Opportunities for emission reductions in this area include energy-efficient lighting and utilizing recycled content in street surfaces.

Existing Actions

For nearly 20 years Benicia has used high pressure sodium light bulbs in streetlights. The City has retrofitted 9 of 10 traffic signals from incandescent lights to light emitting diodes (LED), along with 3 out of 10 intersection walk signals. These actions have reduced energy consumption and associated greenhouse gas emissions.

◆ **Strategy T-2.1. Increase the Efficiency of Streetlights**



Replacing existing streetlights with high efficiency alternatives, such as LED or induction lighting, is an important energy and cost savings measure. The City currently expends approximately \$144,000 annually on energy to power streetlights. Efficient infrastructure is capable of reducing consumption and cost by 35-50%.²²

Implementation Actions

- Evaluate the cost and time frame for purchasing energy efficient streetlight technologies;
- Develop a replacement schedule and budget.

CO2EMT Reduction Range

- 8%-9% of Objective T2.

◆ **Strategy T-2.2. LED Lighting for Intersection Walk Signals**



LED lighting is the most energy-efficient technology for intersection walk signals available at this time. Installing LED lighting in the remaining 7 intersection's walk signals will save energy and reduce emissions.

Implementation Action

- Replace walk signals at the remaining 7 intersections with LED lighting.

CO2EMT Reduction Range

- Unknown Reductions.



First Street (Northern Perspective) (2008).

22) Based on information provided by PG&E related to their LED streetlight rebate program

◆ **Strategy T-2.3. Recycled Content in Street Surfaces**

The net energy expenditure to re-use materials is much lower than the energy required to manufacture and transport un-recycled resources. Integrating recycled rubberized additives when resealing street surfaces can help reduce the City’s greenhouse gas emissions.

Implementation Action

- Use recycled content in street surface construction, where appropriate.

CO2EMT Reduction Range

- Unknown Reductions.

◆ **Strategy T-2.4 Traffic Signal and Stop Sign Optimization**



Synchronize traffic signals and limit uphill stop signs, to improve traffic flow and minimize idling, therefore reducing greenhouse gas emissions and overall travel time. According to the Institute for Transportation Engineers, comprehensive signal programs result in a 6-9% fuel savings.²³

Implementation Actions

- Traffic signal and uphill stop sign assessment study;
- Make necessary upgrades;
- Include suggested upgrades into the Capital Improvement Plan.

CO2EMT Reduction Range

- 90% - 100% of Objective T2.



Pedestrian and bicycle paths at the Benicia State Recreation Area (2008).

Objective T-3: Increase Bicycle and Pedestrian Mode Share by 2020



ALTERNATIVE TRANSPORTATION

Substituting alternative modes of transportation, such as bicycling, walking, and public transit, in-lieu of automobile travel will reduce greenhouse gas emissions and improve our air quality. Infrastructure improvements along with a combination of public outreach and incentive programs will promote the use of alternative modes of transportation. The strategies in this section are assembled into the following three subtopics: Bicycle + Pedestrian Transportation, Public Transportation, and Travel Demand Management.

Bicycle + Pedestrian Transportation

Bicycling and walking are two important alternatives to vehicular travel in Benicia. In addition to reducing greenhouse gas emissions, they are important facets of a healthy lifestyle. Creating a well-connected bicycle and pedestrian system, and an integrated street network with quality infrastructure will provide options for residents to bicycle and walk.

Existing Actions

Portions of the Bay Trail are currently maintained by the City of Benicia. The Benicia General Plan includes policies and programs to create a comprehensive circulation system of pedestrian and bicycle routes. Recent successes include development of a bicycle and pedestrian lane on the Benicia/Martinez bridge. The Benicia Capital Improvement Program includes projects to improve and expand the existing bicycle and pedestrian network. This includes partnering with the Solano Transportation Authority (STA) and Caltrans to connect residential and commercial districts to the bicycle and pedestrian trails at the Benicia State Park, continue expansion of the Bay Trail, and building curb extensions and narrowing street crossing widths at major intersections. In addition, Benicia has received recognition for successful development of Safe Routes to School public infrastructure improvement projects. Safe Routes to School is a Federally funded program that improves pedestrian and bicycle infrastructure to encourage more children to safely walk and bicycle to school.

23) Institute for Transportation Engineers: <http://www.ite.org/signal/index.asp> and www.ite.org/reportcard/badgrade.asp

All Benicia Breeze buses, excluding paratransit vehicles, have bicycle racks, providing a link between pedestrian, bicycle, and public transportation. Bicycle storage is also provided at several major transit stops and at the Benicia Public Library and James Lemos Aquatic Center.

The Solano Transportation Authority has an adopted countywide bicycle master plan and countywide pedestrian master plan, including facilities in and connections to Benicia.

◆ Strategy T-3.1. Increase Bicycle Infrastructure at City Facilities



Adding bicycle racks at City facilities, including City Hall, Gymnasium, Clocktower, Commanding Officer's Quarters, Camel Barn, and City parks promotes bicycle ridership for City employees and residents.

Implementation Actions

- Identify appropriate locations at individual City-owned facilities for bicycle racks;
- Install appropriately sized and weather protected bicycle racks at appropriate locations.

CO2EMT Reduction Range

- 100% of Objective T3 when combined with remaining T3 strategies. T3 strategies were calculated together.

◆ Strategy T-3.2. Bicycle Infrastructure for New Development



Develop a tiered bicycle infrastructure requirement for new development based on size and cost thresholds yet to be determined. Infrastructure may include bicycle lanes, sidewalks, and storage areas depending on building size to ensure safe access for bicyclists throughout the city. This includes connections with public transportation hubs and paths to connect other non-motorized routes.

Implementation Actions

- Require bicycle infrastructure for new developments. Such an ordinance could be tiered similar to a mandatory green building ordinance, requiring varying levels of infrastructure dependent on the size and type of development;
- Infrastructure may include bicycle racks and storage, and dedicated bicycle lanes.

CO2EMT Reduction Range

- 100% of Objective T3 when combined with remaining T3 strategies. T3 strategies were calculated together.

◆ Strategy T-3.3. Implement Bicycle and Pedestrian Safety Measures

Integrating safety measures into the City's bicycle and pedestrian infrastructure is a very important action to promote car-free transportation. Traffic signals that allow bicycle and pedestrian crossing prior to vehicles at major intersections increase both the speed and safety of intersection crossings. A comprehensive system of directional signs for cyclists and pedestrians should indicate directions and distances to various destinations and be color-coded to correspond to the different types of local and regional bike route networks. A path network that is accessible and free of trip hazards allows for use by all residents and visitors.

Implementation Actions

- Add directional signs to highly traveled sections of the bicycle and pedestrian network;
- Upgrade traffic signals to include bike and pedestrian priority crossing (concurrent with LED upgrades);
- Make necessary infrastructure improvements to ensure a safe network of bicycle and pedestrian paths, including sidewalks.

CO2EMT Reduction Range

- 100% of Objective T3 when combined with remaining T3 strategies. T3 strategies were calculated together.

◆ Strategy T-3.4. Bicycle and Pedestrian Master Plan



A bicycle and pedestrian plan, including a 'complete streets' program, would be comprised of an integrated network of trails, sidewalks and bicycle paths; connects key areas of the city, identifies areas for future expansion of services, and addresses safety. The Master Plan should incorporate and supplement strategies from this Plan and include Low Impact Development (LID) standards. LID is an engineering and land use planning approach to naturally manage stormwater runoff. LID principles are based on design strategies that manage stormwater at the source by use of micro-scale natural features that are distributed through the site. This is unlike conventional approaches that typically convey and manage runoff in large facilities located at the base of drainage areas.²⁴

24) US EPA Low Impact Development – A Literature Review, EPA-841-B-00-005, Year 2000 (<http://www.epa.gov/owow/nps/lid/lid.pdf>)

Implementation Actions

- Conduct community survey and other appropriate outreach methods to solicit user feedback;
- Develop a comprehensive bicycle and pedestrian master plan, including a ‘complete streets’ program, with actions to increase safety, mobility, and convenience of bicycle and pedestrian travel.

CO2EMT Reduction Range

- 100% of Objective T3 when combined with remaining T3 strategies. T3 strategies were calculated together.

◆ **Strategy T-3.5. Revise Streetscape Design Standards**



Amend streetscape standards to include LID design criteria, wider sidewalks (where appropriate), street furniture, and drought tolerant planting/landscaping standards. Enhanced streetscapes attract pedestrian activity and promote healthy lifestyles, thus decreasing auto usage and related emissions.

Implementation Actions

- Conduct public outreach and solicit community input;
- Adapt streetscape design standards;
- Upgrade existing infrastructure with new streetscape standards.

CO2EMT Reduction Range

- 100% of Objective T3 when combined with remaining T3 strategies. T3 strategies were calculated together.

Objective T-4: Increase Public Transit Ridership 10% by 2020



Public Transportation

Public transportation includes bus, water and rail transportation services. Strategies are intended to promote the use of the Benicia Breeze bus system, reduce public transit vehicle emissions, promote the establishment of a regional ferry/water taxi service, and create an inter-city train station on Amtrak’s Capitol Corridor line, which currently passes through Benicia’s industrial park. Increasing public transportation as an alternative to automobiles will reduce VMT and greenhouse gas emissions.

Existing Actions

The Benicia Breeze bus system serves the community with two flex-routes and a route to and from Diablo Valley College. A regional bus route connects Benicia with the Vallejo Ferry Terminal, the Pleasant Hill and Walnut Creek BART stations, and the Martinez Amtrak station. Currently, Benicia residents can travel by bus to Vallejo for ferry service to San Francisco. Discount rates are available to students on bus routes 15 and 17, which are specifically designed to get kids to school. Transportation is also provided to get students from school to the City’s after school program, Kids Kaleidoscope.

The Benicia General Plan promotes ferry service to and from Benicia. The Water Emergency Transportation Authority is considering the addition of a ferry route through the Carquinez Strait, connecting Antioch and Martinez with San Francisco.

Since 2007, the City has been pursuing inter-city train service along the Capitol Corridor line. In 2009, the City began pursuing the Benicia Industrial Park Multimodal Transit Project, which will begin with the development of a Transit Plan. The City has received \$1.25 million for the project from Regional Measure 2 funds, which are from tolls collected at the Benicia/Martinez Bridge. The project will result in green infrastructure and a reduction in vehicle miles traveled, both of which lower the Community’s greenhouse gas emissions.

In October 2008, the City consolidated local bus service to improve the system's efficiency. The City trimmed its fleet from 14 buses to seven, retaining four fuel-efficient transit vehicles for its two primary routes. Benicia is currently upgrading bus stop shelters with plans to implement a bus replacement program.

In 2009, the City initiated the Benicia Intermodal Facilities Project to serve the new regional route 78 that provides service between the Vallejo Ferry Terminal and Walnut Creek BART. The project will integrate vital improvements that reduce vehicle miles traveled (VMT) and enhance pedestrian safety, while providing Park-and-Ride facilities for the ridership of the regional route 78 line and the regional route 40 line (for I-680 connection).

◆ Strategy T-4.1. Transit Passes



Establish free or reduced bus fares for select groups of local residents and employees to increase ridership and reduce personal automobile trips.

Implementation Actions

- Coordinate with local businesses, the Chamber of Commerce, the local school district, and college systems including Diablo Valley College and Solano Community College, to expand employee and student transit program;
- Provide reduced fare or free passes to full time students for all routes;
- Establish a program or subsidize costs for businesses to provide transit passes for employees.

CO2EMT Reduction Range

- 100% of Objective T4.

◆ Strategy T-4.2: Encourage BUSD to Reinstate School Buses



Morning and afternoon traffic patterns, as they relate to school drop-off/pick-up, have a significant impact on transportation related GHG emissions. Reinstating a Benicia Unified School District bus program with clean fuel vehicles would significantly decrease community-wide emissions and alleviate concentrated traffic congestion.

Implementation Actions

- Encourage the development and implementation of a "Walking School Bus" program;²⁵
- Engage the Benicia Unified School District to perform a feasibility study on re-establishment of school bussing program;
- Identify funding sources.

CO2EMT Reduction Range

- Unknown reductions.

Objective T-5: Reduce Benicia Breeze Vehicle Emissions 50% by 2020



◆ Strategy T-5.1. Low-Emission Transit Vehicles



Replace fossil fuel powered public transit vehicles with hybrid, electric, or low-emission vehicles to reduce emissions related to public transportation.

Implementation Actions

- Follow the Benicia Breeze Transit System Strategy Report's 10-Year Capital Replacement Schedule, replacing traditional buses with low-emission buses;
- Continue to increase energy standards with fleet procurement.

CO2EMT Reduction Range

- 100% of Objective T5.

25) <http://www.walkingschoolbus.org/>

Objective T-6: Increase the Use of Rail & Water Transportation



◆ Strategy T-6.1. Explore Ferry/Water Taxi Service



The City should continue coordinating with the State Water Emergency Transportation Authority to provide ferry or water taxi service to Benicia, including a First Street terminal to help facilitate the economic sustainability of the downtown. Water taxis provide an alternative mode of transportation that could connect downtown Benicia to regional ferry networks and nearby cities such as Port Costa and Martinez. If the Water Emergency Transportation Authority selects Martinez as a ferry terminal location, water taxi service to Martinez would provide a direct connection for Benicia residents to regional ferry service.

Implementation Actions

- Work with Solano Transportation Authority to add ferry infrastructure to their list of capital projects;
- Monitor the actions of WETA regarding a feasibility study for the Antioch and Martinez ferry terminal locations;
- Pursue funding and feasibility for ferry service, including terminal facilities;
- If ferry service is not feasible, determine feasibility and funding sources for a water taxi service to/from Benicia;
- Establish ferry/water taxi service.

CO2EMT Reduction Range

- Unknown reductions.



The First Street Pier is one potential site for a water taxi and/or ferry terminal (2008).

◆ Strategy T-6.2. Benicia Commuter Rail Stop



Benicia is well positioned for a commuter rail stop on the existing Capitol Corridor line that passes through the Benicia Industrial Park. The stop would provide direct access to Amtrak, decreasing the vehicle miles traveled to rail stops in Suisun and Martinez. In addition to capturing existing ridership, the convenience factor could influence substantial new ridership.

Implementation Actions

- Monitor the actions of the Solano Transportation Authority regarding implementation actions or changes to the Auburn-Oakland regional rail study, and other applicable studies/plans;
- Conduct ridership study to determine feasibility;
- If feasible, secure funding for rail stop development;
- Establish intercity rail stop in Benicia.

CO2EMT Reduction Range

- Unknown reductions.

Objective T-7: Increase Carpooling to 15% of Mode Share by 2020



Travel Demand Management

Services and programs that focus on changing travel behavior can reduce traffic congestion and greenhouse gas emissions. Encouraging carpooling and car sharing reduces total roadway traffic and vehicle miles traveled. Parking restrictions combined with improved alternative transportation infrastructure will utilize financial incentives to change travel behavior.

The Solano Transportation Authority offers free services and information for alternative transportation in Solano County and surrounding regions through the Solano Napa Commuter Information (SNCI) program. Carpool, vanpool, bus, ferry, rail, and bicycling information and services are delivered to the general public and through employers. SNCI is a part of the Bay Area regional 511 program and uses the regional ridematching system to

provide free carpool/vanpool matchlists for commuters. The new ridematching system, implemented in May 2009, has the capability to display a website that can be customized with the identity of a local jurisdiction or employer using logos, colors and other design features – but still have the advantages of a large regional database.

Existing Actions

The Benicia General Plan includes a program to designate carpool parking at schools. The City also plans to upgrade the existing electric vehicle charging stations near the City Hall parking lot to accommodate plug-in hybrid vehicles. The Downtown Mixed Use Master Plan significantly reduced previously existing parking standards for the downtown area, thus encouraging infill development and discouraging auto-oriented developments.

◆ Strategy T-7.1. Carpool Program



A local carpooling program would connect Benicia residents and workforce with carpool partners via an online carpool information and communication center. Such a program would facilitate carpooling for residents commuting in and out of the area, thus reducing emissions by removing automobiles from the roads and highways.

Additional participation in the Solano Napa Commuter Information (SNCI) regional rideshare program would connect Benicia residents and workforce with carpool partners. This would facilitate carpooling, as well as other alternative modes of transit use, for residents coming into and out of the area.

Implementation Action

- Work with SNCI to provide public education and enhance access for Benicia residents, employers and their employees to SNCI ridematching and related services. Provide a direct connection to SNCI services on the City of Benicia web page.

CO2EMT Reduction Range

- 100% of Objective T-7 when combined with T-7.2.

◆ Strategy T-7.2. Carpool Incentives for City Employees



Developing incentives for employees to carpool is a meaningful way for the City to encourage carpooling within its own staff. Carpooling is one of many ways employees can lower their carbon emissions related to work commutes. Incentives include financial incentives and vanpool service.

Implementation Actions

- Provide incentives to City employees for carpooling to work;
- Provide incentives for City employees to live in Benicia.

CO2EMT Reduction Range

- 100% of Objective T-7 when combined with T-7.1.

Objective T-8: Reduce Reliance on Conventional Automobile Travel



◆ Strategy T-8.1. Encourage Local Businesses to Use Alternative Fuel Vehicles



Increasing the usage of fuel-efficient vehicles reduces fuel consumption and costs, as well as greenhouse gas emissions. Pamphlets, workshops, and Internet resources can be effective means to inform local businesses of the merits of using alternative fuel or fuel-efficient vehicles.

Implementation Action

- Educate business owners about benefits of using low emission, fuel-efficient vehicles.

CO2EMT Reduction Range

- Unknown Reductions. The majority of Objective T-8 reductions result from an assumed increase in fuel efficiency by 2020.

◆ **Strategy T-8.2. Create Local Car Share Program**



Facilitate the establishment of car share programs in Benicia, such as Zipcar or City CarShare, which provide convenient and affordable access to vehicles. Reliable car share programs reduce individual car ownership, increasing the usage of alternative transportation.

Implementation Actions

- Work with vendors to establish one or more car share stations;
- Establish a local pilot program and track usage;
- Assess usage and expand the program to meet car share user needs.

CO₂EMT Reduction Range

- Unknown Reductions. The majority of Objective T-8 reductions result from an assumed increase in fuel efficiency by 2020.

◆ **Strategy T-8.3. Revise Parking Standards**

Revise parking requirements in the Benicia Municipal Code to create maximum parking stall requirements and reduced parking requirements for new development and land uses, similar to the Downtown Mixed Use Master Plan. Parking maximums, combined with increased accessibility to alternative modes of transportation, will reduce vehicle miles traveled and emissions, create more attractive street frontages, reduce development costs, and lessen the amount of impervious pavement (which decreases storm water runoff and lowers the heat island effect). Parking limits should be determined through a parking study of existing local shopping centers, industrial parks, and businesses.

Implementation Actions

- Conduct a commuting and parking study of local businesses and developments to assess the usage of existing parking lots, and determine the methods, routes and VMT of employee commutes to Benicia;
- Conduct a feasibility analysis for a ‘one-stop’ parking management program and implement appropriate measures;
- Develop and adopt revised parking standards.

CO₂EMT Reduction Range

- 1% to 2%. The majority of Objective T-8 reductions result from an assumed increase in fuel efficiency by 2020.

Objective T-9: Reduce VMT 1% by Increasing Compact Mixed-Use Development



LAND USE

The distribution of land uses and the degree of street connectivity within a city influences how people travel. Land use strategies that place everyday needs in close proximity to each other provides the foundation for the use of alternative modes of transportation. Encouraging compact, mixed-use development and promoting a jobs-housing balance can reduce VMT by locating jobs and services closer to Benicia residents.

Strategies that support a diversity of uses promote density, encourage reuse of underutilized properties, and create a job-housing balance through the development of affordable housing. These strategies can eliminate or shorten vehicle trip lengths and encourage alternative forms of transportation.

Existing Actions

The City has established an Urban Growth Boundary to protect surrounding agricultural lands, watershed, and open spaces from urban development. The City’s General Plan includes many policies and programs that encourage mixed-use and live/work developments within various areas of the City. In 2007, the City adopted the Downtown Mixed Use Master Plan that incorporates a form-based development code.

Policies that encourage infill housing development include allowing accessory dwelling units on lots over 6,000 square feet, and requiring that a percentage of affordable housing units be included in market-rate housing developments. The City’s General Plan also addresses the need to achieve a jobs-housing balance by means of programs to attract and retain employers.

◆ Strategy T-9.1. Form-Based Code

Unlike traditional zoning codes, form-based codes intentionally emphasize building form rather than use. This increases flexibility for a variety of complementary uses to be permitted in the same area, and the potential for mixed-use developments. Currently, a form-based code regulates development in downtown Benicia. Form-based codes should be considered for areas where mixed-use development can reduce transportation-related GHG emissions.

Implementation Action

- Develop and adopt form-based zoning for appropriate areas.

CO₂EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.

◆ Strategy T-9.2. Live/Work and Work/Live Incentives

Live/work and work/live developments allow residents to live at their place of work. Reducing permit fees and expediting permitting for live/work and work/live units can encourage such developments. An additional incentive may include waiving business license fees for residents in live/work and work/live units to encourage compact development and reduce vehicle miles traveled.

Implementation Action

- Develop and adopt live/work and work/live incentives.

CO₂EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.



Mixed-use office and retail in the downtown (2008).

◆ Strategy T-9.3. Neighborhood Commercial Centers



Amend development regulations to accommodate small neighborhood shopping centers and individual retail establishments in residential neighborhoods. These centers could provide goods and services (e.g., dry cleaning, etc.) adjacent to existing residential neighborhoods, shortening the distance between residents and services. This increases the possibility of walking and biking for errands as an alternative to driving.

Implementation Actions

- Develop a robust public engagement initiative, including education, outreach and facilitated design workshops;
- Evaluate and identify potential neighborhood commercial center sites;
- Adopt interim development regulations;
- Rezone identified areas to Community Commercial.

CO₂EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.

◆ Strategy T-9.4. Development of Underutilized and Vacant Infill Sites



Promote infill development including mixed-use, commercial services, parks, community gardens (see Parks and Open Space section), and limited agricultural uses. Infill development concentrates growth in already urbanized portions of the city, which helps preserve open space and agricultural uses. In addition, infill will result in a more compact urban core and decrease VMT.

Implementation Actions

- Evaluate potential infill sites;
- Amend development regulations to promote higher-density and mixed use projects at infill sites.

CO₂EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.

◆ **Strategy T-9.5. Amend Zoning Regulations for Accessory Dwelling Units**

Amend the Municipal Code to reduce the current minimum lot size and lower impact assessment fees associated with accessory dwelling units outside of the Downtown Historic district. This will concentrate growth in already developed portions of the City and reduce Vehicle Miles Traveled.

Implementation Action

- Amend development regulations.

CO2EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.

◆ **Strategy T-9.6. Industrial Development Workforce Housing Nexus Study**

Consider amending the Inclusionary Housing Ordinance to include affordable housing requirements with future large scale developments such as the Benicia Business Park industrial development, based on the need that is generated by a respective project. This will help the City to achieve a jobs-housing balance, thus reducing commute distance, thereby lowering greenhouse gas emissions.

Implementation Actions

- Conduct nexus study to determine legal viability and appropriate thresholds;
- If nexus study identifies a legal nexus, amend the Inclusionary Housing Ordinance to include a tiered approach based on project size/dollar valuation;
- Amend Inclusionary Housing Ordinance.

CO2EMT Reduction Range

- 100% of Objective T9 when combined with remaining T9 strategies. T9 strategies were calculated together.



BUILDINGS

(Municipal, Residential + Historic)

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Buildings

(Municipal, Residential + Historic)



Building related greenhouse gas emissions are largely attributed to indoor heating, ventilation and air conditioning (HVAC) as well as the efficiency of appliances and other mechanical systems. This includes hot water heaters, dishwashers, washers and dryers, and plumbing fixtures. Consequently, a large portion of the total emissions for both the community and City government can be attributed to the built environment.

The City of Benicia is nearing build-out, limiting opportunities for large residential and commercial development projects. Opportunities for reducing greenhouse gas emissions related to buildings include upgrades and retrofits of the existing building stock. Strategies for increasing building efficiency and reducing emissions related to buildings within Benicia are separated into municipal, residential, and historic buildings.

Green building practices incorporate materials and construction practices that reduce a building's energy consumption. Two widely used green building criteria are the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) and Build It Green's GreenPoint Rated System. Build It Green's GreenPoint Rated System is used for residential construction while the LEED criteria is primarily used for nonresidential construction.

The 2008 California Green Building Standards Code, as Part 11 (Title 24) of the California Standards Code, is a collection of green building "best practices." By mandating these practices, California will become the first state to adopt statewide green building standards that focus on planning and design, water efficiency and conservation, material conservation and resource efficiency, and air quality. The California Building Standards Commission encourages local governments to exceed these standards. As of August, 2009, these practices are voluntary. Select practices, such as diverting 50% of Construction and Demolition Waste from the waste stream will become mandatory in 2010.

Strategies for reducing emissions from industrial and commercial buildings and operations are located in the Industrial and Commercial section of this plan and are consistent with the implementation and phasing of strategies identified in this section.

Adaptation

The anticipated impacts of climate change include frequent and intense heat waves as well as sea level rise. An increased number of summer heat waves will result in increased demand to cool homes and businesses. A rise in sea level will increase flooding of homes and businesses in low-lying areas along the Carquinez shoreline.

Buildings Objective Table	Emissions Reduction Type	Emissions Reduction
Objective B-1: Increase Building and Energy Efficiency in Municipal Buildings by 10% by 2020	City	
Objective B-2: Increase Building Efficiency by 20% in New Residential Construction by 2020	Community	
Objective B-3: Reduce Energy Use by 20% in Single & Multifamily Residential by 2020	Community	
Objective B-4: Green 30% of Historic Structures by 2020	Community	

Co-Benefits of Building Objectives

- Increase in indoor and outdoor air quality
- Reduced operational and maintenance costs
- Increase in building re-sale value

MUNICIPAL BUILDINGS

It is important that the City take a leadership role in meeting the emission reduction targets. Promoting and demonstrating green building practices for new and existing structures are important strategies to reduce greenhouse gas emissions and to educate the public.



Benicia Fire Department (2009).

Existing Actions

Since 2000, the City of Benicia has continued to upgrade outdated equipment with high efficiency equipment as it becomes functionally obsolete. Equipment upgrades include the replacement of boilers and HVAC systems in City owned and maintained facilities. The Capital Improvement Program outlines projects that the City has completed or is expected to complete to increase building and equipment efficiency. These projects include upgrades and improvements to the City Gym, City Hall, Corporation Yard, Senior Center, and the Clocktower. The City has also replaced all lighting within municipal buildings with more efficient T8 and Super T8 lighting fixtures.

In December 2008, the Parks and Community Services Department registered the Benicia Community Center, formerly Mills Elementary School, with the USGBC for potential LEED certification under the Commercial Interiors (CI) designation. The project is currently being re-designed to meet LEED CI certification requirements.

Objective B-1: Increase Building and Energy Efficiency in Municipal Buildings by 10% by 2020



◆ Strategy B-1.1. LEED Certification for Municipal Projects



Municipal buildings should be held to a higher standard than residential, nonresidential, and historic structures as a demonstration of community-wide leadership. New construction of municipal buildings under 5,000 square feet should be LEED Certified (excluding minor construction projects), and structures over 5,000 square feet should be required to obtain LEED Silver certification. In addition, the ordinance should identify standards and definitions for City tenant improvements and minor construction projects.

Implementation Action

- Adopt green building standards for municipal projects as part of the tiered Green Building Ordinance.

CO2EMT Reduction Range

- Unknown.

◆ Strategy B-1.2. Solar Thermal Energy for Municipal Buildings



Integrating solar thermal systems into municipal buildings will decrease emissions and reduce costs associated with heating water. Solar thermal systems utilize solar energy to heat water, thereby avoiding the use of non-renewable fuel sources.

Implementation Actions

- Identify appropriate City facilities;
- Install solar thermal systems.

CO2EMT Reduction Range

- 38-40% of Objective B1.

◆ Strategy B-1.3. Upgrade City Hall HVAC System



The California Energy Commission recommends a heat thermostat threshold of 68 degrees and an air conditioning threshold of 75 degrees. At this time, mandating these thresholds is not a reasonable requirement at City Hall because the existing HVAC system's climate zones are too large to accommodate the variety of building conditions and office configurations. The HVAC system should be upgraded to include the highest levels of efficiency, including microclimate thermostat controls, ideally for each office. After appropriate upgrades are made, it would be reasonable to ban personal space heaters.

Implementation Actions

- Upgrade HVAC systems to include smaller heating and cooling zones for greater flexibility and increased comfort;
- Ban personal space heaters, (after HVAC upgrades are made);
- Regulate thermostats in City owned and operated buildings to comply with CEC.

CO₂EMT Reduction Range

- 63-65% of Objective B1.



City Hall (2009).

Objective B-2: Increase Building Efficiency by 20% in New Single and Multifamily Residential Construction by 2020



RESIDENTIAL BUILDINGS

Green building practices maximize efficiency of buildings and their mechanical systems. In addition, green building practices can increase home values, reduce energy costs, and improve indoor air quality.

Build It Green's GreenPoint Rated System was designed specifically to increase residential building efficiency in California by supplementing existing California energy codes and has become a regional and State standard.

In addition to increasing building energy efficiency standards, incentives and outreach are key strategies for promoting the benefits of green building practices.

Existing Actions

The City of Benicia Building Division distributes information on green buildings, home weatherization, and other energy conservation methods. The City also encourages developers to implement energy conservation measures in projects through building orientation, landscaping, and solar access.

In July 2008, the Bay Area Air Quality Management District adopted a resolution prohibiting wood burning during curtailment periods or Spare the Air days in the Bay Area. BAAQMD has identified wood smoke as being the Bay Area's largest stationary source of particulate matter. The resolution requires that all stoves and inserts used in new construction be EPA certified.

◆ **Strategy B-2.1. Adopt a Tiered Green Building Ordinance**



The City’s green building ordinance will incorporate 2008 California Green Building Standards Code (California Code of Regulations Title 24, Part 11) and 2008 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. While these codes provide a minimum baseline, the City should require more stringent tiered standards similar to Build-It-Green’s Green Point Rated System.

Implementation Action

- Prepare, adopt, and implement a detailed tiered rating system similar to Build-It-Green’s Green Point Rated System.

CO2EMT Reduction Range

- 100% of Objective B2.

◆ **Strategy B-2.2. Promote Local Green Building Projects**



Develop a marketing program to promote green buildings and developments in Benicia including a program logo that could be incorporated on yard signs for residences, and window decals for businesses. Distribute promotional kits to homes and businesses that meet green building standards.

Implementation Actions

- Work with local contractors and homeowners to develop a marketing campaign;
- Develop logo, yard signs, window decals, etc;
- Distribute promotional kits.

CO2EMT Reduction Range

- This strategy supports B-2.1. All reductions for this strategy have been included in B-2.1.

Objective B-3: Reduce Energy Use by 20% in Existing Single and Multifamily Residential by 2020



◆ **Strategy B-3.1. Residential Energy Conservation Ordinance**



Require residential structures to undergo minimum energy efficiency/weatherization upgrades at the time of major renovation. The definition of major renovation should be established by determining a minimum construction valuation threshold. Other cities have adopted a threshold of \$50,000.

Implementation Actions

- Establish program parameters and definitions;
- Adopt a residential energy conservation ordinance.

CO2EMT Reduction Range

- 11%-15% of Objective B3.

◆ **Strategy B-3.2. Adopt Build It Green’s Home Remodel Standards or Equivalent**



Adopt a tiered green remodel requirement as part of the green building ordinance, utilizing Build It Green’s home remodel standards.

Implementation Action

- Incorporate a tiered green remodel requirement into the green building ordinance.

CO2EMT Reduction Range

- 11%-15% of Objective B3.

◆ Strategy B-3.3. Home Energy and Water Audits



Offer energy and water audits free of cost to Benicia residents. Energy and water audits identify efficiency opportunities and provide residents with conservation recommendations.

Implementation Actions

- Establish a City/school (BUSD) partnership to train high school students to provide residential energy and water audits;
- Work with BUSD students, teachers, and administrators to design and implement such program.

CO2EMT Reduction Range

- 12%-15% of Objective B3.

◆ Strategy B-3.4. Energy Efficiency Rebates



Partner with local utility providers and other local and regional agencies to provide rebates and/or promote existing rebates for energy efficient appliances. Projects that may qualify for rebates include radiant roof barriers, home weatherization projects, HVAC systems, water heaters and lights.

Implementation Actions

- Promote existing rebate programs;
- Establish rebates for other energy intensive appliances that are not addressed by existing rebate programs.

CO2EMT Reduction Range

- 76%-80% of Objective B3.

◆ Strategy B-3.5. Ban Wood Burning

A ban on wood burning would improve air quality during the winter months as well as reduce of greenhouse gas emissions. Solano County has the highest asthma symptom rate in the State, with over 14 percent of its residents exhibiting symptoms. Smoke from wood burning contains Particulate Matter (PM)²⁶, which is known to trigger asthma attacks. Natural gas burning fireplaces produce more heat while emitting less carbon dioxide compared with wood burning devices. Such a measure would place a de facto ban on wood burning fireplaces and stoves.

26) Solano County, (2009) Solano County Public Health - Asthma Education. Retrieved July 23, 2009, from http://www.co.solano.ca.us/depts/ph/hp_n_e/programs/asthma_education.asp

Implementation Action

- Adopt an ordinance to ban wood burning.

CO2EMT Reduction Range

- Not Applicable. CO2EMT emissions from wood burning were not accounted for in the greenhouse emissions inventory.

◆ Strategy B-3.6. Wood Fireplace Change-Out/Removal Program



Provide financial assistance to homeowners to change out their existing wood burning fireplaces for natural gas devices, or completely remove existing wood fireplaces. Such a measure would support residents to comply with the ban on wood burning.

Implementation Action

- Develop and fund a wood fireplace change-out/removal program.

CO2EMT Reduction Range

- Not Applicable. CO2EMT emissions from wood burning were not accounted for in the greenhouse emissions inventory.

◆ Strategy B-3.7. Change a Light Campaign



Switching to Compact Fluorescent Light bulbs (CFL) is a low cost way to reduce energy consumption. The City could distribute these light bulbs as part of a larger education and outreach campaign. The program would include an educational component to promote proper disposal of CFL bulbs.

Implementation Action

- Distribute free CFLs.

CO2EMT Reduction Range

- 1%-2% of Objective B3.

Objective B-4: Green 30% of Historic Structures by 2020



HISTORIC BUILDINGS

Benicia has a large number of historically significant structures in the Downtown and Arsenal districts. In addition, the City owns, operates and maintains historic buildings, including City Hall, the Camel Barn complex, Commanding Officer's Quarters and the SP Depot. The California State Office of Historic Preservation states, "older and historic buildings comprise more than half of the existing buildings in the United States. Retention and adaptive reuse of these buildings preserves the materials, embodied energy, and human capital already expended in their construction. The recycling of buildings is one of the most beneficial 'green' practices, and stresses the importance and value of historic preservation in the overall promotion of sustainability."²⁷

The Secretary of the Interior's Standards for the Treatment of Historic Properties provides the framework for local historic conservation plans, which restrict the design and construction activities of designated historic structures in order to preserve the integrity of the buildings and the districts that they are located in. Energy efficiency and green building techniques can be successfully integrated into historic buildings in ways that do not affect the character defining features of the buildings.

Examples include:

- Undoing inappropriate alterations that restrict air flow and block natural light;
- Sealing of air leaks, which can waste 20-50% of energy spent on heating and cooling;
- Repair or replacement of inefficient heating and cooling units;
- On-site energy generation;
- Window efficiency through weather-stripping and caulking;
- Efficient interior and exterior lighting.

²⁷) Greening Main Street Buildings, by Kennedy Smith, from Main Street News, April 2009 found at www.preservationnation.org/main-street/main-street-news/pdfs/msnews-2009-04.pdf

²⁸) The Secretary of the Interior's Standards are the national standards for historic preservation. They were developed to administer Federal tax credits and have since been adopted by state and local agencies as a set of guiding principles to protect features of a property which are significant to its historic, architectural, and cultural values.

Existing Actions

The City of Benicia has taken steps to preserve and protect its historic resources. The Benicia General Plan includes policies to encourage the reuse, rehabilitation and restoration of historic buildings. In 1990 and 1993, the City adopted the Downtown Historic and Arsenal Conservation Plans to promote the conservation, preservation, protection and enhancement of the two historic districts. The City has undertaken projects to rehabilitate and preserve its own historic resources, including City Hall, the Southern Pacific Railroad Depot and the Commanding Officer's Quarters.

◆ Strategy B-4.1. Encourage Energy Efficient Upgrades in Historic Structures



The Downtown Historic Conservation Plan emphasizes the importance of the integrity of historic structures. Retrofitting the interior of existing structures to increase efficiency will reduce energy demand and lower maintenance and operating costs, while staying within the Secretary of the Interior's Standards.²⁸ The City can encourage energy efficiency retrofits by conducting educational workshops and by providing informational handouts and web-based resources.

Implementation Action

- Adopt energy efficiency standards for historic structures as part of green building ordinance.

CO₂EMT Reduction Range

- 96%-100% of Objective B3.



Landmark building located in the Arsenal Historic District (2009).

◆ Strategy B-4.2. Amend the Downtown and Arsenal Historic Conservation Plans



Amending the Historic Conservation Plans to include policies that encourage greening of historic structures will reduce conflicts between historic preservation, renewable energy, and energy efficiency upgrades. This may include suggested locations for solar photovoltaic panels; however, the Solar Rights Act of 1976 requires cities and counties to “administratively” approve applications to install solar energy systems by issuing a building permit or other non-discretionary permit, based strictly on health and safety.²⁸ Therefore, design review cannot be required for the panels themselves or their location; however, if the panels require an additional structure to be constructed the City could require design review for the structure itself.

Implementation Action

- Amend the Historic Conservation Plans to include policies that encourage the greening of historic structures.

CO2EMT Reduction Range

- Unknown.

◆ Strategy B-4.3. Encourage LEED certification and/or Build It Green’s GreenPoint Rated certification for Historic Structures



The benefits of retrofitting a historic structure to achieve LEED certification (for non-residential projects) or GreenPoint Rated certification (for residential projects) include reduced energy consumption and lower maintenance costs. Building owners should be encouraged to rehabilitate their structures to these standards.

Implementation Action

- Encourage green retrofits through education outreach programs and demonstration projects (see strategies B-4.5 and B-4.6).

CO2EMT Reduction Range

- 3%-5% of Objective B4.

◆ Strategy B-4.4. Educate Property Owners, City Commissions, Local Contractors, and Suppliers



Educating property owners, Planning Commissioners, Historic Preservation Review Commissioners, local contractors, and suppliers about the benefits of greening historic structures, will help strengthen public support and supply chains to encourage green building practices in historic retrofits.

Implementation Action

- Organize workshops and presentations about historic preservation and green building practices.

CO2EMT Reduction Range

- Unknown Reductions.

◆ Strategy B-4.5. Retrofit the Clocktower to Achieve LEED Certification



Retrofit the Clocktower to achieve LEED Certification to demonstrate the City’s commitment to sustainable building practices in historic structures. Adding capacity to open and close the windows, among other appropriate rehabilitation measures will reduce energy consumption and maintenance costs, improve indoor air quality, and serve to educate the public about the positive relationship between sustainable building practices and the Secretary of the Interior’s Standards for historic preservation.

Implementation Action

- Pursue funding and conduct Clocktower retrofit.

CO2EMT Reduction Range

- Unknown Reductions.

28) California Solar Rights Act, a Review of the Statutes and Relevant Cases, January 2007, Energy Policy Initiatives Center, University of San Diego School of Law, www.sandiego.edu/epic/publications/documents/070123_RightsActFinal.PDF

◆ **Strategy B-4.6. Energy Efficiency
Demonstration Projects at City Hall**



Perform energy efficiency upgrades at City Hall that are in compliance with the Secretary of the Interior’s Standards for historic preservation. These upgrades can serve as demonstration projects for the historic preservation community.

Implementation Actions

- Perform a comprehensive energy audit with accompanying recommendations;
- Make recommended efficiency upgrades.

CO₂EMT Reduction Range

- Unknown reductions.



INDUSTRIAL + COMMERCIAL

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Industrial + Commercial



In 2000, the Commercial and Industrial sector was the largest contributor to the City of Benicia’s total greenhouse gas emissions. The Emissions Inventory indicates that approximately 95 percent of the Community’s total emissions are related to commercial and industrial uses; 20% of these emissions are attributed to the Valero Refinery and Port of Benicia.

Greenhouse gas emissions related to industrial and commercial uses include business operations, building efficiency, and the transportation of goods.

This focus area identifies strategies to reduce local greenhouse gas emissions through industrial and commercial building efficiency, business operations, and large emitters. Large emitters include the Valero Refinery and Port of Benicia. Greenhouse gas emissions related to the Valero Refinery and Port of Benicia are primarily regulated by federal and State agencies.

Adaptation

Climate change may impact industrial and commercial businesses in Benicia in several ways. Sea level rise could increase flooding for businesses and infrastructure in low-lying areas along the Carquinez shoreline, affecting port and refinery operations. Demand in electricity for heating, ventilation, and air-conditioning (HVAC) systems will increase if heat waves intensify. Businesses may experience a rise in costs of goods as a result of water scarcity and increased fuel costs.

Co-Benefits Of Industrial + Commercial Objectives

- Improved Regional Air Quality
- Reduced transportation expenses for business
- Water Conservation
- Improved Business Community Alliance
- Reduced business utilities cost

Objective IC-1: Reduce Energy Consumption in Industrial and Commercial Buildings 20% by 2020



INDUSTRIAL AND COMMERCIAL BUILDINGS

Increasing the energy efficiency of buildings is a key strategy to reduce greenhouse emissions, and operational and maintenance costs. Adopting a green building ordinance, among other strategies, will increase building efficiency standards for new construction or major retrofits. The United States Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) is the regional standard for industrial and commercial buildings.

Industry + Commercial Objective Table	Emissions Reduction Type	Emissions Reduction
Objective IC-1: Reduce Energy Consumption in Industrial and Commercial and Buildings 20% by 2020	Community	
Objective IC-2: Increase Operational Efficiency 20% by 2020	Community	
Objective IC-3: Encourage the Port of Benicia to Implement Emissions Reduction Measures	Community	n/a
Objective IC-4: Encourage the Valero Refinery to Continue to Reduce Emissions	Community	n/a

Existing Actions

The Downtown Mixed Use Master Plan encourages green building practices and suggests priority permitting as an incentive. The Building Division has also created green building display boards for public areas of City Hall.

◆ Strategy IC-1.1. Building Audit and Efficiency Program



A comprehensive building energy audit program should be established for industrial and commercial structures. The program should include a partnership with PG&E and other relevant stakeholders to promote existing no-cost energy audit programs. For businesses that do not qualify for the program, the City should establish an audit program free of cost.

PG&E's program for large-scale energy users provides cost-free audits performed by qualified engineering firms and include a comprehensive report identifying efficiency measures, such as, weatherization, increased insulation, window seals, and equipment replacement recommendations. The result is increased efficiency, decreased overhead, and a reduction in greenhouse gas emissions and in operating and maintenance costs.

Implementation Actions

- Establish an education and outreach component for businesses that includes best management practices for energy efficiency, water conservation, waste management and heating/ventilation/air conditioning (HVAC);
- Develop partnerships with PG&E and other relevant stakeholders, which includes business outreach and education programs;
- Identify businesses that qualify for existing audit programs;
- Establish an audit program for businesses that do not qualify for such programs.

CO2EMT Reduction Range

- 1.5%-3% of Objective IC-1.

◆ Strategy IC-1.2. Mandate Building Performance Certificates



Building performance certificates display the potential energy performance of a building and identifies areas of improvement, similar to the Environmental Protection Agency fuel economy estimates for new automobiles. The certificate would be presented at the time of sale or rent and would provide transparency of a building's efficiency, giving consumers upfront data.

Implementation Actions

- Develop criteria to measure building performance;
- Establish program guidelines;
- Adopt an ordinance to mandate building performance certificates.

CO2EMT Reduction Range

- Unknown Reductions.

◆ Strategy IC-1.3. Require LEED Certification for New Industrial and Commercial Buildings Larger than 5,000 Square Feet.



The LEED certification system utilizes green building practices and design elements to accrue points on a checklist that correspond to incremental levels of certification. The green building criteria incorporate site design, energy consumption, indoor air quality, and construction materials.

Implementation Action

- Adopt a green building ordinance provision requiring LEED certification for new industrial and commercial construction over 5,000 square feet.

CO2EMT Reduction Range

- 8%-10% of Objective IC-1.

◆ Strategy IC-1.4. Commercial Energy Conservation Ordinance



Require commercial structures to undergo minimum energy efficiency/weatherization upgrades at the time of major renovation. Required upgrades should be established by determining appropriate tiered thresholds, based on construction valuation and/or building addition square footage.

Implementation Actions

- Establish program parameters and definitions;
- Adopt a Commercial Energy Conservation Ordinance.

CO2EMT Reduction Range

- 89%-100% of Objective IC-1.

◆ Strategy IC-1.5. Provide Green Building Consulting and Technical Assistance



Designating a green building staff person will help ensure that projects are planned and constructed to meet adopted standards. This person would be made available to assist homeowners, developers, and contractors and will also be responsible for putting together educational handouts, displays, etc.

Implementation Actions

- Formalize assistance program;
- Train City staff, as necessary.

CO2EMT Reduction Range

- Not Applicable. This strategy supports to IC-1.3 and other strategies.

Objective IC-2: Increase Operational Efficiency 20% by 2020



BUSINESS OPERATIONS

Industrial and commercial businesses contribute a large portion of the Community's total greenhouse gas emissions. In addition to increasing the efficiency of commercial and industrial buildings, a change in operations is required for further emission reductions. Curbside recycling is an important component and has been addressed in the Solid Waste focus area (Strategy SW-2.2)

Existing Actions

Actions to reduce greenhouse gas emissions related to business operations have been limited, thus presenting an opportunity area.

The County of Solano is part of the Bay Area Green Business Program, which is a voluntary program to certify businesses that work to conserve natural resources, reduce pollution and minimize waste. In July of 2009, Benicia's first business was certified by the program.

◆ Strategy IC-2.1. Promote Green Business Certification Program



Solano County's participation in the Bay Area's Green Business Program³⁰ is an important first step in engaging the private sector in the green conversation. The City can work with the county to come up with innovative outreach strategies to encourage participation

Implementation Action

- Work with Solano County staff to tailor ongoing outreach programs, including presentations to the Chamber of Commerce, Benicia Industrial Park Association, Benicia Main Street Program, Community Sustainability Commission, Economic Development Board, and various service organizations.

CO2EMT Reduction Range

- 100% of Objective IC-2.

30) The Bay Area Green Business Program encourages businesses to implement greenhouse gas reduction strategies. To qualify, businesses need to adhere to a specified number of environmental regulations, encouraging businesses to conserve natural resources, reduce pollution, and reduce waste.

◆ **Strategy IC-2.2. Establish a Green Business Committee**



A green business committee would be responsible for promoting sustainable business practices through education and outreach to local businesses. The committee can be formed through a partnership with the Economic Development Board, Benicia Main Street Program, Chamber of Commerce, and the Community Sustainability Commission. In addition to education and outreach, the committee would be responsible for working with City staff and the Bay Area Green Business Program to tailor outreach programs for Benicia’s commercial and Industrial sector.

Implementation Action

- Coordinate with Benicia Main Street and the Chamber of Commerce to establish a green business committee.

CO2EMT Reduction Range

- Not Applicable. This strategy supports to IC-2.1.

Objective IC-3: Encourage the Port of Benicia to Implement Emissions Reduction Measures

CO2EMT estimates not available

PORT OF BENICIA

The Port of Benicia is privately owned by Amports and is one of the industrial park’s largest landowners; their operations are primarily regulated by Federal and State authorities.³¹ The Emissions Inventory includes data for the automobile cargo being unloaded at the Port, but does not include emissions generated from maritime traffic in the Carquinez Straight or for Port operations, such as cleaning each car that is shipped in and out of the Port Facility.

Existing Actions

The Port of Benicia is a member of a regional steering committee that is completing an emissions inventory of all Bay Area ports. Port management is currently investigating the feasibility of electric cars for its fleet uses and upgrades to interior building lights with timing and sensors along with other efficiency improvements.

◆ **Strategy IC-3.1. Complete Emissions Inventory and Port Efficiency Plan**



Encourage the Port of Benicia to develop an emissions inventory specific to its operations. The inventory could include its vehicle fleet, ship traffic, fuel refilling, paint shop, employee travel, and overall energy consumption. This inventory will provide information regarding the Port’s actual contribution of greenhouse gases, and could be used to prepare a Port sustainability plan.

◆ **Strategy IC-3.2. Decrease Transportation Source Emissions**



The Port should consider emission reduction strategies for ships, trains, and semi-trucks operating within the Port, similar to those being required of the municipal fleet. The Port should also encourage ships with which it does business to use higher-grade diesel fuels by offering incentives to those companies.

The Port’s geographic location and proximity to various modes of transportation (truck, rail, etc) makes it a desirable place of entry for imported automobiles, which is the Port’s primary function. Decreasing the number of automobiles processed by semi-truck and increasing the use of freight trains for car shipment would have a large impact on greenhouse gas emissions. An anti-idling policy may reduce tail-pipe emissions during loading and unloading of cargo.

31) The pier and shoreline are public trust lands granted by the state to the City of Benicia to maintain in trust for the public. The lands are leased to Amports for uses consistent with the public trust doctrine.

Objective IC-4: Encourage the Valero Refinery to Continue to Reduce Emissions

CO₂EMT estimates not available

VALERO REFINERY

The Valero Refinery is primarily regulated by State and Federal authorities as a large stationary emitter of greenhouse gases. Emissions produced by Valero are largely a result of refining processes.

Existing Actions

The Valero Improvement Project (VIP) began the permitting approval process in 2002 and construction began in 2009. The VIP includes improving efficiency of several industrial processes that will result in a reduction in specific greenhouse gas emissions. These efficiency improvements will allow Valero to increase refining capacity while achieving a zero net gain in carbon dioxide equivalence (CO₂EMT) emissions. As a condition to the City Use Permit, Valero agreed via the Good Neighbor Steering Committee settlement agreement, to fund \$14,000,000 of water conservation, energy efficiency, and open space conservation projects, among other things. Included in this is \$200,000 per year for three years to fund implementation of the Climate Action Plan.

◆ Strategy IC-4.1. Continue Implementing Capital Improvement Programs



Capital Improvement Programs include regular replacement of inefficient equipment to maintain efficient industrial processes. Improvement programs include increasing Butamer production, recycled water consumption, replacement of floating roofs on storage tanks, and increase use of co-generation. Frequent capital investment programs can ensure that the refinery utilizes the most current equipment and remains economically competitive in future markets.

◆ Strategy IC-4.2. Investigate On-site Energy Production



Generating on-site energy reduces fluctuation in energy cost and increases the efficiency of the power generated because of reduced transmission loss. The refinery should aggressively pursue increased on-site energy production. As future demand and processes change, Valero should consider becoming operationally independent for energy supply. On-site energy production measures include photovoltaic, wind power, and an increased number of co-generation systems, as well as the exploration of fuel cell technologies for energy storage.

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WATER + WASTEWATER

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Water + Wastewater



Nearly a quarter of the City Government’s greenhouse gas emissions result from the electricity required to pump, treat, deliver, collect, and clean water. After wastewater is treated, the leftover ‘sludge’ emits greenhouse gases. The emissions related to water and wastewater can be reduced by: 1) reducing demand, 2) increasing efficiency in water conveyance, and 3) improving treatment plant efficiency.

Adaptation

Climate change may affect both Benicia’s wastewater system and water supply. Sea level rise may impact the City’s wastewater treatment plant, located roughly 30 feet above sea level and adjacent to the Carquinez Strait. The plant relies on gravity during low tide and uses pumps to discharge during high tide. Sea level rise will result in greater reliance on pumping, which will lead to increased emissions, unless modifications are made.

Higher temperatures and changes in the timing and amount of snowmelt from the Sierra Nevada Mountains will also affect Benicia’s water supply by reducing its availability. The City has a detailed Water Shortage Contingency Plan. The plan addresses up to a 50 percent cutback due to catastrophic events. Depending on future water availability and sources, the City may have to adjust plant processes for the quality of the water being treated, which may increase costs and emissions.

Co-Benefits of Water Objectives

- Water independence and security
- Economic benefits from sale of biosolids and/or use as fertilizer on City property
- Operating/utility cost

Objective WW-1: Reduce the Amount of Water Consumed 20% by 2020



DEMAND MANAGEMENT

Water demand management involves measures that promote the efficient use of water, including conservation, volume reduction, and timing of water usage. Reductions in water demand reduce emissions because less energy is used to pump, treat, deliver, and collect water. Under the green building ordinance, new construction will be required to use water conservation fixtures such as waterless urinals, low-flush toilets, and low-flow faucets, helping further reduce future demand. Recommended strategies, which are described in more detail below, include developing alternative water sources for irrigation, and upgrading residential, commercial, and industrial units to become more efficient.

Water and Wastewater Objective Table	Emissions Reduction Type	Emissions Reduction
Objective WW-1: Reduce the Amount of Water Consumed 20% by 2020	City	
Objective WW-2: Reduce the Amount of Emissions Resulting from Pumps and Lift Stations	City	
Objective WW-3: Reduce the Amount of Emissions Resulting from Water and Wastewater Plant Operations 95% by 2020	City	

Existing Actions

The Urban Water Management Plan outlines many of the water reduction programs that the City currently implements. The City has appointed a water conservation coordinator to oversee the implementation and monitoring of water conservation programs. Benicia has a program to assist homeowners with upgrading to more efficient water fixtures such as plumbing retrofits, low-flow showerheads, aerators, and toilet displacement devices. To encourage water conservation, the City meters water usage on a tiered system. Additionally, the City prohibits certain water uses such as the washing off of paved areas with water, and requires controllable leaks to be repaired. The City addresses water use efficiency through education programs in public schools, periodic bill inserts, conservation pamphlets, and irrigation booklets for the public.

The City and the Valero Refinery have conducted a feasibility study for a recycled water project for the refinery. The Water Reuse Project would supply up to 2 million gallons per day of recycled water from the City's wastewater treatment plant for use by the refinery as cooling tower make-up water. However, at the direction of the City Council, this project has been put on hold pending funding in the approximate amount of \$40 million.

In 2004, the City installed smart irrigation controllers, which use weather data to properly adjust watering times, at the Benicia Community Park (BCP) leading to a 21% reduction in the parks water use. In 2008, a similar smart irrigation controller was installed at Joe Henderson. Recently, the Skillman Park has received a similar retrofit making it compatible to the smart irrigation system.

As part of a joint venture with the Solano County Water Agency, the City offers rebates to residences that replace inefficient washing machines and toilets with high efficiency models. Rebates are available of up to \$200 for replacing inefficient washing machines and up to \$125 for replacing inefficient toilets. In 2007, 88 Benicia residents received rebates for replacing washing machines and 6 residents received rebates for replacing inefficient toilets. In 2008, 173 washing machines rebates and 59 high efficiency toilet rebates were issued to Benicia residents.

The City has an existing water audit program for commercial, industrial, and institutional consumers (CII) through its membership with the Solano County Water Agency (SCWA). SCWA pays for a majority of the program and the City pays the remainder. This is a no cost program for CII customers.

In May 2009, the City Council approved funds from the VIP settlement agreement to expand educational water conservation programming offered to grades 3 through 6 to include K-3 graders, which will include puppet shows to engage the students in water wise practices.

In August 2009, the California Building Standards Commission (BSC) lifted California's mandatory permit requirement for household graywater systems. Under the new regulations, residents can install small (under 250 gallons per day) washing machine and single-fixture systems without obtaining a building/construction permit by meeting a list of 12 conditions set by BSC. Residential systems with a capacity over 250 gallons per day (gpd) and indoor systems still require a permit. However, local jurisdictions may choose to expand this exemption to include all small systems, large-scale systems (over 250 gpd), and indoor systems. For indoor systems, local jurisdictions have the ability to establish treatment standards. In all cases, the permit exemption is limited to residential applications.

◆ Strategy WW-I.1. Cash for Grass Rebate Program



Cash for Grass Rebate Programs help property owners convert water-thirsty grass to a water efficient landscape. The City would offer property owners a dollar amount per square foot of grass removed and replaced with water efficient landscaping. Other communities have offered a square footage rebate of \$0.50 - \$1.50. Every square foot of grass replaced with water-smart trees, shrubs and flowers can save an average of 30 gallons of water per year.³²

Implementation Actions

- Develop program guidelines, funding mechanism and outreach materials;
- Launch program.

CO₂EMT Reduction Range

- Unknown reductions.

³² City of Roseville. (2009) Cash for Grass program. http://www.roseville.ca.us/eu/water_utility/water_conservation/for_home/cash_for_grass/default.asp

◆ Strategy WW-1.2. Permitting for Graywater Reuse Systems



Establish appropriate graywater system permitting exemptions for residential applications pursuant to regulations set by the California Building Standards Commission (see *Existing Actions*).

Implementation Actions

- Determine appropriate permit process (or lack thereof) for residential graywater systems;
- Determine what, if any, treatment standards should be allowed for indoor graywater reuse;
- Establish an outreach program to educate residents on graywater permitting standards.

CO2EMT Reduction Range

- Unknown reductions.

What is Graywater?

Graywater is untreated household wastewater from washing machines, bathroom sinks, showers and bathtubs. Graywater systems retain water on-site for irrigation purposes, thereby reducing water demand.

◆ Strategy WW-1.3. Implement Residential Rainwater Collection



Create a policy to support permitting and regulation of residential rainwater systems. Develop a program to distribute rainwater barrels to homeowners to capture water runoff from homes.

Implementation Actions

- Adopt a policy and permit process to regulate residential graywater and rainwater catchment systems;
- Develop rainwater barrel distribution program; identify funding source and secure funding; implement program.

CO2EMT Reduction Range

- 1%-2% of Objective WW-1.

◆ Strategy WW-1.4. Require Commercial Rainwater Collection



Create a policy that requires collection, storage, and use of rainwater from commercial roof surfaces for on-site landscape irrigation uses and establish a financial incentive program to assist property owners. Concurrently, distribute information regarding rainwater collection systems to commercial property owners and assist them in securing financial support for implementation.

Implementation Actions

- Develop an education and outreach program for commercial property owners, brokers, etc;
- Adopt a policy to require collection and reuse of rainwater at industrial and commercial properties;
- Establish a financial assistance program using VIP Settlement funds.

CO2EMT Reduction Range

- Unknown reductions.

◆ Strategy WW-1.5. Incentives for Residential Plumbing Fixture Upgrades



Plumbing retrofits, low-flow showerheads, aerators, and toilet displacement fixtures are responsible for significant water savings. The City should increase the funding and scope associated with existing incentive programs to increase water efficiency and conservation.

Implementation Action

- Establish a financial incentive program using VIP Settlement funds.

CO2EMT Reduction Range

- Unknown reductions.

◆ **Strategy WW-1.6. Incentivize water conservation**



The existing tiered billing structure could be modified to include more significant incentives for water conservation; however, this must be approached extremely carefully to account for the financial realities of water conveyance. Incentives could include tiered rebates and/or a restructuring of the existing billing structure.

Implementation Actions

- Conduct fiscal analysis to determine feasibility of implementing recommended incentive(s);
- Determine appropriate incentive(s) for water conservation;
- Implement incentive program;
- Notify customers through existing billing statements of new incentive program.

CO2EMT Reduction Range

- 98%-100% of of Objective WW-1.

◆ **Strategy WW-1.7. Develop a Businesses Outreach Program**



Create a businesses outreach program on water conservation to provide reduction strategies to businesses within the Community. This program is defined in more detail in the Industrial and Commercial section.

Implementation Action

- Develop business outreach program.

CO2EMT Reduction Range

- Unknown reductions.

Objective WW-2: Reduce the Amount of Emissions Resulting from Pumps and Lift Stations



CONVEYANCE

Increased efficiency of water and effluent conveyance reduces the energy used at pump stations and associated greenhouse gas emissions.

Existing Actions

The City has planned for a number of water and wastewater infrastructure upgrades in the next five years, including improvements to water lift stations, digester cleaning, pump station improvement, and water line upgrades. In addition, the City has a service line replacement program for deteriorating pipes. Replacing aged pipes saves water, which decreases the energy used for pumps, resulting in greenhouse gas reductions.

◆ **Strategy WW-2.1. Incentives for Residential Lateral Upgrades**



Create an incentive program funded by the VIP Settlement funds to repair laterals on private property. During winter months, rainwater seeps into the sewer system primarily through leaks in residential laterals. This unnecessarily increases demand on the wastewater treatment plant.

Implementation Action

- Establish a financial incentive program through the VIP Settlement Agreement funds for residents to repair laterals on private property.

CO2EMT Reduction Range

- 100% of Objective WW-2.

Objective WW-3: Reduce the Amount of Emissions Resulting from Water and Wastewater Plant Operations 95% by 2020



TREATMENT

Upgrades to the water and wastewater plant operations will improve energy efficiency, thus reducing greenhouse gas emissions. Emissions related to the wastewater treatment plant include the energy for operations and emissions associated with the production of sludge.

Existing Actions

The City is continually improving operational and system efficiencies for its water and wastewater plants. The wastewater treatment plant has achieved significant efficiency through equipment upgrades, use of gravity flow for discharge rather than pumping at low tide, and pumping at non-peak hours when possible. The wastewater treatment plant switched to a cogeneration system that powers boilers with off-gassed methane. The plant reduces greenhouse gases by capturing and using methane produced by bio-solids.

In 2008, the City and the Valero Refinery drafted a preliminary design and environmental documentation for a water recycling project. The water reuse project would supply up to 2 million gallons per day of recycled water from the City's wastewater treatment plant for use by the refinery as a coolant. However, such a project is not financially feasible at this time.

In 2008, the City commissioned a feasibility study for renewable energy production at select water and wastewater facilities.

◆ Strategy WW-3.1. Install Renewable Energy Systems



The City conducted a feasibility study for wind and solar electrical production at the water and wastewater treatment plants, as well as at pump station locations (see Energy Production section). All of these stations are dependent on electrically driven motors that consume large amounts of electrical energy. Providing alternative power, such as solar or wind, will result in reduced emissions.

Implementation Actions

- Secure funding via enterprise funds, or a Power Purchase Agreement model, to provide capital for wind and solar production;
- Assess renewable energy options/technologies for water and wastewater facilities.

CO₂EMT Reduction Range

- 100% of Objective WW-3.

◆ Strategy WW-3.2. Class A Biosolids Process

Assess the feasibility of developing a program to produce class 'A' biological solids at the wastewater treatment plant. Biosolids can be used as fertilizer or in a cogeneration system. Class 'A' biological solids are nearly pathogen-free prior to land application, and are therefore safe for human contact. Producing class 'A' biosolids would divert 2,079 tons of biosolids annually from the landfill. The City's wastewater treatment plant does not currently have the ability to produce class "A" biological solids. Facilitates for incineration would have to be added at the plant or the biosolids would have to be taken to a facility for processing, which would require transportation.

Implementation Actions

- Conduct feasibility study;
- Implement project, if deemed feasible.

CO₂EMT Reduction Range

- Unknown reductions.

◆ **Strategy WW-3.3. Water Reuse Project**



Develop a recycled water system, beginning with Valero to decrease the demand on water supply, treatment and conveyance, thereby reducing greenhouse gas emissions.

Implementation Actions

- Identify potential public and private partnership opportunities;
- Secure funding for project development, estimated at approximately \$40 million;
- Begin project development, including necessary environmental review and engineering design.

CO₂EMT Reduction Range

- Unknown reductions.



SOLID WASTE

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Solid Waste



In 2000, the City of Benicia and the community generated approximately 60,000 tons of solid waste. Sixty percent of the solid waste was diverted from the local landfill through recycling and composting programs. The remaining solid waste was transported to a landfill resulting in 23,650 tones of carbon dioxide equivalent (CO₂EQT).

As solid waste decomposes in landfills, methane is released into the atmosphere. Methane has a global warming potential 21 times that of carbon dioxide.³³ At Keller Canyon landfill, the primary facility used to process and store Benicia’s solid waste, the methane released from decomposing waste is captured and used to produce energy. The energy is then sold to energy providers.

Two primary ways to reduce emissions associated with solid waste are reducing the amount of waste transported to the landfill and improving the efficiency of transporting the waste. Public education programs and enforcement measures can help achieve waste reduction and diversion goals.

Adaptation

Rising temperatures resulting from climate change may affect solid waste emissions through an increased generation rate of methane in landfills. For Benicia, this effect should be minimized by Keller Canyon’s methane capturing system. The projected scarcity of crude oil has the potential to influence the costs and emissions associated with the transport of waste materials (See Transportation and Land Use).

WASTE REDUCTION AND DIVERSION

Strategies to decrease waste production and increase waste diversion include regulating waste production, providing composting and recycling programs, and creating education and outreach campaigns.

Allied Waste Services currently implements a tiered pricing system that adjusts the cost of trash cans based on size. As an incentive, recycling is provided at minimal cost to residents.

Co-Benefits of Solid Waste Objectives

- Reduced City spending
- Improved air quality
- Increased social networking within the community

Solid Waste Objective Table	Emissions Reduction Type	Emissions Reduction
Objective SW-1: Commit to a Waste Diversion Goal of 90% for City Government Operations	City	
Objective SW-2: Commit to a Waste Diversion Goal of 75% for the Community	Community	

³³) US EPA, Estimating National Landfill Methane Emissions, (2006). (<http://www.epa.gov/ttn/chief/conference/ei16/session3/weitz.pdf>)

Objective SW-1: Commit to a Waste Diversion Goal of 90% for City Government Operations



Existing Actions

The City of Benicia encourages community members to reduce solid waste by promoting composting, recycling and reuse programs. The Parks and Community Services Department has implemented a ‘Waste in Place’ program that distributes grass clippings from the maintenance of parks as fertilizer.

The City’s waste service provider, Allied Waste Services, provides free cardboard recycling at the City’s corporation yard. The City has also partnered with various businesses to provide e-waste drop-off locations.

◆ Strategy SW-1.1. Limit City Spending on Bottled Water

Limiting City spending on bottled water to necessary fire safety operations will reduce the City’s solid waste consumption and will demonstrate community-wide leadership, while, reducing overhead.

Implementation Action

- Adopt a policy to limit City Government spending on bottled water to necessary safety operations.

CO2EMT Reduction Range

- Unknown reductions.

Did you know?	
	Eight out of ten water bottles in the United States end up in a landfill.
	Bottled water can cost anywhere from 25 cents to two dollars while water from the tap costs around one cent for 16 oz.

◆ Strategy SW-1.2. Establish Education Program for City Staff

Reducing waste generation requires that City staff dispose of all recyclable materials appropriately and make purchasing choices based on the degree to which materials are recyclable and/or reusable.

Implementation Action

- Hold internal workshops and outreach efforts to provide guidance to City departments through the City Green Team.

CO2EMT Reduction Range

- 100% of Objective SW-1.

Objective SW-2: Commit to a Waste Diversion Goal of 75% for the Community



◆ Strategy SW-2.1. Community-Wide Composting Program



Option 1 - Provide do-it-yourself composting bins and training workshops to residents and business owners. Composting can be effectively used at homes and businesses to decrease the amount of biomass sent to landfills.

Option 2 - Curbside Composting Pilot Project – Work with a solid waste collection service provider to establish a curbside composting service as a pilot project.

Implementation Actions

- Educate the community about the benefits associated with composting through brochures and handouts;
- Incorporate composting as a primary element in “waste week.” Establish a do-it-yourself composting bin program with free bins and workshops;
- Contract with solid waste collection service provider to provide curbside composting as a pilot project.

CO2EMT Reduction Range

- Unknown reductions.

◆ Strategy SW-2.2 – Curbside Recycling for Industrial and Commercial Businesses

A standardized curbside recycling program for Benicia businesses would result in a decreased amount of solid waste going to the landfill.

Implementation Actions

- Survey Benicia businesses to determine appropriate level of service;
- Engage solid waste provider(s) to determine most economical solutions;
- Implement curbside recycling program for Benicia businesses.

CO2EMT Reduction Range

- Unknown reductions.

◆ Strategy SW-2.3. Construction and Demolition Recycling Programs



As part of the 2010 California Green Building Standards Code, construction projects will be required to divert 50 percent of construction waste prior to the issuance of a building/demolition permit. Construction generates a large amount of waste that can be sorted, recycled, and diverted from landfills. An online exchange can be established for reusable building materials. Upon completion of a project, contractors can post a list of leftover materials on the website. These materials can be made available to the public.

Implementation Actions

- Require all new construction projects to be accompanied by a recycling plan for the project;
- Design website and outreach materials to distribute information on the program to local contractors.

CO2EMT Reduction Range

- 6%-10% of Objective SW-2.



Construction offers an opportunity to reduce, reuse, and recycle construction materials (2008).

◆ Strategy SW2.4. Waste Audit Program



Create a waste audit program to help enforce and encourage residential and commercial recycling. Audit programs keep the community accountable for their disposal habits by screening dumpsters and trash cans throughout Benicia, issuing written guidance to residents or businesses that incorrectly dispose of recyclables.

Implementation Actions

- Develop and adopt a Waste Audit Program;
- Expand community outreach and education programs relating to the City's recycling program.

CO2EMT Reduction Range

- 57%-60% of Objective SW-2.

◆ Strategy SW-2.5. Feasibility Study for a Waste Reduction Ordinance

Waste reduction ordinances are effective ways for cities to regulate selected waste sources. The proposed ordinance would limit or ban specified prepared food containers, such as styrofoam. Plastic bags have also become a growing concern and could be addressed by such ordinance. The regulation of bags may apply to stores over a specified square footage, ensuring that small businesses would not be unnecessarily burdened.

Implementation Action

- Develop and adopt a Waste Reduction Ordinance.

CO2EMT Reduction Range

- Unknown reductions.

◆ **Strategy SW-2.6 Universal Colors and Labeling for all Trash Receptacles**



Adopt a citywide color code and labeling system for trash receptacles to maintain regional consistency and reduce customer confusion. Common colors used are blue or grey for recyclables; black for trash; and, green for compostables, including yard waste.

Implementation Action

- Adopt and implement a new standardized color scheme for waste receptacles by incorporating such measures into future solid waste collection contracts.

CO₂EMT Reduction Range

- 36%-40% of Objective SW-2.



PARKS + OPEN SPACE

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Parks + Open Space



Parks and open space provide Benicia residents with recreational opportunities and scenic beauty. Emissions associated with parks and open space result from the regular maintenance and irrigation of parks, open space and streetscapes. This includes Parks and Community Services department vehicles, fossil fuel powered maintenance equipment, and treated irrigation water.

Emissions can be reduced by converting maintenance equipment from standard gas and diesel-powered engines to electric alternatives; decreasing the amount of water used for irrigation; and by using reclaimed rather than potable water. Increasing the amount of foliage, such as trees, reduces emissions through carbon sequestration. Trees also provide shade, wind breaks, and reduce the heat island effect. The establishment of community gardens can enhance the local food supply, reduce dependence on distant food producers, and foster community interaction and education.

Adaptation

Climate change may affect park maintenance and irrigation through sea level rise; altered annual precipitation patterns; warmer summers; and an increase in the length, number, and intensity of heat waves. Adapting to changing temperature and precipitation patterns may require adjustments in maintenance, watering schedules, and preferred plant lists. Periodic evaluation of local conditions should be conducted to assure that resources are being effectively used and managed. Benicia's proximity to the ocean reduces the likelihood that native species will suffer dramatic habitat alterations.³⁴ Sea level rise has the potential to affect existing parks adjacent to the Carquinez Strait including Matthew Turner Park, 9th Street Park, Turnbull Park, and the Benicia State Recreation Area.

Did you know?



A large front yard tree can clean 330 lbs. of CO₂ from the atmosphere through direct sequestration in the tree's wood.³⁵

Parks + Open Space Objective Table	Emissions Reduction Type	Emissions Reduction
Objective P-1: Reduce the Water Consumed for the Irrigation of Park Space by 40% by 2020	City	
Objective P-2: Reduce Emissions from Maintenance Equipment 50% by 2020	City	
Objective P-3: Reduce Emissions from Maintenance Vehicles 50% by 2020	City	
Objective P-4: Increase the Number of City Maintained Park and Street Trees	City	
Objective P-5: Increase Number of Trees in the Community	Community	
Objective P-6: Increase Use of Drought Tolerant Landscaping	City	
Objective P-7: Establish Community Gardens	City	

34) Ackerly, D.; Hayoe, K. (2008). Climate change could severely impact California's unique native plants. Retrieved January 29, 2009 from <http://escien-cenews.com/articles/2008/06/24/climate.change.could.severely.impact.californias.unique.native.plants>

35) Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California

Objective P-1: Reduce the Water Consumed for the Irrigation of Park Space by 40% by 2020



IRRIGATION

Irrigation in Benicia includes the watering of community park space, streetscapes, and landscaping. Sustainable irrigation practices can decrease the amount of water pumped to individual sites. Reducing the amount of water used to irrigate and maintain landscaped areas will help the City reduce its greenhouse gas emissions resulting from water pumps and treatment facilities while simultaneously reducing operational costs.

Existing Actions

The General Plan indicates that the City will implement water reduction measures and continue to implement water conservation best management practices.

The City utilizes drip irrigation systems in front of City Hall, the Police Station, and East 6th Street Park during evening hours to reduce the amount of water lost to evaporation and wind. Street landscapes are watered by hand on an “as needed” basis; the volume and frequency of watering is adjusted with the changing seasons.

◆ Strategy P-1.1. Install Drip Irrigation Systems in all City-Maintained Landscapes



Drip irrigation systems reduce water consumption by decreasing runoff and evaporation. Drip irrigation systems should be installed in all flowerbeds, medians, and streetscapes.

Implementation Action

- Begin installation of drip irrigation systems citywide.

CO2EMT Reduction Range

- 38%-40% of Objective P-1.

◆ Strategy P-1.2. Install Irrigation Control Systems



“Smart” irrigation control systems (ICS) monitor water use, measures soil moisture, identifies plumbing leaks, and prevents excessive water loss. These systems decrease water consumption by approximately 25 percent by allowing irrigation adjustments to be made remotely, reducing vehicle miles traveled to individual parks and streetscapes.

Implementation Actions

- Install ICS in the largest City-owned parks and landscaped areas;
- Install ICS in all City-maintained parks, fields, landscaped areas and streetscapes.

CO2EMT Reduction Range

- 62%-70% of Objective P-1.

◆ Strategy P-1.3. Utilize Low-Maintenance, Drought Tolerant Landscaping



Drought tolerant landscapes reduce the amount of water and energy required for irrigation. All landscaping projects should utilize low maintenance, drought tolerant plants.

Implementation Action

- Utilize drought tolerant plants in new landscapes and as replacement plants for existing landscapes.

CO2EMT Reduction Range

- Unknown Reductions.



Jack London Park (2008).

Objective P-2: Reduce Emissions from Maintenance Equipment 50% by 2020



MAINTENANCE EQUIPMENT AND VEHICLE FLEET

The Benicia Parks and Community Services Department primarily utilizes gasoline-powered maintenance equipment, such as lawnmowers, hedge trimmers, and weed whackers, which contribute to the City Government's emissions. The Department's fleet of maintenance trucks is also primarily gasoline or diesel-powered.

Parks are regularly mowed by gasoline-powered mowers twice per week. The trees in the parks typically require minimum maintenance unless they are interfering with private property or pose a hazard to adjacent structures.

Emissions can be reduced by increasing vehicle and equipment efficiency, decreasing VMT and overall equipment usage, and converting trucks and equipment to alternative fuel sources.

Existing Actions

The Parks and Community Services Department of Benicia currently has one hybrid sports utility vehicle in its maintenance fleet.

◆ Strategy P-2.1. Replace Fossil Fuel-Powered Maintenance Tools with Electric Equipment

Replace existing fossil fuel powered maintenance equipment, including existing riding mowers, with electric-powered equipment.³⁶

Implementation Actions

- Establish a phased equipment replacement program for all equipment;
- Fully execute equipment replacement program.

CO₂EMT Reduction Range

- 94%-100% of Objective P-2.

36) Conversion to electric maintenance equipment includes utilizing electric push and riding mowers. There are a variety of mower options and models available.

◆ Strategy P-2.2. Develop a Biodiesel Conversion Program for Diesel powered vehicles

Develop a biodiesel conversion program to convert existing diesel engines to utilize biodiesel fuels.

Implementation Actions

- Assess the feasibility of creating a biodiesel program and purchasing a biodiesel conversion system;
- Develop a biodiesel program with the purchase of a biodiesel conversion system.

CO₂EMT Reduction Range

- Unknown Reductions.

Did you know?



Biodiesel produced from waste oil is far superior to biodiesel created from crop waste; biodiesel produced from crop waste may actually increase greenhouse gas emissions on a global scale due to displacement of food crops and deforestation.

◆ Strategy P-2.3. Utilize Biodiesel Fuel in Maintenance Equipment

Retrofit diesel-powered equipment to operate on B20 biodiesel.

Implementation Actions

- Establish a phased equipment retrofit program for all diesel-powered equipment;
- Fully execute replacement program;
- Convert 50 percent of diesel-powered maintenance equipment to B20 biodiesel.

CO₂EMT Reduction Range

- Unknown Reductions.

◆ Strategy P-2.4. Reduce Mowing Frequency at Parks facilities

Develop a modified lawn mowing schedule that reduces the frequency of mowing of park facility lawns to one time per week.

Implementation Action

- Develop and implement a modified mowing schedule.

CO₂EMT Reduction Range

- 6%-10% of Objective P-2.

Objective P-3: Reduce Emissions from Maintenance Vehicles 50% by 2020



◆ Strategy P-3.1. Replace Unnecessary City Trucks with Alternative-Fuel Vehicles

Replace existing vehicles with high-efficiency compressed natural gas (CNG), electric, or hybrid cars.

Implementation Action

- Conduct a fleet audit to determine which vehicles are necessary. Replace gasoline-powered trucks with alternative fuel compact automobiles.

CO2EMT Reduction Range

- Unknown Reductions.

◆ Strategy P-3.2. Replace Half-Ton Trucks with E85 Ethanol or Compressed Natural Gas (CNG) Trucks

Replace half-ton, gasoline-powered trucks at the end of their lifecycle with ethanol or compressed natural gas (CNG) trucks; such a measure will improve vehicle efficiency and reduce greenhouse gas emissions.

Implementation Actions

- Establish a half-ton truck replacement strategy;
- Begin replacement.

CO2EMT Reduction Range

- 68% to 70% of Objective B-3.

◆ Strategy P-3.3. Biodiesel in Heavy-Duty Trucks

Replace heavy-duty, three-quarter and one-ton and heavy-duty diesel trucks with trucks able to utilize B20 biodiesel at the end of the vehicle's specified lifecycle. Retrofit heavy-duty diesel trucks with B21 biodiesel capability.

Implementation Action

- Establish a biodiesel replacement and retrofit program for heavy-duty trucks.

CO2EMT Reduction Range

- 21% to 25% of Objective B-3.

Objective P-4: Increase the Number of City Maintained Park and Street Trees



TREE PLANTING AND CARBON SEQUESTRATION

Trees provide a number of benefits to the community. Increasing the number of trees in Benicia will increase the amount of carbon dioxide absorbed from the atmosphere. They provide shade to naturally cool buildings, create wind barriers to surrounding areas, and enhance streetscapes to encourage alternative modes of transportation. Benicia currently lacks a formalized approach for increasing the amount of trees within the community, as well as criteria for selecting trees based on drought tolerance and carbon sequestration characteristics.

Existing Actions

The Benicia General Plan recognizes the significance of trees and plants to absorb carbon dioxide, release oxygen, and store carbon. The Tree Committee establishes policy, programs and practices related to tree removal, alterations, and plantings. The Benicia General Plan states the City's intent to preserve significant areas of vegetation, watershed, and open space.

In 2004 the Parks, Recreation and Cemetery Commission formed an ad hoc Tree Committee to review and update Benicia's tree policies. The first task assigned to the committee was to revise Benicia's tree ordinance. In 2008, Benicia adopted a new Tree Ordinance and formally established a Tree Committee. The Tree Committee is charged with the implementation of the Tree Program including advancing arboriculture education and events, as well as review of the Tree Fund.

On March 14, 2009 Benicia was officially designated a Tree City USA community. Tree City USA is a tree planting and tree care program sponsored by the Arbor Day Foundation and the USDA Forest Service Urban and Community Forestry Program. The effort to become a Tree City USA was a joint venture between the City of Benicia and The Rotary Club of Benicia.

◆ Strategy P-4.1. Tree Maintenance Program



Establish a maintenance program through the existing Tree Ordinance “Tree Fund” to ensure the health and safety of trees while replacing dead or dying trees. Pruning should be done at appropriate intervals for the tree species to promote the health and longevity of trees.

Implementation Action

- Establish and implement a tree maintenance program.

CO2EMT Reduction Range

- Unknown Reductions.

◆ Strategy P-4.2. Increase the Number of City Trees



Establish a tree planting program to increase the number of City owned trees in parks and streetscapes, including areas such as the Fleetside and Goodyear sections of the industrial zones and Landscape and Lighting Districts.

Implementation Action

- Establish and implement a tree planting program with a goal of 300 additional trees, with priority given to street trees.

CO2EMT Reduction Range

- 100% of Objective B-4.

Objective P-5: Increase Number of Trees in the Community



◆ Strategy P-5.1. Residential Tree Fund



Create a residential tree fund to provide residents with financial incentives for planting approved street trees and provide City assistance with tree maintenance. Such a strategy will encourage residents to plant drought tolerant, native trees, thus increasing the removal of carbon dioxide from the atmosphere.

Implementation Actions

- Identify funding source;
- Establish tree fund.

CO2EMT Reduction Range

- Unknown Reductions.

◆ Strategy P-5.2. Adopt-A-Tree Program



Create an Adopt-A-Tree Program. The program would allow community members to sponsor City tree planting by offsetting up front costs. Trees would be located on City land and maintained by City staff.

Implementation Action

- Develop an adopt-a-tree program.

CO2EMT Reduction Range

- Unknown Reductions.

Objective P-6: Increase Use of Drought Tolerant Landscaping



◆ Strategy P-6.1. Develop a City-Approved Tree and Plant List



Coordinate with the Tree Committee to adopt an approved tree and plant list. This list should include plants and trees that are drought-tolerant and have excellent carbon sequestration characteristics. The list would be used for municipal landscaping, street tree specifications and the Cash for Grass Program (Strategy WW-1.1)

Implementation Action

- Develop and adopt a drought tolerant tree and plant list.

CO2EMT Reduction Range

- Unknown Reductions.



Tree in the Benicia Capitol State Historic Park (2009).

Objective P-7: Establish Community Gardens



COMMUNITY GARDENS

A community garden is a piece of land that is collectively gardened by an organized group of people. There are several important benefits associated with community gardens, including access to fresh, local produce and emission reductions associated with food distribution. In addition, they can reduce food costs, conserve natural resources and reduce the heat-island effect caused by other land uses such as parking lots.

Existing Actions

The City has initiated preliminary discussions regarding community gardens, potential locations in underutilized portions of existing parks; and, the logistics of growing edible plants on City owned property.

◆ Strategy P-7.1. Community Gardens in City Parks and Underutilized Sites



Develop themed community gardens in to-be-determined locations citywide. The themes may include butterfly gardens, native plant gardens, waterless gardens, edible plant gardens (berries, vegetables, etc), with informational plaques that direct residents to a website where they can learn more about developing their own similar garden.

Implementation Actions

- Engage the community to determine suitable sites, guidelines, and community service group/non-profit partners;
- Determine funding source(s) and secure funding;
- Develop outreach program to promote community engagement;
- Plant community gardens.

CO2EMT Reduction Range

- Unknown Reductions.

Conclusion

EMISSION REDUCTION MEASURES CONCLUSION

Aggressive and timely implementation of the measures detailed in the Climate Action Plan will result in Benicia reaching its emissions reduction targets. Benicia's community emissions profile is unique due to the disproportionately large industrial sector. As a result, reduction measures common to many climate plans, such as alternative transportation and household energy efficiency, comprise a smaller role of in overall Community emissions reductions. Energy Production is a sector area that spans both Community and Government operations. The focus on low emission, renewable energy production allows for reductions to be achieved in the private sector.

City Government Emissions

While the 33 percent emissions reduction target may appear aggressive, it is a realistic and achievable goal due to the actions already being implemented as part of City operations. Implementing all measures detailed in this Plan will allow the City to not only meet, but easily surpass the 2020 target.

Community Emissions

The 2020 emissions reduction target for the community recognizes that the City of Benicia has limited authority over the operations of the largest emitters. The target of 10 percent below 2000 was set assuming that Valero would achieve the reductions mandated by AB 32, a law specifically targeting large stationary emitters. Measures identified in this plan share the assumption that Valero will be required to reduce emissions 10 percent below 2000 levels. However, this assumption may not be met. AB 32 sets emission reduction targets on a State level; therefore, the requirements of individual stationary emitters will vary depending on their existing emission outputs. Regardless, a 10 percent emission reduction for Valero is necessary for the City to reach its emission targets.

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Glossary

A

Adaptation: Adjustment in natural or human systems to a new or changing environment. Adaptation refers to adjustments in natural or human systems, intended to reduce vulnerability to actual or anticipated climate change and variability or exploit beneficial opportunities.

Acre: A unit of land equal to 43,560 square feet.

Alternative Energy: Energy derived from nontraditional sources (e.g., compressed natural gas, solar, hydroelectric, wind)

Atmosphere: The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium and radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains the greenhouse gas water vapor, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.

B

Baseline: A projected level of future emissions against which reductions by project activities might be determined, or the emissions that would occur without policy intervention.

Best Available Control Measure (BACM): A term used to describe the “best” measures (according to U.S. EPA guidance) for controlling small or dispersed sources of particulate matter and other emissions from sources such as roadway dust, woodstoves, and open burning.

Best Available Control Technology (BACT): Under the South Coast Air Quality Management District (SCAQMD) rules, for example, BACT is defined as the most stringent emissions control which for a given air emission source has been 1) achieved in practice; 2) is identified in a State Implementation Plan; or 3) has been found by the SCAQMD to be technologically achievable and cost-effective.

Biofuel: A fuel produced from organic matter or combustible oils produced by plants. Examples of biofuel include alcohol, black liquor from the paper-manufacturing process, wood, and soybean oil.

Biomass: Total dry weight of all living organisms that can be supported at each trophic level in a food chain. Also, materials that are biological in origin, including organic material (both living and dead) from above and below ground, for example, trees, crops, grasses, tree litter, roots, and animals and animal waste.

C

Carbon Dioxide (CO₂): A naturally occurring gas, also a by-product of burning fossil fuels from fossil carbon deposits, such as oil, gas and coal, of burning biomass and of land use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth’s radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.

Carbon Dioxide Equivalent (CO₂EMT): A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP.

Carbon Monoxide (CO): A colorless, odorless, toxic gas produced by incomplete combustion of carbon in fossil fuels.

Carbon Sequestration: The capture and permanent storage of carbon dioxide.

Carbon Sinks: Natural or man-made systems that absorb carbon dioxide from the atmosphere and store them. Trees, plants and the oceans all absorb CO₂ and, therefore, are carbon sinks.

Climate: Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from

months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Climate Change: Any long-term significant change in the weather patterns of an area, which can occur naturally or by changes people have made to the land or atmosphere.

Composting: The process by which discarded organic materials -- including (for example) tree trimmings, grass clippings, yard waste, agricultural wastes, leaf debris and sewage sludge – are converted to usable products through controlled biological decomposition.

D

Density: The average number of people, families, or housing units on one unit of land. Density is also expressed as dwelling units per acre.

District Improvement Financing: Economic tool that promotes redevelopment by channeling dollars into targeted redevelopment districts.

Distributed Generation : Any small scale electric generation that is located at or near the point of end use.

E

Ecological Footprint: The impact of humans on ecosystems created by their use of land, water, and other natural resources. Ecological footprint used as a complex sustainability indicator that answers the question: How much of the Earth's resources does your lifestyle require?

Ecosystem: The species and natural communities of a specific location interacting with one another and with the physical environment.

Emissions: Unwanted substances released by human activity into air or water.

Energy Efficiency: Using less energy to achieve the same outcome. For example, better insulation would enable a home to stay warm utilizing less energy.

Environmental Protection Agency (EPA): The federal body charged with responsibility for natural resource protection and oversight of the release of toxins and other threats to the environment.

F

Fossil Fuels: Carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil, and natural gas.

Fuel Cells: Electro-chemical devices (similar to batteries) that use a continuous supply of hydrogen to produce electricity.

G

Global Warming: Global warming refers to the gradual increase, observed or projected, in global average surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.

Global Warming Potential (GWP): The cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. Inventory are presented in terms of equivalent emissions of carbon dioxide (CO₂), using units of teragrams of carbon dioxide equivalents (Tg CO₂E_{MT}).

Conversion: Tg = 109 kg = 106 metric tons = 1 million metric tons

The molecular weight of carbon is 12, and the molecular weight of oxygen is 16; therefore, the molecular weight of CO₂ is 44 (i.e., 12+[16 x 2]), as compared to 12 for carbon alone. Thus, carbon comprises 12/44ths of carbon dioxide by weight.

Gray Water: Non-industrial wastewater generated from domestic processes such as washing dishes and laundry.

Green Building or Green Design: Building design that yields environmental benefits, such as savings in energy, building materials, and water consumption, or reduced waste generation.

Greenfield: Previously undeveloped land.

Greenhouse Gas: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone (O₃), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).

Groundwater: Water below the land surface.

H

Hydrocarbons: Substances containing only hydrogen and carbon. Fossil fuels are made up of hydrocarbons.

Hydropower: The force of flowing water moving downstream creates energy that can be harnessed and turned into electricity. This is called hydroelectric power or hydropower. Hydropower is produced for mechanical power or electricity generation. Often stored and controlled by dams, hydropower is created when the kinetic energy of moving water (rivers, waterfalls) is converted by turbines and generators into electricity, which is then fed into the electrical grid to be accessed by homes, businesses, and industry.

I

Impact Fees: Costs imposed on new development to fund public facility improvements required by new development and ease fiscal burdens on localities.

Impervious Surface: Ground surface that cannot be penetrated by water. Includes paved and compacted surfaces, as well as those covered by buildings.

Infill Development: Development projects that use vacant or underutilized land in previously developed areas for buildings, parking, and other uses.

Infrastructure: Water and sewer lines, roads, urban transit lines, schools and other public facilities needed to support developed areas.

Intermodal: Those issues or activities which involve or affect more than one mode of transportation, including transportation connections, choices, cooperation and coordination of various modes. Also known as “multimodal.”

L

Landfill Gas: Methane gas that forms in landfills from the decay of organic materials. The gas can be collected and used for power generation.

Land Use: The manner in which a parcel of land is used or occupied.

LEED: Leadership in Energy and Environmental Design Green Building Rating System is a nationally accepted benchmark for the design, construction, and operation of high performance green buildings. Administered by the U.S. Green Building Council LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water

savings, energy efficiency, materials selection, and indoor environmental quality.

Light-emitting Diode (LED): This very energy efficient lighting technology uses 80 to 90% less energy than conventional lights.

Live-Work Unit: An integrated housing unit and working space, occupied and utilized by a single household in a structure that has been designed or structurally modified to accommodate joint residential occupancy and work activity, and which includes:

1. Complete kitchen space and sanitary facilities in compliance with the Building Code; and
2. Working space reserved for and regularly used by one or more occupants of the unit.

In a live-work unit, the “work” component is secondary to its residential use, and may include only commercial activities and pursuits that are compatible with the character of a quiet residential environment.

Low Impact Development (LID): An approach to environmentally friendly land use planning. It includes a suite of landscaping and design techniques that attempt to maintain the natural, pre-developed ability of a site to manage rainfall. LID techniques capture water on site, filter it through vegetation, and let it soak into the ground where it can recharge the local water table rather than being lost as surface runoff. An important LID principle includes the idea that stormwater is not merely a waste product to be disposed of, but rather that rainwater is a resource.

M

Methane (CH₄): A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 23 times that of carbon dioxide (CO₂). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

Metric Tonne: Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs or 1.1 short tons.

Mixed Use Development: Development that is created in response to patterns of separate uses that are typical in suburban areas necessitating reliance on cars. Mixed use developments include residential, commercial, and business accommodations in one area.

N

Nitrogen oxides (NO_x): Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are produced in the emissions of vehicle exhausts and from power stations. In the atmosphere, nitrogen oxides can contribute to formation of photochemical ozone (smog), can impair visibility, and have health consequences; they are thus considered pollutants.

Nitrous Oxide (N₂O): A powerful greenhouse gas with a global warming potential of 296 times that of carbon dioxide (CO₂). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

O

Open Space: Used to describe undeveloped land or land that is used for recreation. Farmland as well as all natural habitats (forests, fields, wetlands etc.) is lumped in this category.

Ozone (O₃): A molecule of three oxygen atoms. A colorless gas formed by a complex series of chemical and photochemical reaction of reactive organic gases, principally hydrocarbons, with the oxides of nitrogen, which is harmful to the public health, the biota, and some materials.

P

Particulate matter (PM): Very small pieces of solid or liquid matter such as particles of soot, dust, fumes, mists or aerosols. The physical characteristics of particles, and how they combine with other particles, are part of the feedback mechanisms of the atmosphere.

Parts per Million (ppm): Number of parts of a chemical found in one billion parts of a particular gas, liquid, or solid mixture.

Parts per Billion (ppb): Number of parts of a chemical found in one million parts of a particular gas, liquid, or solid.

Permeability: The measurement of a material's ability to allow the passage of moisture. For landfill applications, it is usually expressed in centimeters per second.

Photovoltaic: Literally, "light" (photo) and "electricity" (voltaic). The class of equipment used to generate electricity directly from sunlight.

Recharge: Water that infiltrates into the ground, usually from above, that replenishes groundwater reserves, provides soil moisture, and affords evapotranspiration.

Recycling: The process of collecting, sorting, cleansing, treating, and reconstituting materials that would otherwise become solid waste, and returning them to the economic mainstream in the form of raw material for new products. Does not include the conversion of waste into energy.

Renewable Energy: Generation of power from naturally replenished resources such as sunlight, wind, and tides. Renewable energy technologies include solar power, wind power, hydroelectric power, geothermal, and biomass.

Renewable Energy Certificate (REC): A tradable certificate representing the generation attributes of energy derived from a qualified renewable energy source. In the U.S., formal markets for RECs are established in New England and Texas, and are developing elsewhere. Informal and voluntary markets are active or emerging in several other U.S. regions. RECs are also called renewable energy certificates, tradable renewable certificates (TRCs), "green tags", and other names.

S

Solar Power (or Energy): Use of sunlight, or solar energy, to heat and light buildings, generate electricity (using solar photovoltaic systems - PV cells/panels), heat hot water, and for a variety of commercial and industrial uses.

Sprawl: Development patterns where rural land is converted to urban/suburban uses more quickly than needed to house new residents and support new businesses, and people become more dependent on automobiles. Sprawl defines patterns of urban growth that includes large acreage of low-density residential development, rigid separation between residential and commercial uses, residential and commercial development in rural areas away from urban centers, minimal support for non-motorized transportation methods, and a lack of integrated transportation and land use planning.

Streetscape: The space between the buildings on either side of a street that defines its character. The elements of a streetscape include: building frontage/façade; landscaping (trees, yards, bushes, plantings, etc.); sidewalks; street paving; street furniture (benches, kiosks, trash receptacles, fountains, etc.); signs; awnings; and street lighting.

Sulfur oxides (SO_x): The group of compounds formed during combustion or thereafter in the atmosphere of sulfur compounds in the fuel, each having various levels of oxidation, ranging from two oxygen atoms for each sulfur atom to four oxygen atoms.

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

T

Tax Increment Financing (TIF): A program designed to leverage private investment for economic development projects in a manner that enhances the benefits accrued to the public interest.

Transit-Oriented Development (TOD): The development of housing, commercial space, services, and job opportunities in close proximity to public transportation. Reduces dependency on cars and time spent in traffic, which protects the environment and can ease traffic congestion, as well as increasing opportunity by linking residents to jobs and services.

Transportation demand management strategies (TDM): TDM is a general term for strategies that result in more efficient use of transportation resources, including incentives to reduce driving, use alternative options, and improve transit.

W

Weather: Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. Climate in a narrow sense is usually defined as the “average weather”, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and ‘weather’ is what you get (e.g. a blizzard).

Wind Power: Harnessing the wind to generate electricity. Wind turbines produce electricity when wind turns blades that are connected to a shaft that drives a generator.

Wind Turbine: A machine that converts the kinetic energy in wind into mechanical energy. If the resulting energy is used directly by machinery, such as a pump, the machine is usually called a windmill. If the energy is converted to electricity, the machine is called a wind generator.

Work/Live Unit: An integrated housing unit and working space, occupied and utilized by a single household in a structure that has been designed or structurally modified to accommodate joint residential occupancy and work activity, and which includes:

1. Complete kitchen space and sanitary facilities in compliance with the Building Code; and
2. Working space reserved for and regularly used by one or more occupants of the unit.

In a work-live unit, the work component is the primary use, to which the residential component is secondary.

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