City of Vacaville

Energy & Conservation Action Strategy




"Vacaville's Vision for Efficient Growth"

Adopted August 11, 2015 – Resolution 2015-074

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Prepared by:

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in association with:

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1 INTRODUCTION

Vacaville is a vibrant community with a family-friendly atmosphere and a high quality of life. Due to its location, Vacaville serves as a gateway to the Bay Area and the Central Valley, and as such, has achieved impressive growth. Through thoughtful planning over the 120 years since incorporation in 1892, Vacaville's growth reflects respect for its beautiful natural setting, preservation of its historic character, and distinct sense of place. Throughout its history, and as it moves into the 21st century, the residents and leaders of Vacaville recognize that a healthy and prosperous community must consider economic, environmental, and social goals when planning for the future, and must grow in a way that continues to promote the City's values.

Under the leadership of a Steering Committee and the City Council, and with input from the community, the City prepared an updated General Plan concurrent with this Energy and Conservation Action Strategy that is focused on maintaining a high quality of life, improving the environment, and promoting sustainable growth. ***Sustainability*** is commonly defined as "using resources in the present in a manner that does not compromise the choices and quality of life of future generations." The updated General Plan recognizes a variety of ways

that sustainability goals can be met, such as increasing alternative modes of transportation, maintaining a healthy local economy, and preserving open space.

This Energy and Conservation Action Strategy is a strategic tool to implement the General Plan. It is a detailed, long-range strategy to reduce greenhouse gas (GHG) emissions and achieve greater conservation of resources with regards to transportation and land use, energy, water, solid waste, and open space. Collectively addressing community development and conservation through these lenses will help Vacaville remain attractive, prosperous, and adaptive to social, political, and environmental changes.

This Energy and Conservation Action Strategy has been created for Vacaville to be in compliance with State requirements that address the reduction of major sources of GHG emissions. It establishes a strategy that the City and community can implement to achieve the City's GHG emissions reduction target, as identified and required by State legislation.

Implementation of this Energy and Conservation Action Strategy will guide Vacaville's actions through a series of communitywide and municipal GHG emissions reduction measures to decrease the city's contribution to GHG emissions. Communitywide GHG emission reduction measures are exclusively aimed to increase energy independence; reduce spending on gas, electricity, and water; and improve air quality from non-City operations. Municipal GHG emission reduction measures apply exclusively to City operations. Communitywide and municipal GHG emission reduction measures are discussed in Chapters 5 and 6 of this document, respectively.

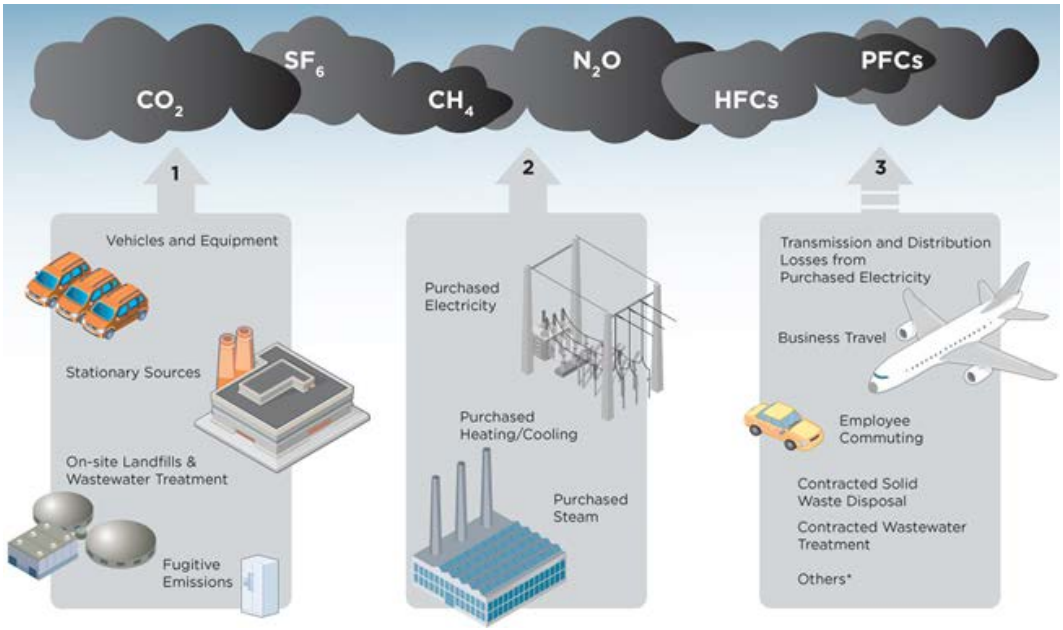
Communitywide measures aim to reduce GHG emissions from activities that occur within Vacaville.

Municipal measures apply exclusively to City government operations.

This Energy and Conservation Action Strategy will support ambitious GHG emission reduction targets adopted by the State and will ensure that Vacaville is eligible for transportation and land use grant funding. The federal, State, and regional requirements are discussed in detail under the heading *Regulatory Action on Greenhouse Gas Emissions* further in this chapter.

This Energy and Conservation Action Strategy will also be utilized for tiering and streamlining future development within Vacaville, pursuant to California Environmental Quality Act (CEQA) Guideline Sections 15152 and 15183.5. It serves as the CEQA

threshold of significance within the city for GHG emissions, by which all applicable developments within the city will be reviewed.



COMMON SOURCES OF GREENHOUSE GAS EMISSIONS

This chapter provides background information on the following topics:

- Greenhouse gases and the theory of global climate change.
- Federal, State, and regional regulatory action on GHG emissions.
- Public participation in the City's sustainability planning processes.

WHAT ARE GREENHOUSE GASES?

Greenhouse gases are vapors that trap heat in the Earth's atmosphere. Federal and California State law identifies the following six gases as GHGs: [1]

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

[1] California Health and Safety Code, Section 38505(g).

- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)

Greenhouse gases emissions are measured in terms of their Global Warming Potential (GWP). The GWP is the ability of a GHG to trap heat in the Earth's atmosphere when compared to an equal amount of carbon dioxide, which assumes a GWP value of 1. The GWP is used to estimate the contribution a GHG will emit in the Earth's atmosphere.

Based on the GWP, all GHGs can be converted into carbon dioxide equivalents (CO_2e), which then enables decision-makers to consider different GHGs in comparable terms. The conversion of GHGs is done by comparing the GWP of each GHG to carbon dioxide. The carbon dioxide equivalent is a quantity that describes the amount of carbon dioxide that would have the same GWP. For example, methane is approximately 21 times more powerful than carbon dioxide on a per weight basis in its ability to trap heat. Therefore, 1 metric ton of methane would be calculated as 21 metric tons of carbon dioxide equivalent ($MTCO_2e$).

What is a metric ton of carbon dioxide?

- *About 1 metric ton of CO_2 is produced to the meet the average monthly energy demand of the typical American household for heating, cooling, cooking, electricity use, and other energy needs. This results in 12 metric tons per house per year.*
- *About 1 metric ton of CO_2 is produced for approximately each 100 gallons of gasoline used. This means if you drive a car that gets 20 miles per gallon, 1 metric ton of CO_2 is released into the atmosphere for every 2,000 miles driven. This is about two months of driving for many US drivers.*

Source: EPA

A brief description of each of the six GHGs is provided below.

Carbon Dioxide (CO_2)

The primary source of carbon dioxide from human activity is burning fossil fuels such as petroleum, coal, and natural gas in factories, electrical power plants, cars, trucks, and other similar sources. Energy use and driving are directly linked to global warming. While carbon dioxide is the most common GHG, it is the least powerful and has a GWP of 1.

Methane (CH_4)

Methane is the primary component of natural gas, which is used for space and water heating, steam production, and power generation. As provided in the example above, the GWP of

methane is 21, or 21 times that of carbon dioxide. Methane in the Earth's atmosphere occurs when organic material breaks down. Modern solid waste landfills, agricultural operations, coal mines, and oil and natural gas operations are the primary sources of human-generated methane emissions.

NITROUS OXIDE (N_2O)

The majority of nitrous oxide is produced from agricultural practices, including nitrogen fertilizers and animal waste, which promote nitrous oxide production from naturally occurring bacteria. Industrial processes and internal combustion engines also produce nitrous oxide. The GWP of nitrous oxide is 310, which means that nitrous oxide is 310 times more powerful than carbon dioxide and would be calculated as 310 metric tons of CO_2e.

HYDROFLUOROCARBONS (HFCS)

Hydrofluorocarbons are typically used as foam-blown insulation and as refrigerants for both stationary refrigeration and mobile air conditioning, and do not occur naturally. The use of hydrofluorocarbons for cooling and foam blowing is growing as the continued phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) increases. The GWP of hydrofluorocarbons ranges from 140 to 6,300.

PERFLUOROCARBONS (PFCS)

Perfluorocarbons are compounds consisting of carbon and fluorine, primarily created as byproducts of aluminum production and semiconductor (e.g. radios, computers, and telephones) manufacturing; they do not occur naturally. Perfluorocarbons are powerful GHGs that range in GWP from 5,700 to 11,900. Perfluorocarbons are a particular concern because they can remain in the Earth's atmosphere for up to 50,000 years after they are released.

SULFUR HEXAFLUORIDE (SF_6)

This gas is most commonly used as an electrical insulator in high voltage equipment that transmits and distributes electricity, and does not occur naturally. Like perfluorocarbons described above, sulfur hexafluoride is an extremely powerful GHG and has a GWP of 23,900. However, sulfur hexafluorides have a small occurrence and contribute very little to overall GHGs in the Earth's atmosphere.

OTHER COMPOUNDS

In addition to the six major GHGs discussed above, many other compounds have the potential to build up in the Earth's atmosphere. Some of these compounds have been identified as the cause of ozone damage and their gradual phase-out is currently in effect. These compounds include ozone, 1,1,1-trichloroethane,[2] hydrochlorofluorocarbons, and chlorofluorocarbons.

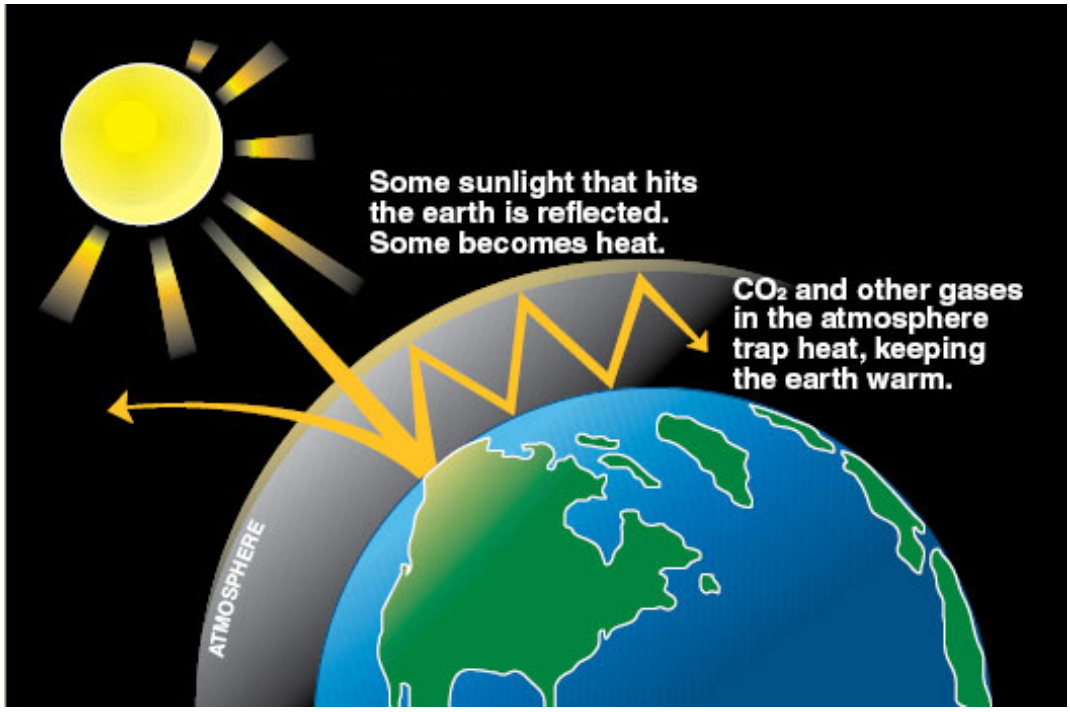
GLOBAL CLIMATE CHANGE THEORY

Currently, global climate change is a controversial topic in the United States. Some people disagree that the climate is changing; others assert that changes in the Earth's climate are part of natural cycles and are not caused by human activity. Although there is extensive scientific research and documentation that supports theories of human-caused global climate change, some scientists believe that the evidence is inconclusive. This section presents the basic concepts underlying the science of global climate change in order to explain why those who are concerned about global climate change, such as California legislators, are seeking to reduce the impacts of specific human activities on the Earth's atmosphere.

The Earth's atmosphere is composed of naturally occurring and human-caused GHGs that trap heat in the atmosphere and regulate the Earth's temperature. This phenomenon, known as the greenhouse effect, is responsible for maintaining a climate suitable for human life. Greenhouse gases in the Earth's atmosphere play an important role in maintaining the Earth's temperature as they trap heat emitted from the Earth's surface which otherwise would have escaped to space, as shown in Figure 1-1.

[2] 1,1,1-trichloroethane was used as an industrial solvent before being banned under the Montreal Protocol in 1996.

FIGURE 1-1 **THE GREENHOUSE EFFECT**



Source: State of Washington Department of Ecology, "What is Climate Change," http://www.ecy.wa.gov/climatechange/whatis.htm, accessed on October 11, 2012.

Water vapor and carbon dioxide are the most abundant GHGs in the Earth's atmosphere. As discussed above, the six GHGs that are considered the main contributors to man-made global climate change are:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)

While human activity results in the release of some GHGs that occur naturally, such as carbon dioxide and methane, other gases, like hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, are completely human-made.

Human activities, including but not limited to burning fossil fuels and removing trees, result in the release of carbon in the form of carbon dioxide into the Earth's atmosphere. Without these human activities, carbon dioxide would be naturally stored underground in sediments, such as petroleum, coal, and natural gas, or on the Earth's surface as plant life. As these types of human activities have increased from the time of the industrial revolution over 200 years ago, the amounts of GHGs in the atmosphere also increased, consequently enhancing the natural greenhouse effect.

It is believed that this enhanced greenhouse effect has contributed to global warming, which is defined as an increased rate of warming of the Earth's surface temperature. As more GHGs build up in the Earth's atmosphere, more heat is trapped in the Earth's atmosphere, thereby increasing evaporation rates and temperatures near the surface. The warming of the Earth induces large-scale changes in ocean circulation patterns, precipitation patterns, global ice cover, biological distributions, and other large-scale changes to the Earth's systems that are collectively referred to as global climate change.

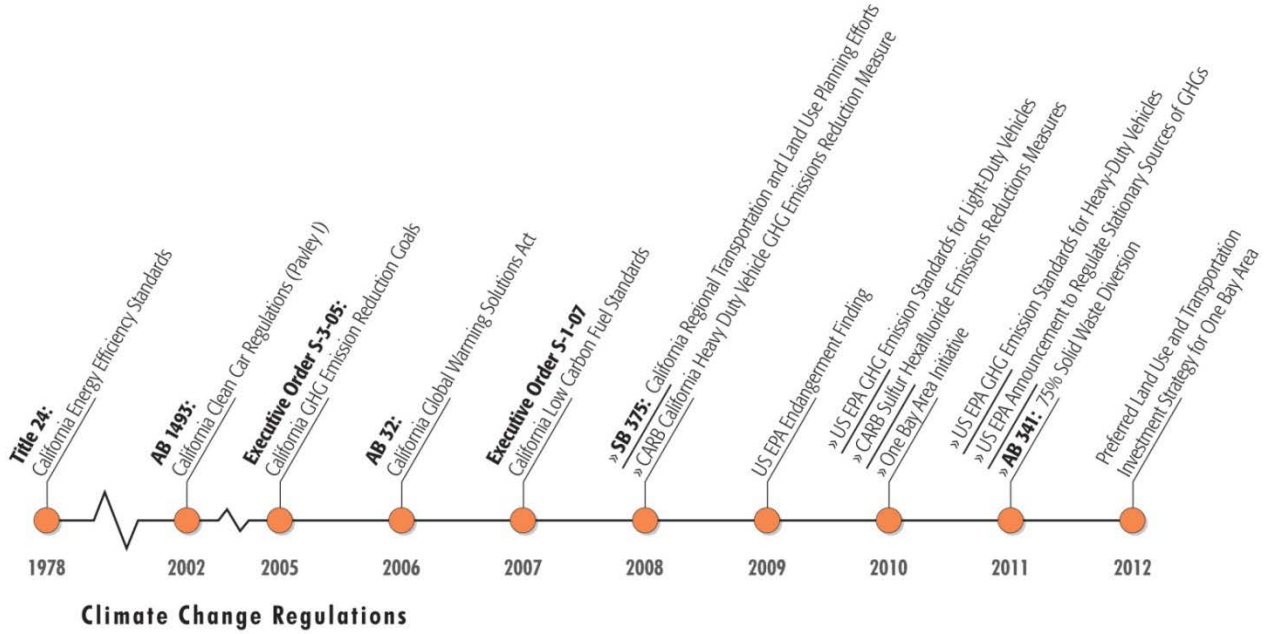
REGULATORY ACTION ON GREENHOUSE GAS EMISSIONS

Many federal, State, and regional government agencies and organizations are working to develop and implement solutions to control GHG emissions and slow their effects on natural ecosystems.

At the federal level, in December 2009, the US Environmental Protection Agency (EPA) found that elevated concentrations of the six key GHGs in the atmosphere, which are discussed earlier in this chapter, endanger the public health and welfare of current and future generations. In collaboration with the National Highway Traffic Safety Administration, the EPA established GHG emission standards for light-duty vehicles (e.g. cars) in 2010 and heavy-duty vehicles (e.g. trucks) in 2011. Additionally, on January 2, 2011, the EPA announced that it would regulate GHG emissions from major stationary sources of GHGs, including oil refineries and fossil fuel burning power plants, through modifications to the existing Clean Air Act permitting programs. At the State level, California's major laws and regulations include:

- **Energy Efficiency Standards (1978)** to reduce the State's energy consumption by providing regularly updated standards that incorporate new energy efficiency goals, methods, and technologies.

- **Clean Car Regulations (Assembly Bill 1493, 2002)** to decrease GHG emissions from new passenger vehicles and light duty trucks through California Air Resources Board (CARB) adopted regulations.
- **Executive Order S-3-05 (2005)** to reduce emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050 through a California Environmental Protection Agency (Cal/EPA) led multi-agency effort that identified GHG emission reduction strategies and measures.
- **Global Warming Solutions Act (AB 32, 2006)** to cap California's GHG emissions at 1990 levels by 2020 through CARB-identified discrete, early and easy-to-implement actions to reduce emissions and through a CARB-developed statewide scoping plan to identify how to meet the emissions reduction targets.
- **Executive Order S-01-07 (2007)** to reduce the carbon content of passenger vehicle fuels by 10 percent by 2020 through establishing a low carbon fuel standard (LCFS) for transportation fuels sold in California.[3]



[3] On December 29, 2011, the US District Court for the Eastern District of California issued several rulings in federal lawsuits challenging the LCFS. One of the court's rulings preliminarily prohibits CARB from enforcing the regulation during the time of the litigation. In January 2012, CARB appealed the decision and on April 23, 2012, the Ninth Circuit Court granted CARB's motion for a stay of the injunction while it continues to consider CARB's appeal of the lower court's decision.

- **Regional Transportation and Land Use Planning Efforts (SB 375, 2008)** to support AB 32 by requiring California metropolitan planning organizations (MPOs) to prepare a sustainable communities strategy to reduce vehicle miles traveled (VMT) in their regions and demonstrate their ability to reach CARB targets for 2020 and 2035 and by providing incentives for governments and developers to implement compact and efficient growth patterns.
- **Heavy Duty Vehicle GHG Emissions Reduction Measure (2008)** to improve the fuel economy of heavy duty vehicles through requiring long-haul truckers to retrofit their trailers with fuel-efficient tires and aerodynamic devices.
- **Sulfur Hexafluoride Emissions Reductions Measures (2010)** to reduce sulfur hexafluoride emissions from semiconductor (e.g. radios, computers, and telephones) and non-semiconductor applications through CARB-adopted regulations including reporting and reduction requirements for semiconductor operations and new restrictions on the use and sale of sulfur hexafluoride.
- **Solid Waste Diversion (AB 341, Chesbro, 2011)** to reduce waste diversion by 75 percent by 2020 through requiring the Department of Resources, Recycling, and Recovery (CalRecycle) to provide strategies for achieving the reduction, certain businesses to arrange for recycling services, and local governments to implement a commercial recycling program, and through revising technical and procedural facets of solid waste facility regulatory laws.

In addition to federal- and State-level regulations and policies, there are regional-level regulations and policies relating to GHG emissions. The majority of Vacaville is within the Yolo-Solano Air Quality Management District (YSAQMD), and the extreme southeast corner of Vacaville is in the Bay Area Air Quality Management District (BAAQMD). The YSAQMD reports its emissions from business operations to the Climate Registry, a national nonprofit registry that provides tools and resources to help calculate, verify, report, and manage GHG emissions in a publicly transparent and credible way.[4] The YSAQMD does not yet have its own GHG standards; however, the BAAQMD has a regional Climate Protection Program with measures to help meet GHG reductions. The YSAQMD has allowed projects to use the BAAQMD GHG emissions thresholds while the YSAQMD develops its own GHG standards and criteria.

[4] See www.theclimateregistry.org.

In addition to its Climate Protection Program with measures to help meet GHG reductions, the BAAQMD also requires that all pollution sources warranting an air quality permit estimate what their GHG emissions would be and pay a fee[5] based on the metric ton of carbon dioxide equivalent ($MTCO_2e$) emissions. Consistent with SB 375, the BAAQMD, the Association of Bay Area Governments (ABAG), the Metropolitan Transportation Commission (MTC), and the Bay Area Conservation and Development Commission (BCDC) established One Bay Area, an initiative to coordinate regional GHG emission reduction efforts. One Bay Area's Plan Bay Area has a sustainable communities strategy, which links land use and transportation to GHG emission reduction goals. Vacaville's plans, projects, and development must be consistent with Plan Bay Area in order for the City to be eligible for transportation and land use grant funding.

Additionally, the MTC has committed the Bay Area region, including Vacaville, to a 15 percent reduction in GHG emissions by 2035 and has adopted a Preferred Land Use and Transportation Investment Strategy. This includes a commitment to locate new development in core urban areas and guidelines for evaluating projects and potential grants against the stated goals of Plan Bay Area.

SUSTAINABILITY CHALLENGES

Like other communities in California and around the world, the City of Vacaville faces a number of sustainability challenges. This section describes sustainability challenges related to the GHG emission-generating sources covered in this Energy and Conservation Action Strategy.

TRANSPORTATION AND LAND USE

During the second half of the 20th century, transportation and driving patterns in the US shifted dramatically. Vehicle miles traveled (VMT) per person increased by around 140 percent between 1956 and 1998.[6] This growth in VMT is the result of increasing car trips and increasing average trip length. These increases have been driven by a variety of factors, including changes in demographics, land use, urban design, and public transportation

[5] A fee of $0.042 per metric ton of carbon dioxide equivalent (MTCO2e) was required at the time this document was prepared and could be subject to change over time.

[6] Puentes, Robert and Adie Tomer, 2008, *The Road…Less Traveled: An Analysis of Vehicle Miles Traveled Trends in the US,* Brookings Institution, Washington D.C.

systems. It means that the number of miles driven in America has increased much more dramatically than the increase in population.

As the proportion of two-income households grew, and as jobs shifted to areas further from the traditional town center, long car commutes became more common. This has been true of Vacaville, as more residents work outside of Vacaville in places like Fairfield, Vallejo, and Benicia. In addition, changes in land use and in building and streetscape design also contributed to increased car trips. The separation of uses and driver convenience often came at the expense of pedestrians and other non-automotive users. As commercial areas became more disconnected from residential neighborhoods, it became less convenient to reach these destinations by means other than a car. Auto-oriented designs, which can be unpleasant, intimidating, or even dangerous for non-drivers, have made non-automotive transportation modes more difficult and less appealing to use. Additionally, public transit systems have seen their coverage decreased and their services cut as funding declines, and in some cases they have been removed completely.

Because of the obstacles created by development and design, driving is often the only viable mode of transportation. Consequently, residents have fewer opportunities for physical activity, and those who cannot drive, including children, seniors, and disabled people, can have trouble accessing services.

ENERGY

Energy production is a major economic, security, and environmental challenge at the local, national, and global levels. Although Vacaville receives its energy from Pacific Gas & Electric Company (PG&E), which provides an energy mix that is cleaner than what many other US utilities provide, it still relies on fossil fuels – coal, oil, and natural gas – for about half of its energy.[7]

[7] Pacific Gas and Electric website, http://www.pge.com/myhome/environment/pge/cleanenergy/, accessed on May 1, 2012.

The US imports approximately 60 percent of its petroleum from foreign countries. This dependence potentially makes our economy and security vulnerable to political and resource instability in other parts of the world.

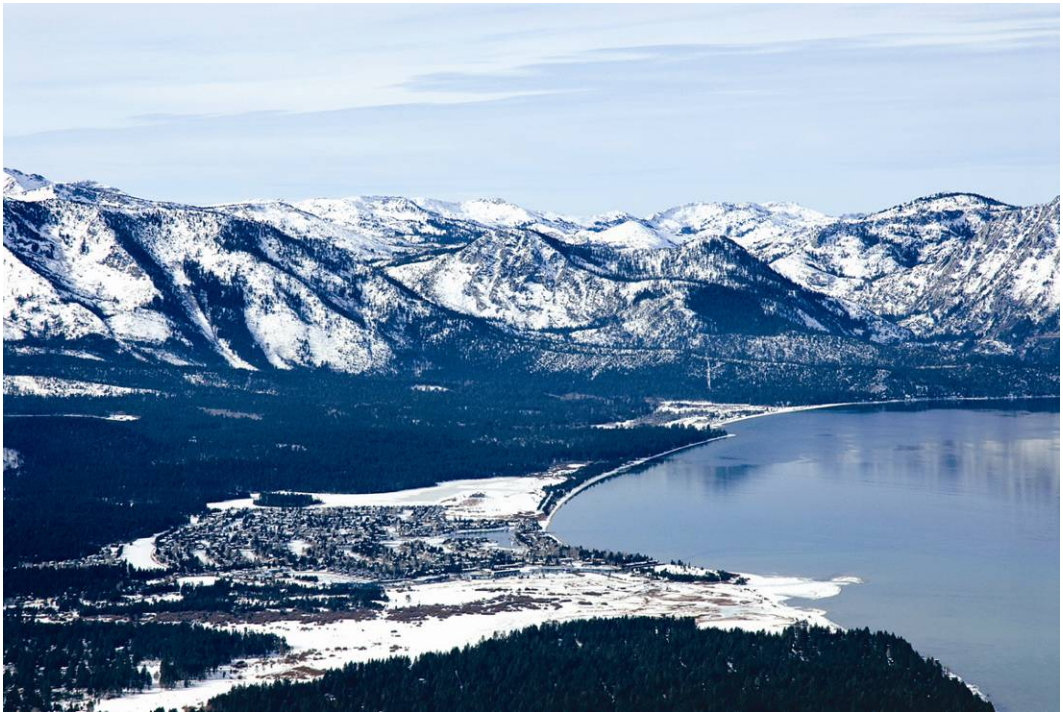
The combustion of fossil fuels to produce heat or electricity, or to power internal combustion engines, is a main contributor to GHG emissions and other environmental problems. Because fossil fuels are found deep in the ground, they must be extracted and transported to provide energy. Surface and groundwater pollution can occur during extraction, storage, and transportation. Land subsidence can result when oil and gas are removed from below ground with nothing left to support the land above. There is also the potential for storage tank leakage and oil spills during transportation, causing widespread pollution and requiring costly cleanup efforts.

WATER

Water conservation is important both to protect water resources, which are expected to be negatively impacted by GHG emissions, and to reduce these GHG emissions that occur when water is treated and transported.

Though the 2010-2011 water year brought some relief to drought conditions in California, the winter of 2011-2012 marked the fourth year of dry conditions within the past five years. The year 2009 featured the driest spring and summer on record, low water content in the Sierra snowpack, and a historic low in the State's reservoir levels. As of early 2009, the drought had damaged crops and prevented farmers from planting or replanting 100,000 acres of agricultural land, causing agricultural revenue losses of more than $300 million.[8] Such drought conditions also threaten aquatic ecosystems, increase the risk of wildfires, increase food prices, and harm livelihoods dependent on agriculture, natural resources, and tourism. Responding to these wide-ranging impacts, the Governor proclaimed a State of

[8] Office of the Governor, State of California, February 27, 2009, Press Release, *Gov. Schwarzenegger Takes Action to Address California's Water Shortage.*



Emergency in February 2009, calling for an immediate 20 percent reduction in water use by urban water users and the use of efficient water management practices by agricultural users.[9]

SOLID WASTE

The production and transport of consumer products creates large amounts of GHGs. A large percentage of these products are disposed of after only one use, requiring more raw materials to be extracted to replace these products. Making new products or buildings from raw materials generally requires more energy, uses more water, and creates more air and water pollution

[9] Office of the Governor, State of California, February 27, 2009, Press Release, *Gov. Schwarzenegger Takes Action to Address California's Water Shortage.*

than reusing materials or making the same product from recycled materials, thereby increasing GHG emissions.

Once in the landfill, solid waste continues to emit GHGs as it rots, most notably methane, which as previously noted is approximately 21 times more potent than carbon dioxide in terms of its global warming impacts. Landfills also release harmful contaminants such as vinyl chloride and benzene. In addition, as rainwater filters through the layers of solid waste in a landfill, it absorbs harmful chemicals, which are then carried into soil, surface water, and groundwater contamination. Poor management of landfills can increase disease carriers and create nuisances related to odor, litter, and dust.

The GHG emissions and other environmental problems associated with solid waste can be reduced through diverting waste from landfills by reducing consumption of single-use or disposable products, reusing, and recycling.

OPEN SPACE AND AGRICULTURE

Within its Sphere of Influence and Urban Growth Boundary, Vacaville has approximately 2,500 acres of public open space and 2,500 acres of agricultural land. These open space areas can store carbon in trees and plants. Conversion of these open space lands to development can release GHGs into the Earth's atmosphere. Forests, orchards, and other open spaces with long-lived plants can store significant carbon.[10]

Depending on the types of farming practices used, agricultural land uses can serve to "sequester," or hold, varying amounts of carbon dioxide and other GHGs. When trees and plants are removed as part of the process of converting agricultural land to other uses, the carbon that is stored in the plants and trees is released into the Earth's atmosphere. This process eliminates the possibility of using the land for plants that would store carbon in the future and disrupts the biological processes that allow land to hold GHGs. In addition,

[10] International Panel on Climate Change (IPCC), 2006. *IPCC Guidelines for National Greenhouse Gas Inventories*; and IPCC, 2000, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*.

developing on forest land or agricultural land can result in the release of nitrous oxide emissions from the soil when it comes into contact with oxygen.

PUBLIC OUTREACH AND PARTICIPATION

Preliminary measures to include in this Energy and Conservation Action Strategy were drafted based on measures that have been successful in other California and Bay Area communities. These preliminary measures were then reviewed by a technical advisory committee made up of City staff from multiple departments. Based on this direction, the measures were refined in preparation for review and input by the public and Steering Committee.

The City held a community workshop on March 17, 2012 to discuss draft sustainability targets and measures for this Energy and Conservation Action Strategy. The workshop included a formal presentation to acquaint participants with the principles of sustainability planning. Participants were given the opportunity to view and comment upon comprehensive lists of potential communitywide and municipal measures for GHG reduction, as well as to suggest other potential measures. These comments served to influence which measures were emphasized and included in the Energy and Conservation Action Strategy. A summary of the input from the workshop is provided as Appendix A.

Following this workshop, the General Plan Steering Committee, which is composed of members of three different city commissions, the Planning Commission, Community Services Commission, and Housing and Redevelopment Commission, held a public meeting on March 22, 2012 to review the draft GHG reduction measures. The public was invited to provide comments, and the Steering Committee provided direction on edits to the draft measures, which were incorporated into this Energy and Conservation Action Strategy.

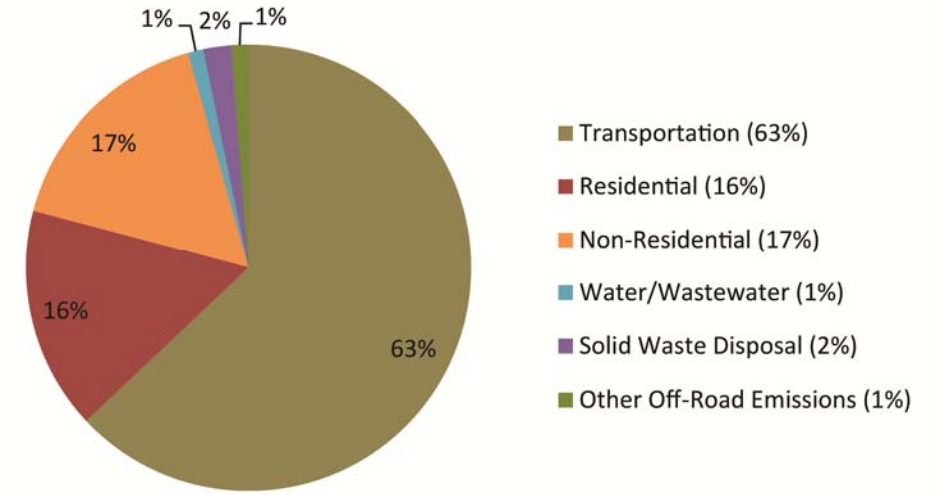
2 EXISTING GREENHOUSE GAS EMISSIONS INVENTORY

This chapter summarizes existing greenhouse gas (GHG) emissions in the City of Vacaville resulting from the following GHG emission-generating sources:

- Transportation
- Residential energy use
- Non-residential energy use
- Moving and treating water/wastewater
- Solid waste disposal
- Other off-road emissions (e.g. from lawnmowers and construction equipment)

Vacaville's baseline, or current, GHG inventory was compiled for the year 2008.[1] Vacaville's average annual communitywide GHG emissions in 2008 were 949,340 metric tons of carbon dioxide equivalent (MTCO2e). (See Chapter 1 for an explanation of carbon dioxide equivalent.) The results of the inventory are shown in Figure 2-1.

FIGURE 2-1 ***GREENHOUSE GAS INVENTORY***



Appendix B provides the technical documentation for this inventory. An explanation of these GHG emission-generating sources and how they were calculated in Vacaville is presented below.

[1] Energy use (purchased electricity and natural gas), water use, and waste disposal fluctuate based on meteorological conditions (e.g. precipitation and temperatures), so it is recommended that a three-year average be used. A three-year average between 2006 and 2008 was obtained for energy use and waste disposal; however, three years of data were unavailable for water use.

TRANSPORTATION EMISSIONS

Cars and trucks release GHGs when they burn gasoline and diesel fuel. Vacaville's emissions from cars and trucks, also called transportation emissions, were calculated based on the trips to and from the homes, schools, shopping centers, office buildings, and other destinations in Vacaville.[2] For the purposes of the Energy and Conservation Action Strategy, transportation emissions include 100 percent of trips that both begin and end within Vacaville. For trips from Vacaville to somewhere else and trips from somewhere else to Vacaville (external-internal trips), only 50 percent of the trip length is included as part of the City's inventory. For trips that pass through Vacaville, such as cars driving from San Francisco to Sacramento on Interstate 80, no emissions are included as part of the City's inventory. Vacaville's total transportation emissions are shown in Table 2-1.

TABLE 2-1 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION SOURCES**

Vehicle Miles Traveled		GHG Emissions
Daily	Annual	MTCO2e /Year
3,075,130	1.067 Billion	598,040

Notes: Daily VMT is multiplied by 347 days/year to account for reduced traffic on weekends and holidays, consistent with the CARB methodology within the *Climate Change Scoping Plan Measure Documentation Supplement*. Emissions are rounded to the nearest tens place. MTCO2e = metric tons of carbon dioxide equivalent.
Source: EMFAC2011.

[2] Vehicle miles traveled (VMT) generated by land uses within the City was compiled by Kittelson & Associates for the City of Vacaville for 2008. GHG emissions from those VMT were compiled by LSA Associates using the California Air Resources Board's (CARB) Emissions Factors 2011 (EMFAC2011) program.

RESIDENTIAL EMISSIONS

"Residential land uses" refers to the single-family houses, apartments, mobile homes, townhouses and other residential units where people live. People's homes generate GHG emissions primarily from electricity and natural gas used for heating and cooking.[3] Pacific Gas and Electric Company (PG&E) provided residential purchased energy use and natural gas use for the years from 2006 to 2008. This data is shown in Table 2-2.

TABLE 2-2 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM RESIDENTIAL LAND USES**

Source	Energy Usage	GHG Emissions MTCO2e /Year
Residential Building Purchased Energy	253,500,590 kWh	66,760
Residential Building Natural Gas	12,966,918 therms	86,450
Total		**153,210**

Notes: Based on the three-year average energy use from 2006 to 2008. Excludes properties owned by another governmental entity that are outside the land use authority of the City of Vacaville (i.e. County or State jurisdiction). Based on PG&E's third-party verified GHG emission factors. Emissions are rounded to the nearest tens place.
kWh = kilowatt hours. A kilowatt hour is a unit of energy equivalent to one kilowatt of power expended for one hour of time. As an example, a small electric heater with one heating element can use 1 kilowatt.
Therms = A unit of heat equivalent to 100,000 British thermal units (BTUs). A BTU is the amount of heat required to raise 1 pound of water (approximately 1 pint), 1 degree Fahrenheit at or close to its point of maximum density.
MTCO2e = metric tons of carbon dioxide equivalent.
Source: PG&E, May 11, 2012, *Community Wide Inventory Report for Cities in Solano County 2003 to 2010.*

[3] GHG emissions are categorized by whether they are human-made (anthropogenic) or part of the natural atmospheric cycle (biogenic). Burning wood is considered a biogenic source of carbon dioxide (a GHG) because the carbon is associated with recently living organic material. Biogenic sources of GHG emissions are not included as part of the communitywide GHG inventory because the release of carbon dioxide simply restores the atmosphere to prior levels. This is consistent with the State GHG emissions inventory, which does not include biogenic sources of GHG emissions.

NON-RESIDENTIAL EMISSIONS

The non-residential category includes GHG emissions associated with commercial, office, and industrial land uses, such as hotels, office buildings, hospitals, gas stations, factories and warehouses. Like homes, non-residential land uses generate GHG emissions primarily from electricity and natural gas used for heating and cooking, as in restaurants. PG&E provided data on non-residential purchased energy use and natural gas use for years from 2006 to 2008, as shown in Table 2-3.

TABLE 2-3 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM NON-RESIDENTIAL LAND USES**

Source	Energy Usage	GHG Emissions MTCO2e /Year
Non-Residential Building Purchased Energy	303,085,739 kWh	79,820
Non-Residential Building Natural Gas	11,485,325 therms	76,570
Total		**156,390**

Notes: Based on the three-year average energy use from 2006 to 2008. Excludes properties owned by another government entity that are outside the land use authority of the City of Vacaville (i.e. County or State jurisdiction). Based on PG&E's third-party verified GHG emission factors. Emissions are rounded to the nearest tens place.
kWh = kilowatt hours. A kilowatt hour is a unit of energy equivalent to one kilowatt of power expended for one hour of time. As an example, a small electric heater with one heating element can use 1 kilowatt.
Therms = A unit of heat equivalent to 100,000 British thermal units (BTUs). A BTU is the amount of heat required to raise 1 pound of water (approximately 1 pint), 1 degree Fahrenheit at or close to its point of maximum density.
MTCO2e = metric tons of carbon dioxide equivalent.
Source: PG&E, May 11, 2012, *Community Wide Inventory Report for cities in Solano County 2003 to 2010.*

WATER/WASTEWATER EMISSIONS

Using water and flushing the toilet results in GHG emissions for two reasons: first, from the electricity required to move and treat potable (drinking) water, and second, from methane and nitrous oxide from sewage that are not captured within the wastewater treatment system. Table 2-4 shows GHG emissions from the city's water use and wastewater (sewage) generation.

Fugitive, or escaping, GHG emissions occur as a result of the wastewater treatment process, which generates emissions of nitrous oxide, a GHG. These are shown in Table 2-4 as Fugitive Emissions. For the purposes of comparison to other emissions sources, these emissions are converted to CO2e.

TABLE 2-4 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM WATER USE AND WASTEWATER TREATMENT**

	Energy (Megawatt Hours/Year)[a]	Energy Emissions (MTCO2e/ Year)[b]	Fugitive Emissions (MTCO2e/ Year)	Total GHG Emissions (MTCO2e/ Year)
Water Use	22,689	5,990	--	5,990
Wastewater Treatment	5,580	4,000[c]	690	4,690
Total	**28,269**	**9,990**	**690**	**10,680**

Notes: Emissions are rounded to the nearest tens place.
[a] Energy associated with water conveyance, treatment, and distribution, and wastewater treatment.
[b] Based on GHG emission factors provided by PG&E, GHG Inventory for Project EIR, Easterly Wastewater Treatment Plant, Ryan Hougham, E.I.T, December 29, 2009, and Vacaville General Plan Update and EIR water demand and wastewater treatment information.
[c] PG&E GHG Inventory for Project EIR, Easterly Wastewater Treatment Plant, Ryan Hougham, E.I.T, December 29, 2009. Treatment Plant is under City ownership, but also treats waste from outside the city. Specifically, there are 2,531 MTCO2e generated from waste from outside of the city, which was added to 1,472 MTCO2e from waste originating inside the city.
MTCO2e = metric tons of carbon dioxide equivalent.

The vast majority of households and businesses in Vacaville are connected to the City's sanitary sewer system.[4] Wastewater connected to the sanitary sewer system in Vacaville is treated at the Easterly Wastewater Treatment Plant (EWWTP). Treated water is discharged as fresh water into Old Alamo Creek.

SOLID WASTE DISPOSAL EMISSIONS

Trash, also referred to as "solid waste," produces a significant amount of methane, a powerful GHG. Most operating landfills in California have installed landfill gas recovery systems as a common way to reduce methane emissions from solid waste disposal. These systems capture the methane gas released from the rotting garbage in the landfill and convert it to a useable energy source. Although solid waste disposal sites produce carbon dioxide from bacteria or biological processes that occur in the landfill, known as biogenic carbon dioxide, these biogenic sources of GHG emissions are not included as part of a communitywide GHG inventory because they are part of a natural process and are not under the City's control.

The California Department of Resources Recycling and Recovery (CalRecycle) maintains a disposal reporting system (DRS) to document waste disposal by jurisdiction and facility; this system was used to access the data needed to identify GHG emissions from garbage generated in Vacaville. The CalRecycle DRS tracks solid waste disposal and "alternative daily cover" (ADC), which is used as a temporary overlay to cover exposed garbage to reduce insects and vermin. Typical ADC materials include green materials, sludge, ash and kiln residue, compost, construction, and demolition debris, and special foams and fabric; these materials contribute to the total solid waste disposal documented for Vacaville.

The US Environmental Protection Agency's (EPA's) Waste Reduction Model (WARM) software (Version 12) was used to calculate average annual GHG emissions from

[4] A small portion of households in the hillsides are on separate septic tank systems. For the purpose of this GHG emissions inventory, all wastewater was modeled as treated wastewater.

communitywide waste disposed in a given year. Pursuant to the Bay Area Air Quality Management District's (BAAQMD) methodology, a three-year average (2006 to 2008) was compiled. According to the CalRecycle DRS, between 2006 and 2008, Vacaville disposed of an average of 105,168 tons of solid waste and 5,864 tons of ADC, for a total disposal of 111,032 tons of solid waste. The vast majority (approximately 99 percent) of solid waste generated by the City is disposed at the Recology Hay Road Landfill, which has an active landfill methane gas collection system.[5] A landfill gas control efficiency of 75 percent was assumed based on the default value recommended by the Local Governments Operations Protocol (LGOP). This means that 75 percent of the landfill GHG emissions are controlled and therefore not released into the atmosphere. However, in reality, most large landfills, such as the Recology Hay Road Landfill, have more efficient tools for controlling GHG emissions, such as clay or geomembrane covers, which have a gas collection efficiency of 85 to 90 percent, respectively.[6] Therefore, GHG emissions estimates for Vacaville from waste disposal are conservative. Table 2-5 shows total GHG emissions from waste disposal for the city.

TABLE 2-5 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM WASTE DISPOSAL**

CO2e Generated (Metric Tons/Year)	Fugitive CO2e Not Captured (Metric Tons/Year)[a]
76,130	19,030

Notes: Biogenic carbon dioxide is not included because the carbon is associated with recently living material, which is part of a natural process and is not under the City's control. Highest emissions occur approximately three years after disposal. An aggregated three years of emissions was used to account for cumulative disposal. Emissions are rounded to the nearest tens place. MTCO2e = metric tons of carbon dioxide equivalent.
[a] Assumes a landfill gas control efficiency of 75 percent based on the LGOP.
Source: US EPA, February 2012, Waste Reduction Model (WARM), Version 12.

OTHER OFF-ROAD EMISSIONS

GHGs are also emitted from landscaping, light commercial and industrial, and construction equipment such as blowers, generators, and bulldozers that burn gas or diesel fuel. These

[5] PG&E, 2012, *Hay Road and Yuba Sutter Landfill Projects, Recology*, http://www.pge.com/myhome/environment/whatyoucando/climatesmart/climatesmartabout/projects/hayroadyubasutterlandfill.shtml, accessed June 8, 2012.

[6] BAAQMD, 2008, *Greenhouse Gas Mitigation Landfill Gas and Industrial, Institutional, and Commercial Boilers, Steam Generators and Process Heaters*, prepared by URS Corporation.

emissions are referred to as "off-road emissions" in this inventory and are summarized in Table 2-6.

TABLE 2-6 **BASELINE COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM OTHER OFF-ROAD EMISSIONS**

Source	GHG Emissions (MTCO2e/Year)
Landscaping Equipment	850
Light Commercial and Industrial Equipment	3,050
Construction Equipment	8,100
Total	**11,990**

Notes: Emissions are rounded to the nearest tens place. MTCO2e = metric tons of carbon dioxide equivalent.
Source: Solano Transportation Agency, 2011, *Greenhouse Gas Inventory*.

This category includes GHG emissions from the following types of equipment used within Vacaville:

- Landscaping equipment, including blowers, mowers and other landscaping tools.
- Light commercial and industrial equipment, including generators, pressure washers, welders, and pumps.
- Off-road construction equipment such as bulldozers, cranes, backhoes, and water trucks.

The Solano Transportation Authority (STA) is responsible for countywide transportation planning in Solano County. In 2011, the STA prepared a GHG inventory for the seven cities within the county, including Vacaville. The emissions presented in Table 2-6 are based on the results of the GHG inventory for Solano County for the year 2005 completed by the engineering firm AECOM in May 2011 for STA.[7] AECOM used CARB's OFFROAD2007 modeling software to calculate these stationary sources of emissions on a countywide level.

[7] Solano Transportation Agency, 2011, *Greenhouse Gas Inventory*.

Pursuant to BAAQMD guidance, stationary emissions for the city were estimated based on the percentage of the Solano County inventory that represents Vacaville's GHG emissions.

GHG EMISSION-GENERATING SOURCES NOT INCLUDED

INDUSTRIAL GHG EMISSIONS

Vacaville has several major industrial sources of GHG emissions that are regulated by the Yolo-Solano County Air Quality Management District (YSAQMD). These uses include emergency diesel engines, removing contaminates from soils, energy used for utilities (e.g. electricity and wastewater treatment), and various manufacturing operations that use heating boilers and operate metal coating facilities. Between 2006 and 2008, 37 average annual permits were issued for diesel, propane, and natural gas stationary emissions sources.[8] The GHG emissions from these years are summarized in Table 2-7.

TABLE 2-7 **GHG EMISSIONS FOR INDUSTRIAL STATIONARY SOURCES IN VACAVILLE**

Year	Total GHG Emissions (MTCO2e/Year)
2006	21,080
2007	30,310
2008	25,460
Average	**25,620**

Note: Emissions are rounded to the nearest tens place. MTCO2e = metric tons of carbon dioxide equivalent.
Source: Cassandra Kirkbride, Air Quality Engineering Technician, May 30 2012, *Yolo-Solano Air Quality Management District Data Request*.

Industrial stationary source emissions are presented here for informational purposes, but are not included in the inventory because those emissions are under the jurisdiction of the YSAQMD and not the City of Vacaville.

CARBON STOCK/CARBON SEQUESTRATION

As described in Chapter 1, Vacaville has 2,500 acres of agricultural land. Development of agricultural land can result in the release of nitrous oxide emissions from exposing soil to

[8] Includes sources inside the Vacaville city limits only.

oxygen (i.e. soil oxidation) through activities such as tilling and draining. This also can release carbon dioxide emissions from removal of plant materials that store carbon. The amount of biological material from living or recently living organisms (i.e. biomass) stored in agricultural areas within the city boundary is not a substantial portion of Vacaville's GHG emissions. Therefore, carbon stock from agricultural biomass is not included in this GHG emissions inventory.

If future projects result in the removal of a significant amount of plants that is not planned for in the General Plan, then the net loss of biomass should be accounted for in the project's GHG emissions inventory. However, future projects that are consistent with the General Plan and this Energy and Conservation Action Strategy would not be required to account for removal of biomass in the project's inventory; only projects that are not consistent with the General Plan (e.g. development in an area that the General Plan designates as open space) would be required to account for biomass removal.

MUNICIPAL EMISSIONS

Emissions from City government operations, such as the electricity used in City office buildings, or gas burned by Vacaville Police Department cars, are a very small percentage of the overall emissions within the city limits of Vacaville. Therefore, the focus of this Energy and Conservation Action Strategy is on the communitywide GHG emissions and on measures to reduce those communitywide emissions. While this Strategy includes measures that the City will implement in order to reduce the emissions from its municipal operations, those reductions will not significantly affect the overall amount of GHGs emitted in Vacaville. Additionally, the GHG emissions reductions from changes to City government operations are too small to quantify accurately. Because the reductions from municipal measures were not quantified, the baseline municipal GHG emissions were not quantified as part of this inventory.[9]

[9] However, a municipal inventory was prepared separately by AECOM as part of a countywide effort led by STA.

3 2020 Business as Usual and Adjusted Greenhouse Gas Emissions Inventory

This chapter forecasts the greenhouse gas (GHG) emissions in Vacaville in the year 2020. The year 2020 was selected to be consistent with the statewide target established by Assembly Bill (AB) 32, which, as explained in Chapter 1, is to limit California's GHG emissions to 1990 levels by the year 2020.

As described in the inventory of existing emissions in Chapter 2, this forecast looks at GHGs emissions from:

- Transportation
- Residential energy use
- Non-residential energy use
- Moving and treating water/wastewater
- Solid waste disposal
- Other off-road emissions (e.g. from lawnmowers and construction equipment)

This chapter discusses two scenarios for the year 2020:

1. A "business as usual" (BAU) forecast, if no steps were taken to reduce emissions.
2. An "adjusted" forecast, which takes into account State and federal regulations and standards to reduce emissions that will be in effect by the year 2020.

BUSINESS AS USUAL FORECAST

The BAU forecast refers to a scenario in which neither California nor the US government adopts any measures to reduce GHG emissions.

For Vacaville's BAU forecast, the projected GHG emissions in 2020 were based on the communitywide GHG emissions inventory for the year 2008, which as identified in Chapter 2 is 949,340 metric tons of carbon dioxide equivalent ($MTCO_2e$). These 2020 GHG emission projections assume that future growth in Vacaville will produce the same carbon intensities as the buildings and cars in 2008 produced. Table 3-1 shows Vacaville's projected population, housing, non-residential building square footage, and employment in 2020, based on the amount and type of development that is reasonably foreseen. These 2020 projections were based on the differences between 2008 conditions and the proposed General Plan 2035 land use map and policies. Table 3-1 totals the number of residents and number of employees working in Vacaville to arrive at the "service population." Since both residents and workers in a community drive, use energy, flush toilets, and throw away trash,

GHG emissions analyses frequently refer to a "service population" of both workers and residents, rather than the standard population, which refers only to residents.

TABLE 3-1 **EXISTING AND 2020 POPULATION, EMPLOYMENT, AND HOUSING PROJECTIONS**

	2008 Baseline	2020 Forecast[e]	Percent Change from Existing
Population	87,340[a]	98,300	12.6%
Housing	32,550[b]	37,060	13.9%
Employment	30,250[c]	33,740	11.5%
Service Population[d]	117,590[e]	132,040	12.3%

[a] State of California, Department of Finance, May 2010, E-5 Population and Housing Estimates for Cities, Counties, and the State, 2001-2010, with 2000 Benchmark. Excludes prison population, based on: State of California, Department of Corrections and Rehabilitation, Data Analysis Unit, January 7, 2008, Weekly Report of Population as of midnight January 2, 2008.
[b] State of California, Department of Finance, May 2010, E-5 Population and Housing Estimates for Cities, Counties, and the State, 2001-2010, with 2000 Benchmark.
[c] 2009 ABAG Projections.
[d] Population plus employment.
[e] Estimated by The Planning Center | DC&E based on the land use map in the General Plan Update.

Table 3-2 identifies the 2008 baseline communitywide GHG emissions inventory (from Chapter 2) and the 2020 BAU communitywide GHG emissions projection for Vacaville.

Technical documentation for the BAU and adjusted forecasts are provided in Appendix B.

ADJUSTED FORECAST

The "adjusted" forecast refers to a scenario that assumes federal- and State-mandated GHG emission reduction measures would be implemented. As described in Chapter 1, federal and State regulations have already been adopted that will require reductions in GHG emissions from a wide range of activities, including how energy is generated and how vehicle fuels are formulated. These federal- and State-mandated GHG emission reductions will occur regardless of any reduction measures that the City of Vacaville does or does not implement in this Energy and Conservation Action Strategy, so they are included in the adjusted forecast.

TABLE 3-2 **BASELINE YEAR 2008 AND FORECAST YEAR 2020 BUSINESS AS USUAL COMMUNITYWIDE GREENHOUSE GAS EMISSIONS SUMMARY**

	2008 Baseline GHG Emissions ($MTCO_2e$/Year)	2020 BAU GHG Emissions ($MTCO_2e$/Year)	Increase from Baseline ($MTCO_2e$/Year)
Transportation[a]	598,040	808,140	210,100
Residential[b]	153,210	172,440	19,230
Non-Residential[b]	156,390	174,510	18,120
Water/Wastewater[c]	10,680	12,780	2,100
Solid Waste Disposal[d]	19,030	21,370	2,340
Other Off-Road Emissions[e]	11,990	13,470	1,480
Total	**949,340**	**1,202,710**	**253,370**

Note: Emissions are rounded to the nearest tens place.
[a] EMFAC2011 based on vehicle miles traveled (VMT) provided by Kittelson & Associates, as modeled by LSA Associates.
[b] Natural gas and purchased energy provided by PG&E.
[c] LGOP Version 1.1 based on water/wastewater use in the city. Includes wastewater treated at the City's wastewater treatment plant but generated by land uses outside the city.
[d] US EPA WARM model based on waste disposal obtained from CalRecycle.
[e] Estimate of stationary equipment use for landscaping, light commercial and industrial, and construction equipment, based on Solano Transportation Agency's (STA) 2011 GHG Inventory.
Source: The Planning Center | DC&E, 2012; LSA Associates, 2012; and STA, 2011.

The adjusted forecast does not include GHG emission reductions from federal or State requirements that must be implemented at the local level. For example, California AB 341, which requires municipalities to achieve 75 percent solid waste diversion by 2020, will be implemented by the City and not by the State. Therefore, the GHG emission reductions from AB 341 are excluded from the adjusted forecast, and instead included in the forecast of GHG emission reductions resulting from the City's actions under this Energy and Conservation Action Strategy.

Accordingly, by considering an adjusted forecast that reflects GHG emission reductions that federal and State regulations will achieve, the City can more precisely determine what additional GHG emission reductions it needs to reach its local GHG emissions reduction target (discussed further in Chapter 4).

Table 3-3 compares the inventory of existing emissions to the adjusted forecast for year 2020 GHG emissions based on federal and State GHG regulations and programs currently in place. This adjusted forecast accounts for GHG emission reductions from the specific federal and State regulations described below.

TABLE 3-3 BASELINE YEAR 2008 AND ADJUSTED FORECAST YEAR 2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS SUMMARY

	2008 Baseline GHG Emissions ($MTCO_2e$/Year)	2020 Adjusted GHG Emissions ($MTCO_2e$/Year)	Decrease from Baseline ($MTCO_2e$/Year)
Transportation[a]	598,040	639,790	-41,750
Residential[b]	153,210	131,940	21,270
Non-Residential[b]	156,390	126,870	29,520
Water/Wastewater[c]	10,680	8,690	1,990
Solid Waste Disposal[d]	19,030	21,370	-2,340
Other Emissions[e]	11,990	12,120	-130
Total	**949,340**	**940,780**	**8,560**

[a] EMFAC2011 based on VMT provided by Kittelson & Associates, as modeled by LSA Associates.
[b] Natural gas and purchased energy provided by PG&E.
[c] LGOP Version 1.1 based on water/wastewater use in the city. Includes wastewater treated at the City's wastewater treatment plant but generated by land uses outside the city.
[d] US EPA WARM model based on waste disposal obtained from CalRecycle.
[e] Estimate of stationary equipment use for landscaping, light commercial and industrial, and construction equipment, based on Solano Transportation Agency's (STA) 2011 GHG Inventory.
Source: The Planning Center | DC&E, 2012; LSA Associates, 2012; and STA, 2011.

PAVLEY I – CLEAN CAR STANDARDS

The "Pavley" standards, or AB 1493, are named for their author, Assemblywoman Fran Pavley. These standards, originally passed in 2002, required automakers to limit carbon dioxide and pollutants from new cars and light trucks, starting with the 2009 model year. In 2009, CARB adopted amendments to the "Pavley" standards that require manufacturers to achieve higher fuel efficiency standards. The Pavley regulation is anticipated to reduce GHG emissions from new passenger vehicles by 31.4 percent for the 2016 model year.[1]

[1] Based on a California fleet mix of 70 percent passenger cars and light duty trucks (LDT1) and 30 percent light duty trucks (LDT2) as stated in CARB's *2008 Comparison of Greenhouse Gas Reductions under CAFE Standards and CARB Regulations Adopted Pursuant to AB 1493*.

Federal Corporate Average Fuel Economy Standards

In 2010, the US Environmental Protection Agency (EPA) adopted federal Corporate Average Fuel Economy (CAFE) standards for model years 2012 through 2016. In 2011, the EPA, the US Department of Transportation, and the State of California announced a single time frame for proposing the fuel economy and GHG standards for model years 2017 to 2025 passenger vehicles. However, the adjusted forecast does not account for these additional reductions because they are not yet adopted by CARB or EPA.

Low Carbon Fuel Standard

CARB identified the Low Carbon Fuel Standard (LCFS) as an early action item in its Climate Change Scoping Plan, and adopted the LCFS regulation in 2009; it became law in 2010. The LCFS requires a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020.

Renewable Portfolio Standard

A major component of California's Renewable Energy Program is the renewable portfolio standard (RPS) under Senate Bill (SB) 1078. Under the RPS, certain retail sellers of electricity, like PG&E, were required to increase renewable energy by at least 1 percent each year in order to reach at least 20

percent by December 30, 2010. According to CARB, PG&E served 15.9 percent of their electricity sales with renewable power in 2010.

CARB has now approved an even higher goal of 33 percent by 2020. Renewable sources of electricity include wind, small hydropower, solar, geothermal, biomass, and biogas. Increasing renewable sources of electricity will decrease indirect GHG emissions from buildings that use energy because electricity production from renewable sources is generally considered carbon neutral.

SMART GRID

The California Public Utilities Commission (CPUC) requires California investor-owned electric utilities to develop a smarter or more efficient electric grid in the State. In July 2011, California utilities, including PG&E, filed ten-year "Smart Grid deployment plans" with the CPUC showing how they will become more efficient.

CALIFORNIA BUILDING AND ENERGY EFFICIENCY STANDARDS (TITLE 24)

Title 24, Part 6 of the California Code of Regulations (CCR) requires that the design of building shells and building components conserve energy. The standards are updated periodically to consider and incorporate new energy efficiency technologies and methods. The 2013 Building and Energy Efficiency standards, which will go into effect on January 1, 2014, are approximately 24 percent more energy efficient for residential buildings and 30 percent more energy efficient for non-residential buildings compared to the previous 2008 Building and Energy Efficiency Standards.

CALIFORNIA GREEN BUILDING STANDARDS CODE (TITLE 24)

On July 17, 2008, the California Building Standards Commission adopted the nation's first green building standards. The California Green Building Standards Code (proposed Part 11, Title 24) was adopted as part of the California Building Standards Code (Title 24, CCR), known as CALGreen. The 2010 edition of the code established voluntary standards on planning and design for sustainable site development, energy efficiency (in excess of the California Energy Code requirements), water conservation, material conservation, and

internal air quality. The mandatory provisions of the code became effective January 1, 2011. CALGreen refers to the mandatory Building and Energy Efficiency Standards described above, and also includes voluntary Tier 1 and Tier 2 programs for cities and counties that wish to adopt more stringent energy efficiency requirements that are 15 percent and 30 percent more energy efficient than the current Title 24 standards, respectively. In addition, CALGreen includes mandatory increases in indoor and outdoor water efficiency for new building construction.

California Appliance Efficiency Regulations

The 2006 Appliance Efficiency Regulations (Title 20, CCR Sections 1601 through 1608) were adopted by the California Energy Commission on October 11, 2006, and approved by the California Office of Administrative Law on December 14, 2006. The regulations include standards for both federally regulated appliances and non-federally regulated appliances.

GHG EMISSIONS BY SOURCE

This section describes the assumptions for the six individual GHG emission-generating sources previously listed. For all sources, 2020 emissions are based on the 2020 population and employment in Vacaville shown in Table 3-1. As Table 3-1 shows, this forecast anticipates a 13.9 percent increase in residential units and an 11.5 percent increase in jobs in Vacaville by 2020, which is equivalent to a total service population increase of 12.3 percent. These numbers are based on the amount and type of development that is reasonably foreseen, and the differences between 2008 conditions and the proposed General Plan 2035 land use map and policies.

TRANSPORTATION AND LAND USE EMISSIONS

VMT was compiled by Kittelson & Associates for the City of Vacaville for 2008 and 2020. GHG emissions from VMT generated by land uses within the city were compiled using CARB's EMFAC2011 program, as modeled by LSA Associates, and are shown in Table 3-4.

TABLE 3-4 **2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION SOURCES**

Vehicle Miles Traveled		2020 BAU GHG Emissions ($MTCO_2e$/Year)	2020 Adjusted GHG Emissions ($MTCO_2e$/Year)
Daily	Annual		
3,913,894	1.358 Billion	808,137	639,785

Notes: Daily VMT is multiplied by 347 days/year to account for reduced traffic on weekends and holidays, consistent with the CARB methodology within the *Climate Change Scoping Plan Measure Documentation Supplement*. Emissions are rounded to the nearest tens place.
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
Source: EMFAC2011.

As explained above, the adjusted scenario includes GHG emissions reductions from the Pavley fuel efficiency standards and the Low Carbon Fuel Standard (LCFS), which are fuel and vehicle efficiency standards required by the State.

RESIDENTIAL AND NON-RESIDENTIAL EMISSIONS

Energy use and natural gas use from residential and non-residential buildings will grow in proportion to the number of people who live and work in Vacaville. Table 3-5 shows anticipated BAU and adjusted GHG emissions for residential and non-residential uses in 2020. The adjusted scenario includes GHG emissions reductions from the RPS, Smart Grid, and the Title 24 updates.

TABLE 3-5 **2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM RESIDENTIAL AND NON-RESIDENTIAL LAND USES**

Source	2020 BAU GHG Emissions ($MTCO_2e$/Year)	2020 Adjusted GHG Emissions ($MTCO_2e$/Year)[a]
Residential Buildings	172,440	131,940
Non-Residential Buildings	174,510	126,870
Total	**346,950**	**258,810**

Notes: Excludes properties owned by another governmental entity that are outside the land use authority of the City of Vacaville (e.g. County or State jurisdiction). Based on PG&E's third-party verified GHG emission factors. Emissions are rounded to the nearest tens place.
$MTCO_2e$ = metric tons of carbon dioxide equivalent.
[a] Based on PG&E's forecasted GHG emission rates in 2020.
Source: PG&E, April 2012, Community Wide GHG Inventory Report for Vacaville 2003 to 2010.

WATER/WASTEWATER EMISSIONS

The increase in water demand and wastewater generation within the City is based on current demand and generation rates applied to expected development in 2020. Table 3-6 shows anticipated BAU and adjusted water demand and wastewater generation and associated GHG emissions in 2020. The adjusted scenario includes GHG emissions reductions from the RPS. The RPS will reduce GHG emissions attributable to water demand and wastewater generation by reducing the GHG emissions from electricity used to treat and transport water and wastewater. The adjusted scenario does not include any reductions from State water efficiency requirements because the City is ultimately responsible for implementing those requirements.

TABLE 3-6 ***2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM WATER USE AND WASTEWATER GENERATION***

	2020 BAU			2020 Adjusted		
Land Use	Energy ($MTCO_2e$/ Year)[a]	Fugitive ($MTCO_2e$/ Year)[b]	Total GHG Emissions ($MTCO_2e$/ Year)	Energy ($MTCO_2e$/ Year)[a]	Fugitive ($MTCO_2e$/ Year)[b]	Total GHG Emissions ($MTCO_2e$/ Year)
Water Use	6,720	--	6,720	3,440	--	3,440
Wastewater Generation	5,290[c]	770	6,060	4,480[c]	770	5,250
Total	**12,010**	**770**	**12,780**	**7,920**	**770**	**8,690**

Notes: Water and wastewater GHG emissions are generated from the energy associated with water conveyance, treatment, and distribution, and wastewater treatment. Emissions are rounded to the nearest tens place. $MTCO_2e$ = metric tons of carbon dioxide equivalent.

[a] Based on GHG emission factors provided by PG&E.

[b] CARB, May 2010, Local Government Operations Protocol (LGOP), Version 1.1.

[c] Treatment Plant is under City ownership, but also treats waste from outside the city. Specifically, in 2020, there will be 3,638 $MTCO_2e$ generated from waste from outside of the city, which was added to 1,650 $MTCO_2e$ from waste originating inside the city under the BAU scenario, and 840 $MTCO_2e$ from waste originating inside the city under the adjusted scenario.

Source: Based on water demand and wastewater generation estimated in the Vacaville General Plan Update Environmental Impact Report, October 2013, and percent forecast change in service population by 2020.

SOLID WASTE DISPOSAL EMISSIONS

The amount of trash thrown away in Vacaville will increase in proportion to the number of people that live and work there. The adjusted scenario does not include any reductions from State and federal solid waste diversion requirements because the community is ultimately responsible for the extent of waste reduction. Table 3-7 shows anticipated GHG emissions in 2020.

TABLE 3-7 **2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM WASTE DISPOSAL**

	2020 BAU Waste Disposal (Tons)	2020 BAU GHG Emissions ($MTCO_2e$/Year)
Total	118,090	21,370

Notes: Assumes a landfill gas control efficiency of 75 percent based on the *International Panel on Climate Change's Local Government Operations Protocol*. Biogenic carbon dioxide is not included. Emissions are rounded to the nearest tens place. $MTCO_2e$ = metric tons of carbon dioxide equivalent.
Source: US EPA, February 2012, Waste Reduction Model (WARM), Version 12.

OTHER OFF-ROAD EMISSIONS

Projections for other off-road emission sources in 2020 are based on increases proportional to projected population and employment growth. The BAU and adjusted forecasts for other off-road emissions are summarized in Table 3-8. The adjusted forecast includes reductions from the LCFS.

LANDSCAPING EQUIPMENT

Landscaping equipment use is assumed to be proportional to population growth.

LIGHT COMMERCIAL AND INDUSTRIAL EQUIPMENT

Stationary equipment from non-residential land uses, including generators, pressure washers, welders, and pumps, is assumed to be proportional to employment growth.

CONSTRUCTION EQUIPMENT

The 2020 BAU forecast assumes similar use of construction equipment as baseline conditions.

TABLE 3-8 **2020 COMMUNITYWIDE GREENHOUSE GAS EMISSIONS FROM OTHER OFF-ROAD EMISSIONS**

Source	2020 BAU GHG Emissions ($MTCO_2e$/Year)	2020 Adjusted GHG Emissions ($MTCO_2e$/Year)
Landscaping Equipment	960	860
Light Commercial and Industrial Equipment	3,420	3,080
Construction Equipment	9,090	8,180
Total	**13,470**	**12,120**

Note: Emissions are rounded to the nearest tens place. $MTCO_2e$ = metric tons of carbon dioxide equivalent.
Source: Solano Transportation Authority (STA), 2011. Based on the OFFROAD2007 emissions inventory for the County of Solano, Year 2008, proportioned for the City of Vacaville and projected based on the increase in employment and population growth.

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4 GREENHOUSE GAS EMISSIONS REDUCTION TARGET

This chapter establishes the local target of GHG emissions reductions that Vacaville will strive to reach through implementation of this Energy and Conservation Action Strategy.

As explained in Chapter 1, the California Air Resources Board (CARB) 2008 statewide Climate Change Scoping Plan (2008 Scoping Plan) represents the State's strategy for achieving the GHG emissions reduction target identified in Assembly Bill (AB) 32, the 2006 Global Warming Act. The AB 32 target is to reduce GHG emissions to 1990 levels by the year 2020. In order to identify the appropriate level of GHG emissions reductions needed statewide over the 12 years from 2008 to 2020, the 2008 Scoping Plan used statewide GHG emissions inventory data that had been collected through the year 2004, and that projected future emissions based on prior inventory data. Specifically, the 2008 Scoping Plan identified:

- Statewide 1990 GHG emissions (to establish the targeted amount of reductions needed): 427 million metric tons of carbon dioxide equivalent ($MTCO_2e$).
- Statewide 2002-2004 GHG emissions: 469 million $MTCO_2e$ (average for three years).
- Projected statewide 2005-2008 GHG emissions: 498 million $MTCO_2e$ (average for four years).
- Projected statewide 2020 GHG emissions if no actions were taken to reduce GHG emissions (i.e. business as usual [BAU] conditions): 596 million $MTCO_2e$.

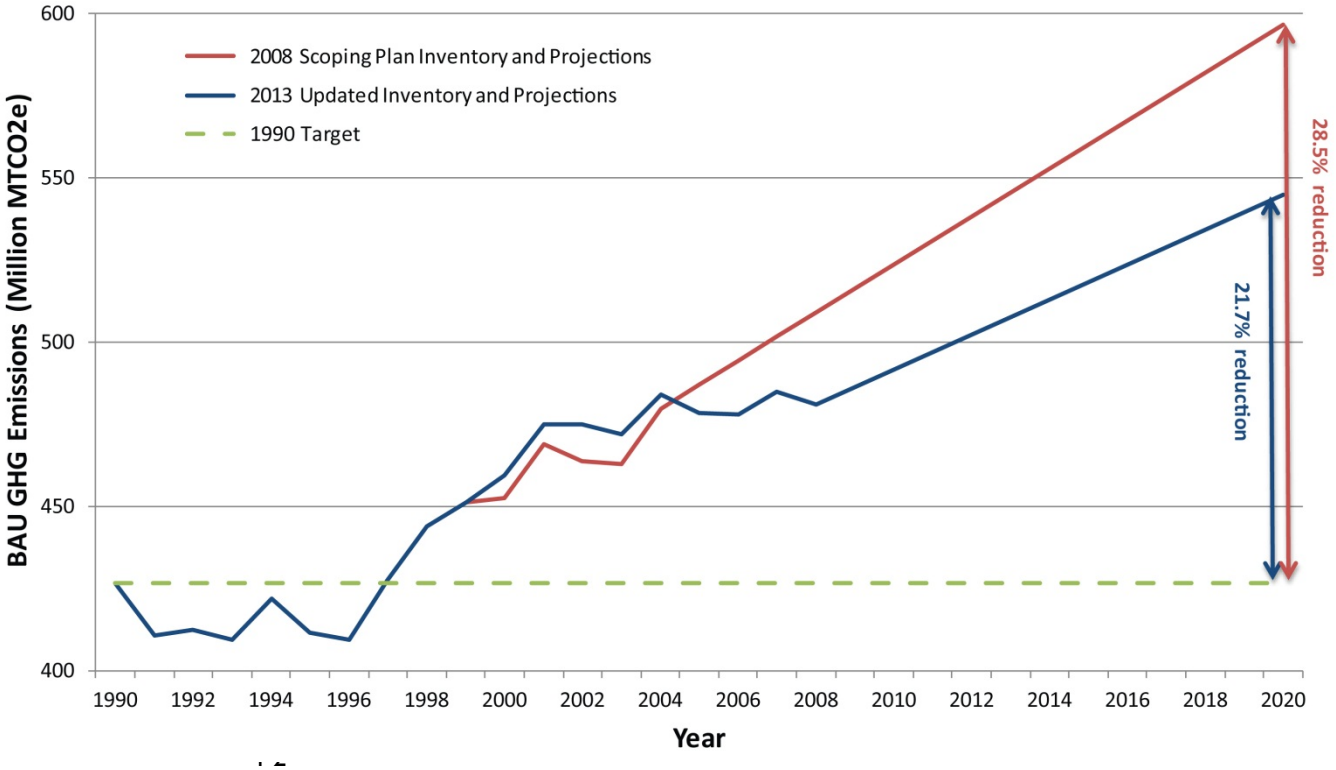
Using the above data, the 2008 Scoping Plan concluded that in order to achieve the targeted 1990 levels of GHG emissions (427 million $MTCO_2e$), the State would need to reduce GHG emissions as follows:

- Reduce 2005-2008 GHG emissions (498 million $MTCO_2e$) by 71 million $MTCO_2e$, an approximately 15-percent reduction.
- Reduce 2020 BAU GHG emissions (596 million $MTCO_2e$) by 169 million $MTCO_2e$, an approximately 30-percent reduction.

Based on the conclusions above, the 2008 Scoping Plan recommends, but does not require, that local governments (cities and counties) reduce GHG emissions by 15 percent below "current" (i.e. 2005-2008) emissions by 2020. Some local governments have used this recommended target for local GHG emission reduction plans, while others have established their target as a 30-percent reduction from 2020 BAU GHG emissions. Some jurisdictions have established other targets that take into account local considerations, such as local air district guidance.

CARB is in the process of completing a five-year update to the 2008 Scoping Plan, as required by AB 32. A discussion draft of the 2013 Scoping Plan was released on October 1, 2013. The 2013 Scoping Plan update defines CARB's climate change priorities for the next five years and lays the groundwork to reach the post-2020 goal set forth in Executive Order S-3-05, including a recommendation for the State to adopt a mid-term target. Because the State has not yet adopted a mid-term target, this ECAS does not include a target beyond 2020.

Many factors affect GHG emissions, including the economy, demographics, improved efficiency standards, and changes in environmental conditions such as drought, so it is important to periodically update the statewide inventory to measure actual emissions and account for these factors.[1] In 2013, as part of the ongoing process of meeting the 1990 statewide GHG emissions target required by AB 32, CARB released an updated statewide GHG emissions inventory for the years 2000 to 2010.[2] This update provides actual GHG emissions data for this time period, whereas the previous statewide inventory relied on projections for years after 2004. This updated and comprehensive annual statewide emissions inventory offers a better understanding of historical GHG emission trends, which, in turn, helps track progress towards meeting the State's target.



The 2000-2010 statewide GHG emissions inventory shows that GHG emissions in California are increasing at a slower rate than anticipated in the 2008 Scoping Plan, likely due to the downturn in the economy. Based on the revised data available in the 2000-2010 inventory, CARB projects that statewide BAU emissions in 2020 would be approximately 545 million $MTCO_2e$, about 10 percent lower than the 596 million $MTCO_2e$ projected in 2008. Therefore, to achieve the AB 32 target of 427 million $MTCO_2e$ by 2020 (i.e. 1990 emissions levels by 2020), the State would only need to reduce emissions by 118 million $MTCO_2e$ compared to BAU conditions, a reduction of 21.7 percent from BAU in 2020.[3] Table 4-1 illustrates the GHG emissions inventories and reductions identified by the State.

TABLE 4-1 **STATEWIDE GHG EMISSIONS INVENTORY HISTORY**

GHG Emissions Inventory Years	Projected 2020 BAU GHG Emissions (Million $MTCO_2e$/Year)[a]	Reduction Needed to meet 1990 Levels	
		Million $MTCO_2e$/Year	Percentage
1990 to 2004 (2008 Scoping Plan)	596	169	28.5
2000 to 2010 (2013 Updated Inventory)	545	118	21.7

BAU = business as usual, $MTCO_2e$ = metric tons of carbon dioxide equivalent.
[a] The 2020 BAUGHG emissions forecasts in this column are based on the actual inventory data collected for each of the GHG emissions inventory years indicated below (1990-2004 and 2000-2010).
Source: Association of Environmental Professionals, 2012, *Forecasting Community-Wide Greenhouse Gas Emissions and Setting Reduction Targets (Draft)*, available at: http://www.califaep.org/docs/AEP_Next_Steps_White_Paper.pdf.

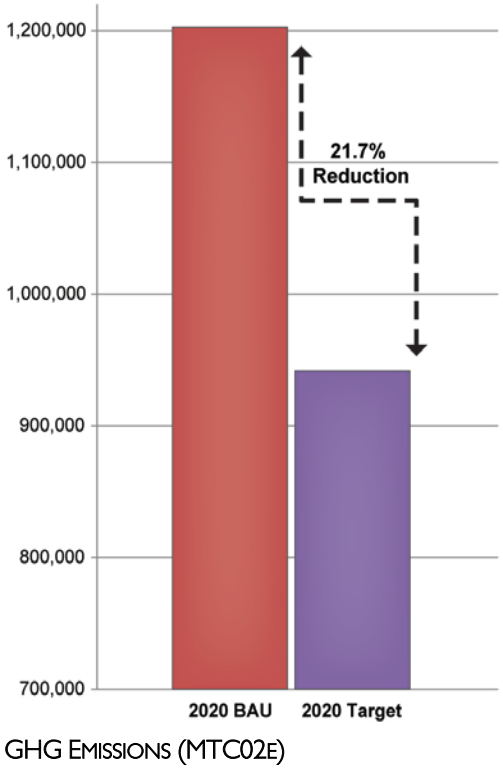
Based on the updated statewide GHG emissions inventory and forecast data discussed above, this Energy and Conservation Action Strategy uses the following local target, which applies the same statewide ratio of reductions needed to Vacaville's local emissions:

- **Reduce GHG emissions by 21.7 percent below Vacaville's 2020 BAU forecast.**

Vacaville's 2020 BAU emissions are projected to be 1,202,710 $MTCO_2e$. To achieve the local target of a 21.7-percent reduction, forecasted 2020 GHG emissions in Vacaville must be

[3] Association of Environmental Professionals, 2012, *Forecasting Community-Wide Greenhouse Gas Emissions and Setting Reduction Targets (Draft)*, available at: http://www.califaep.org/docs/AEP_Next_Steps_White_Paper.pdf.

reduced by 260,988 $MTCO_2e$.[4] This reduction would result in 941,722 $MTCO_2e$ in total emissions in 2020 for Vacaville.[5]



TARGET OPTIONS CONSIDERED BUT REJECTED

To support State efforts, Vacaville would need to select a target that is compatible with adopted State GHG emission reduction targets or related regional targets. The majority of the Vacaville city limits are within the Yolo Solano Air Quality Management District (YSAQMD) and a small part of the city limits are within the Bay Area Air Quality Management District (BAAQMD).[6] The YSAQMD has not yet established any guidance on appropriate targets for local greenhouse gas reduction plans, and the BAAQMD GHG emissions thresholds are based on conditions that are specific to the San Francisco Bay Area, which are different than the majority of Vacaville. As discussed above, the 2008 Scoping Plan is the State's strategy for achieving the GHG emissions reduction target identified in AB 32. Therefore, the City selected the 2008 Scoping Plan and statewide GHG emissions inventory data as the guiding documents to prepare this Energy and Conservation Action Strategy.

Based on the 2008 Scoping Plan and the statewide GHG emissions inventory data, the City considered the following target options:

- **Reduce GHG emissions to 1990 levels by 2020**. This is a direct translation of the AB 32 goal.

[4] 1,202,710 MTCO2e times 0.217 equals 260,988 MTCO2e.

[5] 1,202,710 MTCO2e minus 260,988 MTCO2e equals 941,722 MTCO2e.

[6] As discussed in Chapter 1, the extreme southwest corner of Vacaville is located within the Bay Area Air Quality Management District.

Because the City did not conduct a 1990 emissions inventory, and data is not available to conduct such an inventory today, the first target option is not feasible.

- **Reduce GHG emissions by 15 percent below baseline (2008) emissions by 2020.** This is the target that the 2008 Scoping Plan recommends in order for local jurisdictions to support the State's goal to achieve 1990 levels by 2020.

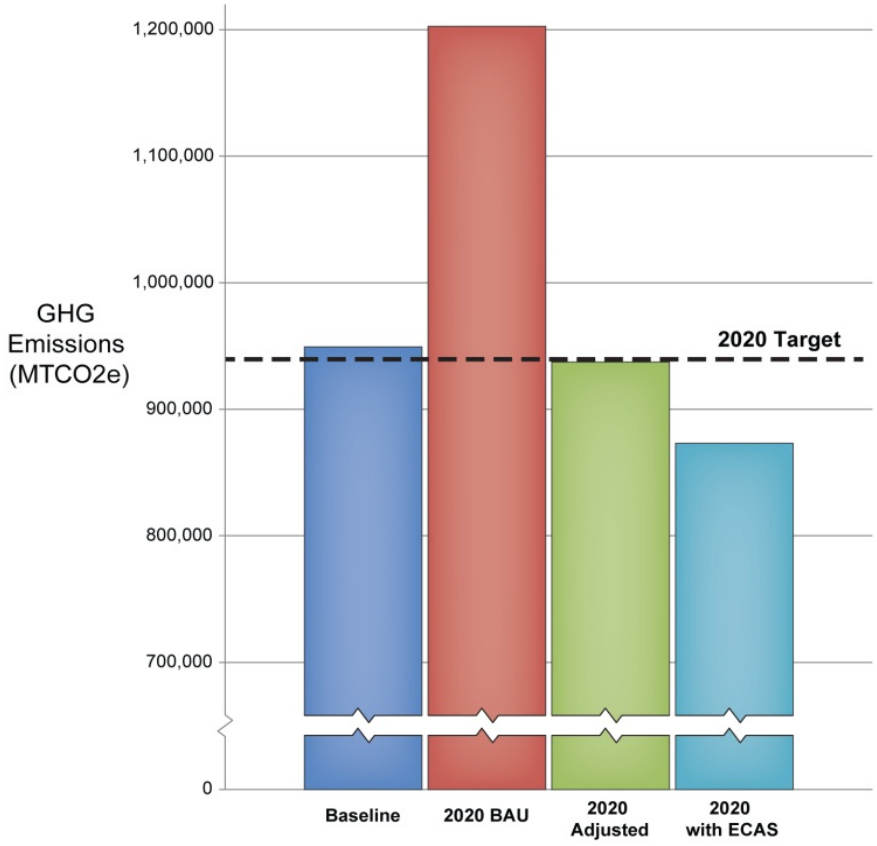
Although the 2008 Scoping Plan recommends the second target option, it does not mandate any specific level of reduction for local governments. The 2008 Scoping Plan's recommend-dation applies to California as whole, but does not require each individual city in California to meet this specific target in order to support the State's goal of reducing emissions to 1990 levels by the year 2020. Not all cities in California are growing at the same rate. It is difficult for cities like Vacaville, which has the capacity and demand to accommodate its fair share of expected population growth in the region, to achieve a 15 percent reduction from baseline emissions, because the amount of anticipated population growth is likely to overwhelm the needed reduction. Therefore, this target option is also considered infeasible for this Energy and Conservation Action Strategy.

- **Reduce GHG emissions by approximately 30 percent below the 2020 BAU forecast.** This is a target option that is derived from the 2008 Scoping Plan, which indicated that the State would need to reduce GHG emissions by 28.5 percent from 2020 BAU levels in order to reach 1990 levels.

The third target option is very similar to the City's selected target of reducing 2020 BAU GHG emissions by 21.7 percent. Both the selected target and this third target option utilize the same approach of a substantial percentage reduction from the 2020 BAU forecast. However, option #3 would be based on outdated data from the 1990 to 2004 statewide GHG emissions inventory. Therefore, the City has selected a target based on the more current data that indicates that a 21.7-percent reduction from 2020 BAU would achieve the 1990 target.

ACHIEVING THE TARGET

As noted above, to achieve the target of reducing 2020 BAU emissions by 21.7 percent, 2020 BAU GHG emissions in Vacaville must be reduced by 260,988 $MTCO_2e$,[7] to achieve no more than 941,722 $MTCO_2e$ in total emissions in 2020.



As described in the adjusted forecast in Chapter 3, federal and State regulations regarding fuel standards, renewable energy generation, energy conservation, and green building materials will substantially reduce GHG emissions in Vacaville, regardless of actions by the City. After taking these reductions into account in the 2020 adjusted forecast, we can see that 2020 emissions in Vacaville would be 940,780 $MTCO_2e$, just below the 941,722

[7] This number was calculated by multiplying the 2020 BAU emissions described in Chapter 2 as 1,202,710 MTCO2e by 0.217.

$MTCO_2e$ that represents the target of a 21.7 percent reduction from 2020 BAU. This means that federal and State regulations alone would achieve the City's GHG emissions reduction target. Nevertheless, the City has identified additional measures to implement at the local level in order to further reduce GHG emissions in Vacaville. The main reason to do this is because the federal and State measures would only exceed the target by 942 $MTCO_2e$, or less than 1 percent of the needed reduction from 2020 BAU. Because the GHG emissions reductions from the federal and State measures rely on modeling estimates, it's possible that the actual reductions will be less effective than expected, and the City would not meet the target without additional local actions. In addition, the City has identified additional local measures in order to demonstrate the City's responsiveness to community concerns about this issue and the City's commitment to supporting State and national efforts to reduce GHG emissions.

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5 COMMUNITYWIDE MEASURES, IMPLEMENTATION, AND MONITORING

This chapter presents the communitywide measures that the City of Vacaville will implement in order to increase energy independence; reduce spending on gas, electricity, and water and improve air quality by the year 2020. These communitywide measures were developed with community involvement, including a Community Workshop held on March 17, 2012 and a Steering Committee meeting held on March 22, 2012. Each measure is based on careful consideration of existing priorities and resources and the potential costs and benefits of various possible approaches.

Some of the communitywide measures are programs, such as the *Schoolpool* program, that are already underway. If such a program began after 2008, the baseline inventory year, then the program is included in this chapter so that the City can "take credit" for it in the future 2020 GHG emissions forecast. The measures that describe such existing programs include the words "continue to…," indicating that this is an existing program.

The measures are divided into the following nine sectors:

1. Transportation and Land Use
2. Green Building
3. Renewable Energy and Low Carbon Fuels
4. Energy Conservation
5. Water and Wastewater
6. Solid Waste
7. Parks, Open Space, and Agriculture
8. Purchasing
9. Community Action

The measures were simulated using the following simulation models; the assumptions from the modeling processes are summarized for each measure, below, and are documented in Appendix C. In general, to result in a conservative estimate of likely emissions, the model does not assume that every project will comply with every measure, particularly for voluntary measures where it is difficult to project future participation rates.

- Emissions Factors 2011 Model (EMFAC2011)
- Off-Road Emissions 2007 Model (OFFROAD2007)
- US Environmental Protection Agency's WARM tool
- California Air Resources Board's (CARB) Local Government Operations Protocol (LGOP)

This chapter presents the environmental benefits of each communitywide measure, as well as implementation information, including action items, responsible parties, cost effectiveness, and a schedule for implementation. In cases where an individual communitywide measure includes many different components, the information on how it will be implemented is provided separately for each component. The amount of GHG emissions reduction that each communitywide measure results in will serve as the standard that the City will use to evaluate whether the reduction target is being met.

The cost effectiveness evaluation makes a qualitative assessment rather than a measured or quantified assessment. The qualitative assessment takes into account both the cost to implement the communitywide measure and its benefits. Due to data constraints in some measures, it is not possible to estimate specific dollar costs for each measure and would likely be inaccurate or misleading to do so. For those measures, this chapter offers a qualitative assessment of the likely cost to implement the measure as compared to the likely benefits of the measure. Highly cost-effective measures may have only moderate benefits, but low implementation costs. Similarly, highly cost effective measures may be expensive to implement, but result in very high benefits.

The measure implementation schedule separates the measures into two main time periods for implementation: 2014 to 2015 and 2015 to 2020. The implementation phases indicate when implementation of the measure will begin. Overall maintenance of the measure will extend well beyond the allotted phase. The implementation schedule prioritizes measures based on their effectiveness at reducing GHG emissions, cost-effectiveness, and/or feasibility. Some measures are expected to be implemented on a later timeline due to obstacles of available data, technology, or finances.

As discussed in Chapter 3, the reductions from federal and State requirements that must be implemented by the City, such as complying with State requirements to reduce the amount of solid waste sent to landfills, are included with the communitywide measures identified in this chapter because they will be done by the City and not by the federal or State governments.

In total, implementation of the communitywide measures described in this chapter, plus local compliance with State and federal requirements, will decrease Vacaville's GHG emissions by 63,472 metric tons of carbon dioxide equivalent ($MTCO_2e$) by 2020. As discussed in Chapter 4, the GHG emissions reductions from federal and State actions (shown in the adjusted BAU forecast) would alone enable Vacaville to exceed its GHG

reduction target by 942 $MTCO_2e$, even without any local actions. **The communitywide measures discussed in this chapter would further reduce GHG emissions, and, in combination with the federal and State actions, would achieve the reduction target and surpass it by 64,414 $MTCO_2e$.**

By achieving even more reductions than the minimal necessary to meet its target, the City has some flexibility to allow for differences in the actual GHG emission reductions compared to the modeled reductions, while still meeting the target. In addition, adopting communitywide measures that exceed Vacaville's GHG emission reduction target demonstrates the City's commitment and responsiveness to the need to mitigate GHG emissions.

A summary of the reductions by sector is provided in Table 5-1. The technical documentation for the measure modeling is provided in Appendix C.

The communitywide measures discussed in this chapter are the backbone of this Energy and Conservation Action Strategy. The GHG emission reductions achieved by these measures will help to mitigate the GHG emissions generated by activities allowed by the City's General Plan, enabling the City to comply with State law and responding to community members who support energy and conservation planning. Adopting this strategy will position the City to be eligible for State and regional grants. Future development that is consistent with this Strategy will benefit from a streamlined CEQA process because it will not be required to do a costly and time-consuming project-specific GHG emissions analysis.

UNDERSTANDING NON-QUANTIFIED MEASURES

In the sections below, many communitywide measures are reported to have no measureable reduction in GHG emissions beyond the other measures that were simulated. However, these "non-quantified measures" could still reduce VMT or GHG emissions. A measure may not be quantified for a variety of reasons.

- The measure is simply not quantifiable because there are too many unknown variables affecting implementation, such as when the program will be established, how many people will use the program, or the range of projects that will qualify for the program. An example of this type of measure is measure EC-7, Financing for Energy Efficiency and Renewable Energy.

TABLE 5-1 **COMMUNITYWIDE GHG EMISSION AND VMT REDUCTIONS**

Sector	VMT Reduction	Total GHG Reduction in 2020 ($MTCO_2e$)	Percent of Total Reduction[a]
Transportation and Land Use[b]			
LU-1 Emphasis on Pedestrian Entrances	28		<1%
LU-2 Pedestrian or Bicycle Connections	1,037		1%
LU-3 Traditional Development Patterns	40		<1%
LU-4 Pedestrian Access	24		<1%
TR-1 Bikeway Plan	68		<1%
TR-2 Bike Parking in Commercial Development and Park-and-Ride Lots	1,707		2%
TR-3 Shared Parking and Infill Parking Reductions	21,000		26%
TR-4 Voluntary Trip Reduction Program	23,184		29%
TR-5 Commute Reduction Strategies	12,886		16%
TR-6 School Trip Reduction	13,643		17%
TR-7 Shuttle Service for Major Employment Centers	417		1%
TR-8 Parking Cash-Out	1,171		1%
TR-9 Transit Network Expansions	5,059		6%
Total	*80,264*	*53,682*	*85%*
Green Building	No measurable reductions		
Renewable Energy and Low Carbon Fuels			
RE-1 Renewable Energy Generation in Projects		20	<1%
Total		*20*	*<1%*
Energy Conservation			
EC-1 Energy-Efficient Appliances and Lighting		10	<1%
EC-2 Promotion of Energy Conservation		70	<1%

TABLE 5-1 **COMMUNITYWIDE GHG EMISSION AND VMT REDUCTIONS**

Sector	VMT Reduction	Total GHG Reduction in 2020 ($MTCO_2e$)	Percent of Total Reduction[a]
EC-3 Heat Gain Reduction		220	<1%
EC-4 Energy-Efficient Street Lights		250	<1%
Total		*550*	*1%*
Water and Wastewater			
WW-1 Water Conservation		1,450	2%
Total		*1,450*	*2%*
Solid Waste			
SW-1 Waste Reduction		7,770	12%
Total		*7,770*	*12%*
Parks, Open Space, and Agriculture	No measurable reductions		
Purchasing	No measurable reductions		
Community Action	No measurable reductions		
All Sectors Total		**63,472**	

[a] For each measure, the percent of the total GHG emissions reductions for that sector is provided. For each sector, the percent of the total GHG emissions reductions for the entire Energy and Conservation Action Strategy is provided.
[b] For transportation and land use measures, percent reductions correspond to VMT reductions rather than GHG reductions.
Source: Kittelson & Associates, LSA Associates, and The Planning Center | DC&E, 2013.

- The measure would result in no measureable benefit or the benefit is too small to be accurately simulated by modeling software. For example, measure OS-4 directs the City to support the Vacaville Farmers' Market, which supports the consumption of locally-grown food, thereby reducing GHGs related to the transportation of food. However, because food transportation-related GHG emissions make up a relatively small portion of the total GHG emissions generated by a typical person, and because this measure is strictly voluntary, the GHG emissions reduced by it are too small to be modeled.

- Another quantified measure achieves a similar purpose. For example, measure RE-1 requires that new large non-residential development incorporate on-site renewable energy generation, and there is a quantified GHG reduction associated with that measure. Measure RE-5 requires that new buildings be constructed for the easy, cost-effective installation of future solar energy systems, but this alone would not increase the GHG emissions reductions above what would result from measure RE-1, so no additional benefit is reported.

Although measures may not have a quantifiable reduction, they are still an important component to this Energy and Conservation Action Strategy because they support other measures and demonstrate the City's commitment to take action to increase energy independence, save money, and reflect Vacaville's citizens' values of environmental stewardship. In addition, for some of the non-quantified measures, data and modeling techniques may be available in the future that will allow the measure to be modeled for monitoring activities and for future plans.

TRANSPORTATION AND LAND USE

As shown in Table 5-1, the transportation and land use measures would decrease GHG emissions in Vacaville by a total of 53,682 $MTCO_2e$. A summary of the VMT reductions and implementation items for each transportation and land use measure is provided in Table 5-2. Because the transportation and land use measures are interrelated and support one another, it is not possible to calculate an independent GHG reduction value for a single individual measure. Therefore, this analysis presents only the total combined GHG reduction value for all of the measures in the transportation and land use sector. However, it is possible to estimate the vehicle miles traveled (VMT) that each measure would achieve, which gives a sense of approximate contribution of each measure to the total GHG reduction value for this sector.

In addition, because the individual GHG reductions from any one measure remain uncertain, there are many measures for which a cost-effectiveness determination is not possible. Nevertheless, the section below discusses the potential costs and savings of all transportation and land use measures, and, if possible, this information is used to determine cost effectiveness.

BENEFITS OF THESE MEASURES

Beyond reducing GHG emissions and VMT, the transportation and land use measures in the Energy and Conservation Action Strategy would yield other sustainability benefits. Offering people options besides riding alone in their cars will help reduce traffic congestion; improve mobility for seniors, who will be an increasing part of the population in the coming decades; improve air quality, which negatively affects children; enhance public health as more residents walk or bike; and reduce wear and tear on city streets. Additionally, by promoting more compact development, these measures would limit the loss of natural and farmland areas, preserving the hillside views, wildlife habitat, and local agriculture that form an important part of Vacaville's character and heritage.

In addition, the transportation and land use measures support the General Plan policies and actions that help the City to comply with the California Complete Streets Act (AB 1358), which directs the City plan for a balanced and multimodal transportation network that meets the needs of all transportation users, including bicyclists, children, persons with disabilities, motorists, pedestrians, users of public transportation, and seniors.

TABLE 5-2 **TRANSPORTATION AND LAND USE MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
TRANSPORTATION & LAND USE							
Because the transportation and land use measures are interrelated and support one another, an independent GHG reduction value cannot be calculated for a single individual measure. However, the approximate contribution of each measure to the total GHG reduction value for this sector can be estimated based on the reduction in VMT that was projected for each measure.		**53,682 GHG** **80,264 VMT**		**85%**			
LU-1	Encourage all new residential, commercial, and public buildings and places of assembly to include a principal functional entry that faces a public space such as a street, square, park, paseo, or plaza, in addition to any entrance from a parking lot. For other, less public buildings such as warehouses, manufacturing, and storage buildings, encourage entries to ancillary office, break room, or staff uses to face a public space.	28 VMT	<1%		Moderate to High	City/Development	2014–2015
LU-2	Require new residential projects to include a pedestrian or bicycle through-connection in any new cul-de-sacs, unless prohibited by topographical conditions or other site-specific constraints.	1,037 VMT	1%		High	City/Development	2014–2015
LU-3	Require that new neighborhoods be based on traditional residential development patterns (i.e. interconnected streets or a grid pattern) in a variety of densities with a pedestrian-friendly network of streets and parks, unless prohibited by topographical conditions or other site-specific constraints.	40 VMT	<1%		Moderate to High	City/Development	2015–2020
LU-4	Require adequate pedestrian access to or through all new commercial, residential, and mixed-used development. New pedestrian infrastructure shall incorporate amenities such as street trees to shade sidewalks, lighting, benches, signage, and pedestrian signalization at major transportation points to increase pedestrian convenience, comfort, and safety.	24 VMT	<1%		High	City/Development	2015–2020
LU-5	Encourage a variety of local-serving commercial uses and encourage mixed-use development in the Downtown and RUHD Overlay areas, reducing VMT.	--			High	City/Development	2014–2015
LU-6	During Design Review, encourage street and house orientation in new neighborhoods and roof types that maximize the south-facing exposure of new homes, unless prohibited by topographical conditions or other site-specific constraints.	--			High	City/Development	2015–2020
LU-7	Continue to promote the development of employment-generating uses.	--			High	City	Ongoing
LU-8	Discourage density reductions on infill sites within ¼-mile of retail and employment centers and transit routes.	--			High	City/Development	2014–2015
LU-9	Require development on infill sites within ¼-mile of retail and employment centers, transit routes, and recreation areas to provide pedestrian and bicycle connections to those destinations.	--			Moderate to High	City/Development	2014–2015
LU-10	As part of each Housing Element Update, continue to study the skills and education levels of Vacaville residents and the housing choices of Vacaville employees, and use the information as a guide for recruiting new firms and housing types to the city to reduce vehicle miles traveled (VMT).	--			Unknown	City	Ongoing
TR-1	Develop and implement a Bikeway Plan that provides connections to the existing bikeway network and improves access to schools, Downtown, and large employment sites in the northeast quadrant of the city, and include strategies to support bicycle use.	68 VMT	<1%		High	City	2014–2015
TR-2	Continue to require bike parking in new commercial developments and at park-and-ride lots. Long-term parking and areas that are protected from the elements should be provided at park-and-ride lots and for employees in commercial areas. Short-term parking, such as U-racks, should be provided for visitors in commercial areas in close proximity to store entrances.	1,707 VMT	2%		Unknown	City/Development	Ongoing

TABLE 5-2 **TRANSPORTATION AND LAND USE MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
TR-3	Revisit off-street parking ordinances to encourage shared parking and parking maximums. Reduce required parking as an incentive for infill development and the installation of bikeways and bicycle parking.	21,000 VMT	26%		High	City/Development	2014–2015
TR-4	Implement a voluntary employer-based trip reduction program for all existing and future employers. The program could include a resource page on the City's website for trip reduction information, a direct link to the Solano-Napa Commuter Information Program website, and promotional events. The City could also encourage employers, including State and County government employers in Vacaville (e.g. the California Medical Facility) to implement ride-sharing programs, such as a carpooling matching service and preferred parking for vanpools and carpools.	23,184 VMT	29%		High	City/Employers	2014–2015
TR-5	Encourage employers to allow telework (where employees work from home or other satellite locations close to home), institute flexible work schedules, and provide employer-sponsored vanpools.	12,886 VMT	16%		High	City/Employers/ Development	2014–2015
TR-6	Continue to support school districts and the Solano Transportation Authority in encouraging participation in *Schoolpools*, a ridesharing program for school children, and/or work with a private entity to establish a transportation service for children to schools, households, and other activities.	13,643 VMT	17%		High	City/Private Entity	Ongoing
TR-7	Encourage new, large employers, defined as having a minimum of 100 employees, to provide employer-sponsored shuttles or vanpools (operated by employees) that provide direct service between major employment centers and the Vacaville Transportation Center.	417 VMT	1%		Unknown	City/Employers/ Development	2015–2020
TR-8	Encourage new employers to offer employee parking cash-out. Parking cash out allows workers to receive a regular payment when they consistently forgo the use of a parking spot their vehicle would otherwise occupy.	1,171 VMT	1%		High	City/Employers/ Development	2014–2015
TR-9	Expand the transit network as demand warrants, funding allows, and State farebox recovery is achieved to include service to large employers and park-and-ride lots, and ensure that information about transit connections is added to the City Coach and City of Vacaville's websites.	5,059 VMT	6%		Unknown	City	2014–2015
TR-10	Develop a pedestrian plan and implement network improvements, especially where needed to fill in gaps in the existing network. Include baseline data with goals to increase the percent of walking for transportation purposes.	--			Moderate	City	2014–2015
TR-11	Require the provision of secure bike parking, protected from the elements, for multi-unit residential developments that lack individual garages.	--			Unknown	City/Development	2015–2020
TR-12	Require developments requiring specific plans to provide land for multi-use trails that connect to existing or future bikeways, according to the adopted bikeway plan.	--			Unknown	City/Development	2014–2015
TR-13	Encourage employers to provide end-of-trip facilities for bicyclists, such as secure parking and locker, shower, and changing room facilities.	--			Unknown	City/Development	2014–2015
TR-14	Support existing programs that provide incentives for developers and private business to install electric charging vehicle stations in residential and commercial developments.	--			Unknown	City	2014–2015
TR-15	Continue to install electric vehicle charging stations in high traffic areas. As charging stations are installed, continue to update the City's map of electric vehicle charging stations on its website and provide information to the Solano Transportation Authority for their public outreach.	--			Unknown	City/STA	Ongoing
TR-16	Continue to use solar panels to power or supplement electric vehicle charging stations where geographically possible, demand warrants, and funding allows.	--			High	City	Ongoing
TR-17	As new development occurs or parking lots are re-striped, evaluate the demand for designated preferred parking spaces for low-carbon, electric, and carpool vehicles in City-owned lots and Downtown.	--			High	City	2014–2015

TABLE 5-2 **TRANSPORTATION AND LAND USE MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
TR-18	Continue to coordinate with STA on TDM planning, TDM activities, TDM requirements, and education and outreach programs through the Solano Napa Commuter Information (SNCI) website.	--			High	City/STA	Ongoing
TR-19	Provide a prominent link on the City's website to the Solano Transportation Authority's (STA) Commuter Info website, and work with STA to provide up-to-date commute information in Vacaville.	--			High	City/STA	2014–2015
TR-20	Support efforts by the school districts to improve transit options for students, which could include reinstatement of school busing or working with the Solano Transportation Authority to provide free or subsidized bus passes to students in Vacaville.	--			Unknown	City/School Districts/STA	2014–2015
TR-21	Continue to market, promote, and educate students and parents about the benefits of using public transit as a mode of travel to school, considering the comments and concerns of the Vacaville and Travis School Districts.	--			Unknown	City/School Districts	Ongoing
TR-22	Coordinate with local schools and the school district to improve walking and biking access to school by providing input and staff support for Safe Routes To School grant applications and implementation of projects.				High	City/School Districts	2014–2015
TR-23	Encourage the State of California to reinstate school busing.				High	City/State/ School Districts	2014–2015
TR-24	Implement improvements to transit stops, such as real-time transit information and shelters, where demand warrants and funding allows, and access for passengers arriving by foot, and require transit stop improvements as conditions of approval for nearby development as appropriate.	--			Unknown	City/Development	2014–2015
TR-25	Continue to implement strategies to improve signalization, incident responsiveness, traveler information systems (such as wayfinding and real-time traveler information), and active traffic management to smooth traffic flow as budget and staff levels allow.	--			Unknown	City	Ongoing
TR-26	Continue to include pedestrian, bicycle and transit facilities in projects funded by Vacaville's transportation impact fee program, and consider including specific improvements to pedestrian, bicyclist and transit facilities as part of the Transportation Impact Fee updates if a nexus between those improvements and new development can be demonstrated.	--			Unknown	City	2014–2015
TR-27	Require electric loading docks for large developments with 100 or more employees that receive deliveries by refrigerated trucks.	--			Unknown	City/Development	2014–2015

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QUANTIFIED LAND USE MEASURES

LU-1 EMPHASIS ON PEDESTRIAN ENTRANCES

Encourage all new residential, commercial, and public buildings and places of assembly to include a principal functional entry that faces a public space such as a street, square, park, paseo, or plaza, in addition to any entrance from a parking lot. For other, less public buildings such as warehouses, manufacturing, and storage buildings, encourage entries to ancillary office, break room, or staff uses to face a public space.

VMT REDUCTION: Approximately 28 miles per year

PERCENT OF TOTAL VMT REDUCTIONS: Less than 1 percent

REDUCES VMT BY:

- Increasing convenient access for pedestrians and cyclists.
- Encouraging alternative forms of transportation by placing the entrances near sidewalks.
- Reducing automobile use and associated fossil-fuel consumption.

VMT REDUCTION ASSUMES:

- A 0.5 percent reduction in vehicle use for trips generated by new development for trip distances of 0.5 miles or less.

COST EFFECTIVENESS: MODERATE TO HIGH

City costs would stem from staff time needed to draft, adopt, and implement policies supporting this measure. Developers/property owners would incorporate pedestrian-serving entrances during design phase. Possible cost savings from reduced parking needs or from increased commercial district vitality. Any increased costs to property owner would be minimal and voluntary.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Amend Land Use & Development Code and Residential Design Guidelines to encourage these entries in new buildings.
- Review architectural plans for consistency with measure LU-1.

Developers/Property Owners:

- Design and construct new buildings to have these entries.

IMPLEMENTATION SCHEDULE: 2014–2015

LU-2 Pedestrian or Bicycle Connections

Require new residential projects to include a pedestrian or bicycle through-connection in any new cul-de-sacs, unless prohibited by topographical conditions or other site-specific constraints.

VMT Reduction: Approximately 1,037 miles per year

Percent of Total VMT Reductions: 1 percent

Reduces VMT By:

- Increasing convenience, comfort and safety, and use of walking and bicycling.
- Decreasing conflicts between pedestrians and bicyclists, and other vehicles.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 0.625 percent reduction in vehicle use for trips generated by new residential development for trip distances of 5 miles or less.

Cost Effectiveness: High

City costs would stem from staff time needed to draft, adopt, and implement ordinances to enact measure requirements. Costs to developers would be low because these connections can be incorporated in the design phase of the project.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend Land Use and Development Code and Residential Design Guidelines to include this requirement.
- Review architectural plans and environmental documents for consistency with measure LU-2.

Developers/Property owners:

- Design projects to include bike and pedestrian connections through cul-de-sacs.

Implementation Schedule: 2014–2015

LU-3 TRADITIONAL DEVELOPMENT PATTERNS

Require that new neighborhoods be based on traditional residential development patterns (i.e. interconnected streets or a grid pattern) in a variety of densities with a pedestrian-friendly network of streets and parks, unless prohibited by topographical conditions or other site-specific constraints.

VMT REDUCTION: Approximately 40 miles per year

PERCENT OF TOTAL VMT REDUCTIONS: Less than 1 percent

REDUCES VMT BY:

- Increasing convenience, comfort and safety, and use of walking and bicycling.
- Reducing conflicts between pedestrians and bicyclists, and other vehicles.
- Making neighborhoods more easily navigable for all users.
- Reducing automobile use and associated fossil fuel consumption.

VMT REDUCTION ASSUMES:

- A 12.0 percent reduction in vehicle use for trips generated by new development for trip distances of 0.5 miles or less.

COST EFFECTIVENESS: MODERATE TO HIGH

City costs would stem from staff time needed to draft, adopt, and implement ordinances, design guidelines, and land-use regulations to support measure requirements. When incorporated at the design phase there should be no cost to developers to design traditional residential development patterns at new sites. Possible cost savings for drivers by from increasing the convenience of walking or biking and improving accessibility to transit.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Amend Land Use and Development Code to require traditional residential development patterns in new subdivisions.
- Review architectural plans and environmental documents for consistency with measure LU-3.

Developers/Property owners:

- Incorporate traditional residential development patterns in the design of new development.

IMPLEMENTATION SCHEDULE: 2015–2020

LU-4 Pedestrian Access

Require adequate pedestrian access to or through all new commercial, residential, and mixed-used development. New pedestrian infrastructure shall incorporate amenities such as street trees to shade sidewalks, lighting, benches, signage, and pedestrian signalization at major transportation points to increase pedestrian convenience, comfort, and safety.

VMT Reduction: Approximately 24 miles per year

Percent of Total VMT Reductions: Less than 1 percent

Reduces VMT By:

- Increasing convenience, comfort and safety, and use of walking and bicycling.
- Decreasing conflicts between pedestrians and bicyclists, and other vehicles.
- Making neighborhoods more easily navigable.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 2.0 percent reduction in vehicle use for trips generated by new development for trip distances of 5 miles or less.

Cost Effectiveness: High

City costs would stem from staff time needed to draft, adopt, and implement ordinances to enact measure requirements. When space for pedestrian access is planned during the design phase, increases to development costs would be negligible.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend Land Use and Development Code and Residential Design Guidelines.
- Review architectural plans and environmental documents for consistency with measure LU-4.

Developers/Property owners:

- Incorporate space for pedestrian access in the design of new development.

Implementation Schedule: 2015–2020

NON-QUANTIFIED LAND USE MEASURES

The following measures (LU-5 through LU-10) would not result in a measureable reduction in GHG emissions in Vacaville beyond the reductions already achieved by measures LU-1 through LU-4. Therefore, the matrix does not show a quantified percent of total VMT reductions for the non-quantified measures, and it does not list any assumptions. However, these measures do play an important role in supporting measures LU-1 through LU-4 and helping to reach the City's overall goal of reducing GHG emissions in Vacaville.

LU-5 LOCAL-SERVING AND MIXED USES IN DOWNTOWN

Encourage a variety of local-serving commercial uses and encourage mixed-use development in the Downtown and RUHD Overlay areas, reducing VMT.

VMT REDUCTION: Measure LU-5 would not result in direct VMT reductions; however, this measure supports measures LU-1 through LU-4.

REDUCES GHG BY:

- Increasing convenience of walking and bicycling in downtown and immediately surrounding areas.
- Promoting the use of alternative transportation.
- Reducing automobile use and associated fossil-fuel consumption.

COST EFFECTIVENESS: HIGH

City costs would stem from staff time needed to draft and adopt approaches to implement measure. Costs associated with increased provision of municipal infrastructure or services would likely be offset by increased property and sales tax receipts and/or covered by developers. Possible cost savings for City and developers by increasing service efficiency and economies of scale for new services, and increases in revenue.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Amend Land Use and Development Code to encourage local-serving commercial uses and encourage mixed-use development in the RUHD Overlay.
- Review architectural plans and environmental documents for consistency with measure LU-5.

Developers/Property owners:

- Incorporate local-serving commercial uses and mixed-use development when proposing development in the RUHD Overlay.

IMPLEMENTATION SCHEDULE: 2014–2015

LU-6 Solar Street and Roof Orientation

During Design Review, encourage street and house orientation in new neighborhoods and roof types that maximize the south-facing exposure of new homes, unless prohibited by topographical conditions or other site-specific constraints.

VMT Reduction: Measure LU-6 would not result in direct VMT reductions; however, this measure supports measures GB-2, RE-1, RE-2, RE-3, and RE-5.

Reduces GHG By:

- Supporting alternatives to non-renewable energy sources.
- Supporting the use of natural lighting and heat.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: High

City costs would stem from staff time needed to draft and adopt implementing language. Cost savings would result from increasing solar power generation. Any costs to developers would be voluntary and minimal.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend Land Use and Development Code to encourage appropriate street and house orientation for south-facing roof exposure in new residential subdivisions as part of the project design review.

Developers/Property owners:

- Design and construct projects to maximize the south-facing exposure of rooftops.

Implementation Schedule: 2015–2020

LU-7 EMPLOYMENT-GENERATING USES

Continue to promote the development of employment-generating uses.

VMT REDUCTION: Measure LU-7 would not result in direct VMT reductions; however, this measure supports measures LU-1 through LU-4.

REDUCES GHG BY:

- Bringing additional jobs into Vacaville.
- Reducing the number of Vacaville residents that commute long distances to work.
- Reducing automobile use and associated fossil-fuel consumption.

COST EFFECTIVENESS: HIGH

City costs would stem from staff time needed to continue the application of compatible existing City policies, and consideration for this measure's principles in preparing future City policies. Possible increased revenue would result from increased sales taxes from new businesses and the economic activity generated by the presence of additional employers.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department and City Manager's Office staff:

- Continue conducting outreach and marketing to bring employment-generating uses to Vacaville.

IMPLEMENTATION SCHEDULE: Ongoing

LU-8 Minimum Densities on Infill Sites

Discourage density reductions on infill sites within ¼-mile of retail and employment centers and transit routes.

VMT Reduction: Measure LU-8 would not result in direct VMT reductions; however, this measure supports measures LU-1 through LU-4.

Reduces GHG By:

- Placing high density development near employment and retail centers and transit routes, which allows residents to walk or take transit to work or shopping, and/or reduces the number of miles they have to drive.
- Reducing automobile use and associated fossil-fuel consumption

Cost Effectiveness: High

Possible cost savings associated with increased provision of municipal infrastructure or services. Reduced costs for City and developers by allowing increased overall efficiency of serving these properties and encouraging economies of scale for new services and infrastructure.

Action Items and Responsible Parties:

Community Development Department staff:

- Review architectural plans and environmental documents for consistency with measure LU-8.

Developers/Property owners:

- Incorporate minimum density requirements into design of new residential and mixed-use development when located within ¼-mile of retail and employment centers and transit routes.

Implementation Schedule: 2014–2015

LU-9 Pedestrian and Bicycle Connections for Infill Development

Require development on infill sites within ¼-mile of retail and employment centers, transit routes, and recreation areas to provide pedestrian and bicycle connections to those destinations.

VMT Reduction: Measure LU-9 would not result in direct VMT reductions; however, this measure supports measures LU-1 through LU-4.

Reduces GHG By:

- Placing high density development near employment and retail centers and transit routes, which allows residents to walk or take transit to work or shopping, and/or reduces the number of miles they have to drive.
- Increasing convenience, comfort, safety, and use of walking and bicycling.
- Increasing transit ridership.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Moderate to High

City costs would stem from staff time needed to draft and adopt development code design requirements consistent with the measure. Developer costs would be minimal when bicycle and pedestrian connections are planned and incorporated at the design phase.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure LU-9.
- Review architectural plans and environmental documents for consistency with measure LU-9

Developers/Property owners:

- Design and construct pedestrian and bicycle connections to retail and employment centers, transit routes, and recreation areas for new residential and mixed-use development when located within ¼-mile of these areas.

Implementation Schedule: 2014–2015

LU-10 Education and Housing Studies

As part of each Housing Element Update, continue to study the skills and education levels of Vacaville residents and the housing choices of Vacaville employees, and use the information as a guide for recruiting new firms and housing types to the city to reduce vehicle miles traveled (VMT).

VMT Reduction: It would be speculative to estimate a specific VMT reduction from this measure, but it supports measure LU-7 and other economic development strategies the City is pursuing.

Reduces GHG By:

- Increasing employment opportunities convenient to housing.
- Reducing overall automobile use and associated fossil-fuel consumption.
- Decreasing trip distance.
- Shortening trips to increase convenience for pedestrians, bicyclists and transit riders.

Cost Effectiveness: Unknown

Costs from staff time needed to oversee surveys of education and skills. Possible cost savings in the future from applying this information to guide planning decisions.

Action Items and Responsible Parties:

Community Development Department staff:

- Conduct education and housing studies as part of each Housing Element Update.
- Conduct marketing and outreach to recruit the desired employment and housing types to Vacaville.

Implementation Schedule: Ongoing

QUANTIFIED TRANSPORTATION MEASURES

TR-1 BIKEWAY PLAN

Develop and implement a Bikeway Plan that provides connections to the existing bikeway network and improves access to schools, Downtown, and large employment sites in the northeast quadrant of the city, and include strategies to support bicycle use.

VMT REDUCTION: Approximately 68 miles per year

PERCENT OF TOTAL VMT REDUCTIONS: Less than 1 percent

REDUCES VMT BY:

- Increasing bicycling as a viable mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

VMT REDUCTION ASSUMES:

- A 0.1 percent reduction in vehicle use for trips of 5.0 miles or less.

COST EFFECTIVENESS: HIGH

Staff time would be needed to draft, adopt, and implement the plan, as well as any consultant costs to prepare the plan. The City and/or developers would incur costs associated with construction and maintenance expenses to implement the plan. Costs related to additional infrastructure such as bike signals, crossings, loop detectors, etc. would depend on the number and type of facilities installed. Costs could range from as high as $550,000 per mile for separated Class I bicycle trails, to $2,500 per mile for shared-lane Class III bike routes. Because bicycle routes are an important component of plans to reduce commute- and school-related trips, this measure supports the significant VMT reductions associated with measures TR-4, TR-5, and TR-6, and is therefore considered highly cost effective.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development and Public Works Department staff:

- Develop and implement a bikeway plan that meets the guidelines established in the measure.

IMPLEMENTATION SCHEDULE: 2014–2015

TR-2 Bike Parking in Commercial Development and Park-and-Ride Lots

Continue to require bike parking in new commercial developments and at park-and-ride lots. Long-term parking and areas that are protected from the elements should be provided at park-and-ride lots and for employees in commercial areas. Short-term parking, such as U-racks, should be provided for visitors in commercial areas in close proximity to store entrances.

VMT Reduction: Approximately 1,707 miles per year

Percent of Total VMT Reductions: 2 percent

Reduces VMT By:

- Increasing bicycling as a viable mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 0.625 percent reduction in vehicle use for trips of 5.0 miles or less.

Cost Effectiveness: Unknown

Staff time would be needed to amend the Land Use and Development Code to incorporate these requirements. The City and property owners would fund the installation and maintenance of bicycle parking in new development. The costs of bicycle parking vary greatly depending on the number and type of installations, from $50 to $200 per space for a conventional bike rack up to $950 to $2500 for secure bicycle lockers.[1] Costs to business owners would decrease if bicycle parking is used in lieu of car parking. Improved health and productivity of residents and employees could yield indirect cost savings.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Amend the Land Use and Development Code to include the bicycle parking requirements in measure TR-2, including long-term parking facilities for employees in commercial areas.
- Work with Caltrans to ensure that bike parking is available at park and ride lots in Vacaville.
- Review project plans and environmental documents for consistency with measure TR-2.

Developers/Property owners:

- Design and construct short-term and long-term bike parking areas for new commercial developments and at park-and-ride lots.

Implementation Schedule: Ongoing

[1] Benjamin, Matthew T., 2003, *Bicycle Parking: A Plan for the Los Angeles County Metropolitan Transportation Authority*.

TR-3 Shared Parking and Infill Parking Reductions

Revisit off-street parking ordinances to encourage shared parking and parking maximums. Reduce required parking as an incentive for infill development and the installation of bikeways and bicycle parking.

VMT Reduction: Approximately 21,000 miles per year

Percent of Total VMT Reductions: 26 percent

Reduces VMT By:

- Reducing incentives to drive by reducing parking options.
- Increasing efficient land use by using less land for parking.
- Increasing bicycling and other forms of alternative transportation as viable mobility choices.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 9.0 percent reduction in vehicle trips associated with new development.

Cost Effectiveness: High

Developers and landowners could save substantial money by increasing the amount of property that can be developed and reducing the amount of land that must be bought to provide parking. Potential indirect costs could result from increased demand for on-street parking, in the event that developments do not provide sufficient private parking to meet the needs of their users. Indirect cost savings would result from reduced traffic congestion and air pollution as VMT decreases. City costs would stem from staff time costs for the drafting and adoption of changes to development and parking standards.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Amend the parking requirements of the Land Use and Development Code to include measure TR-3.
- Review architectural plans and environmental documents for consistency with measure TR-3.

Developers/Property owners:

- Design and construct shared-parking features and apply parking standards for new development projects that are consistent with measure TR-3.

Implementation Schedule: 2014–2015

TR-4 Voluntary Trip Reduction Program

Implement a voluntary employer-based trip reduction program for all existing and future employers. The program could include a resource page on the City's website for trip reduction information, a direct link to the Solano-Napa Commuter Information Program website, and promotional events. The City could also encourage employers, including State and County government employers in Vacaville (e.g. the California Medical Facility) to implement ride-sharing programs, such as a carpooling matching service and preferred parking for vanpools and carpools.

VMT Reduction: Approximately 23,184 miles per year

Percent of Total VMT Reductions: 29 percent

Reduces VMT By:

- Increasing opportunities for employees to reduce their driving through transit use, bicycling, carpooling, vanpooling, and/or telecommuting.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 5.2 percent reduction in vehicle use for work commute trips for all employment sites.

Cost Effectiveness: High

Costs from staff time needed to collect information and to conduct outreach and provide informational materials to businesses. See the cost effectiveness analysis for measure TR-5 for a detailed discussion of the possible costs and benefits of trip reduction programs. Any costs to employers would be voluntary.

Action Items and Responsible Parties:

Public Works Department staff:

- Conduct outreach and provide informational materials to existing and future employers.

Employers:

- Develop and offer trip reduction programs.

Implementation Schedule: 2014–2015

TR-5 Commute Reduction Strategies

Encourage employers to allow telework (where employees work from home or other satellite locations close to home), institute flexible work schedules, and provide employer-sponsored vanpools.

VMT Reduction: Approximately 12,886 miles per year

Percent of Total VMT Reductions: 16 percent

Reduces VMT By:

- Allowing employees to reduce driving.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 2.8 percent reduction in work commute trips.

Cost Effectiveness: High

City costs would stem from staff time needed to craft and adopt city policies to encourage implementation of telecommuting and outreach to employers. The City could benefit from indirect long-term costs savings from decreased traffic congestion and air pollution. Vacaville employers would incur costs from implementing and administering telecommute programs, such as acquiring the technology and personnel needed to administer a telecommuting system. However, reduced need for parking spaces and office space could more than offset these costs, and employers could benefit from improved worker productivity and morale. Employees would save money on car maintenance and gas.

Action Items and Responsible Parties:

Public Works Department Staff:

- Contact employers to encourage commute reduction strategies.

Employers:

- Develop and offer commute reduction strategies.

Developers/Property owners:

- Include telework, flexible work schedules, and provide employer-sponsored vanpools as part of development application and implement upon project completion.

Implementation Schedule: 2014–2015

TR-6 School Trip Reduction

Continue to support school districts and the Solano Transportation Authority in encouraging participation in *Schoolpools*, a ridesharing program for school children, and/or work with a private entity to establish a transportation service for children to schools, households, and other activities.

VMT Reduction: Approximately 13,643 miles per year

Percent of Total VMT Reductions: 17 percent

Reduces VMT By:

- Increasing viable transportation opportunities for school-age children to get to and from school.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- An 11.5 percent reduction in vehicle use for school trips.

Cost Effectiveness: High

Costs from staff time needed to coordinate with school districts, as well as STA and/or a private entity to promote *Schoolpool* programs. Residents will save money by decreasing the need to transport their children to and from school, thereby saving time, fuel, and other vehicle-related costs. The City could benefit from indirect long-term cost savings by reducing traffic congestion and air pollution.

Action Items and Responsible Parties:

Public Works Department staff, School Districts, and STA:

- Continue to support the *Schoolpool* program

Parents and caregivers:

- Continue to participate in the *Schoolpool* program.

Implementation Schedule: Ongoing

TR-7 Shuttle Service for Major Employment Centers

Encourage new, large employers, defined as having a minimum of 100 employees, to provide employer-sponsored shuttles or vanpools (operated by employees) that provide direct service between major employment centers and the Vacaville Transportation Center.

VMT Reduction: Approximately 417miles per year

Percent of Total VMT Reductions: 1 percent

Reduces VMT By:

- Allowing employees to reduce driving by taking shuttles to the Vacaville Transportation Center.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 1.7 percent reduction in vehicle use for work trips generated by new development with 100 or more employees.

Cost Effectiveness: Unknown

The City would incur costs from staff time needed to craft and adopt City ordinances to implement the measure, but could potentially benefit from indirect long-term savings from decreased congestion and air pollution. New Vacaville employers that participate would incur costs from the initiation and ongoing operation of shuttle/vanpool services. Costs for such transport vary considerably depending on vehicle types, frequency, and other factors. If employers are able to decrease their overall parking needs through these programs, and can thus provide fewer parking spaces, cost savings have the potential to more than offset program costs. Employees would save money on car maintenance and gas.

Action Items and Responsible Parties:

Community Development Department and Public Works Department staff:

- Amend the Land Use and Development Code to encourage measure TR-7.
- Review proposed development applications for consistency with measure TR-7.

Large employers:

- Provide shuttle service to Vacaville Transit Center.

Developers/Property owners:

- Include employer-sponsored vanpools or shuttles that provide direct service between major employment centers and the Vacaville Transportation Center as part of development application and implement upon project completion.

Implementation Schedule: 2015–2020

TR-8 Parking Cash-Out

Encourage new employers to offer employee parking cash-out. Parking cash out allows workers to receive a regular payment when they consistently forgo the use of a parking spot their vehicle would otherwise occupy.

VMT Reduction: Approximately 1,171 miles per year

Percent of Total VMT Reductions: 1 percent

Reduces VMT By:

- Providing incentives for employees to use alternative modes of transportation.
- Reducing construction of parking spaces.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 0.75 percent reduction in vehicle use for work trips.

Cost Effectiveness: High

The City would incur costs from staff time needed to craft and adopt city ordinances to implement measure TR-8, but would possibly realize indirect long-term savings from decreased congestion and air pollution. Vacaville employers would incur ongoing costs from parking cash-out programs, which could be offset by decreased costs to provide parking. Employees would save money on car maintenance and gas.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to encourage measure TR-8.
- Review proposed development applications and for consistency with measure TR-8.

Large employers:

- Offer parking cash-out programs.

Developers/Property owners:

- Design and implement employee parking cash-out program.

Implementation Schedule: 2014–2015

TR-9 Transit Network Expansions

Expand the transit network as demand warrants, funding allows, and State farebox recovery is achieved to include service to large employers and park-and-ride lots, and ensure that information about transit connections is added to the City Coach and City of Vacaville's websites.

VMT Reduction: Approximately 5,059 miles per year

Percent of Total VMT Reductions: 6 percent

Reduces VMT By:

- Increasing convenience of public transit and encouraging public transit use.
- Reducing automobile use and associated fossil-fuel consumption.

VMT Reduction Assumes:

- A 0.6 percent reduction in vehicle trips.

Cost Effectiveness: Unknown

The City would incur costs to pay for new transit vehicles, stops, and operators. However, total costs to the City will depend on the specific future expansions and the amount of future funding available from State and federal sources. Residents and businesses could experience indirect savings from decreased parking, fuel, and other vehicle-related costs.

Action Items and Responsible Parties:

Public Works Department staff:

- Monitor transit demands, funding, and State farebox recovery, and expand the transit network as appropriate and where demand warrants and funding allows.
- Maintain the City Coach and City of Vacaville websites to ensure that current transit information is provided.

Implementation Schedule: 2014–2015

NON-QUANTIFIED TRANSPORTATION MEASURES

The following measures (TR-10 through TR-27) would not result in a measureable reduction in GHG emissions in Vacaville beyond measures TR-1 through TR-9. Therefore, the matrix does not show a quantified percent of total VMT reductions for the non-quantified measures, and it does not list any assumptions. However, they support measures TR-1 through TR-9, and are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville. Some measures, such as TR-10, address concerns raised by the community as priorities for the General Plan Update.

TR-10 PEDESTRIAN PLAN AND IMPROVEMENTS

Develop a pedestrian plan and implement network improvements, especially where needed to fill in gaps in the existing network. Include baseline data with goals to increase the percent of walking for transportation purposes.

REDUCES GHG BY:

- Encouraging walking as a viable alternative mode of transportation.
- Increasing convenient trip distance, comfort, and safety for pedestrians.
- Decreasing conflicts between pedestrians and other vehicles.

COST EFFECTIVENESS: MODERATE

Costs from staff time needed to draft, adopt, and implement the pedestrian plan and associated third-party costs to assist the City if needed. The significant improvements to the pedestrian system would make them more viable and useful.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development and Public Works Department staff:

- Develop a pedestrian plan that meets the guidelines established in measure TR-10.
- Implement network improvements, especially where needed to fill in gaps in the existing network.

IMPLEMENTATION SCHEDULE: 2014–2015

TR-11 Bike Parking for Multi-Family Residential Uses

Require the provision of secure bike parking, protected from the elements, for multi-unit residential developments that lack individual garages.

Reduces GHG By:

- Improving and expanding bike parking facilities.
- Encouraging residents to bicycle as a viable mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Staff time to draft and adopt ordinances to implement measure requirements. Costs to residents would be negligible, but developers would bear the costs of providing required bicycle parking. Potential cost-savings for developers if bicycle parking and facilities are used in lieu of or as a direct replacement for automobile parking.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure TR-11.
- Review proposed development applications and environmental documents for consistency with measure TR-11.

Developers/Property owners:

- Design and construct bicycle parking and amenities for new development projects.

Implementation Schedule: 2015–2020

TR-12 Multi-Use Trails in Large Developments

Require developments requiring specific plans to provide land for multi-use trails that connect to existing or future bikeways, according to the adopted bikeway plan.

Reduces GHG By:

- Increasing convenient trip distance, comfort and safety for pedestrians and bicyclists.
- Encouraging walking and bicycling as viable alternative modes of transportation.
- Decreasing conflicts between pedestrians and other vehicles.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Staff time to draft and adopt ordinances to implement measure requirements. Costs to City if and when it extends bicycle infrastructure to such dedicated land. Developers could bear negligible costs indirectly through loss of developable space.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Amend the Land Use and Development Code to include measure TR-12.
- Review proposed development applications and environmental documents for consistency with measure TR-12.

Developers/Property owners:

- Design and construct large developments to include land for multi-use trails that connect to existing or future bikeways, according to the adopted bikeway plan.

Implementation Schedule: 2014–2015

TR-13 End-of-Trip Bike Facilities

Encourage employers to provide end-of-trip facilities for bicyclists, such as secure parking and locker, shower, and changing room facilities.

Reduces GHG By:

- Improving and expanding bike parking facilities.
- Increasing convenience and comfort of bicycling.
- Encouraging residents to bicycle as a viable mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed to draft and adopt ordinances to implement measure. Potential costs to employers and potentially developers for providing bicycle parking and shower facilities. Possible cost savings to developers if bicycle parking and facilities are used in lieu of or as a direct replacement for automobile parking.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure TR-13.
- Review proposed development applications and environmental documents for consistency with measure TR-13.

Developers/Property owners:

- Include end-of-trip facilities for bicyclists as part of development application and implement upon project completion.

Implementation Schedule: 2014–2015

TR-14 Incentives for Electric Vehicle Stations

Support existing programs that provide incentives for developers and private business to install electric charging vehicle stations in residential and commercial developments.

Reduces GHG By:

- Encouraging the use of electric vehicles as a viable mode of transportation.
- Increasing the use of renewable energy by decreasing fossil fuel demand.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed to provide support for incentive programs. Possible cost savings to property owners and developers by decreasing the expenses associated with installation of electric vehicle charging stations.

Action Items and Responsible Parties:

Community Development Department staff:

- Provide support to existing incentive programs, such as providing information and links on the City's website and preparing brochures.

Implementation Schedule: 2014–2015

TR-15 Electric Vehicle Stations in High Traffic Areas

Continue to install electric vehicle charging stations in high traffic areas. As charging stations are installed, continue to update the City's map of electric vehicle charging stations on its website and provide information to the Solano Transportation Authority for their public outreach.

Reduces GHG By:

- Encouraging the use of electric vehicles as a viable mode of transportation.
- Increasing the use of renewable energy by decreasing fossil fuel demand.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs to City from installation of charging stations, and costs from staff time needed to identify high traffic areas and maintain up-to-date information about charging stations.

Action Items and Responsible Parties:

Public Works Department staff:

- Identify high traffic areas and continue to install electric vehicle charging stations in these areas.
- Maintain up-to-date information about charging stations on the City's website and with the Solano Transportation Authority.

Implementation Schedule: Ongoing

TR-16 Solar Power for Electric Vehicle Charging Stations

Continue to use solar panels to power or supplement electric vehicle charging stations where geographically possible, demand warrants, and funding allows.

Reduces GHG By:

- Encouraging the use of electric vehicles as a viable mode of transportation.
- Increasing the use of renewable energy by decreasing fossil fuel demand.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: High

Costs from staff time needed to continue ongoing policies relating to solar panel installation at charging stations. Potential cost and savings to City through the installation of these solar systems; however, solar powers systems typically offset their own costs over a relatively short timeframe.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Continue to use solar panels to power and supplement electric vehicle charging stations.

Implementation Schedule: Ongoing

TR-17 Preferred Parking for Low-Carbon Vehicles

As new development occurs or parking lots are re-striped, evaluate the demand for designated preferred parking spaces for low-carbon, electric, and carpool vehicles in City-owned lots and Downtown.

Reduces GHG By:

- Providing incentives for using low-carbon, electric, and carpool vehicles.
- Encouraging the use of low-carbon, electric vehicles, and carpooling as a viable modes of transportation.
- Increasing the use of renewable energy by decreasing fossil fuel demand.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: High

Costs from staff time needed to administer the selection and creation of designated parking spaces and associated costs from signing, striping, or other means to demarcate such dedicated spots.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Designate preferred parking through the installation of appropriate signage and parking enforcement.

Implementation Schedule: 2014–2015

TR-18 Transportation Demand Management

Continue to coordinate with STA on TDM planning, TDM activities, TDM requirements, and education and outreach programs through the Solano Napa Commuter Information (SNCI) website.

Reduces GHG By:

- Promoting alternative modes of transportation as viable options for travel.
- Increasing the use of renewable energy by decreasing fossil fuel demand.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: High

City costs would stem from staff time needed for ongoing coordination efforts with the Solano Transportation Authority.

Action Items and Responsible Parties:

Public Works Department staff:

- Continue to coordinate with STA on TDM planning, activities, and requirements and education and outreach.

Implementation Schedule: Ongoing

TR-19 Commuter Info Website

Provide a prominent link on the City's website to the Solano Transportation Authority's (STA) Commuter Info website, and work with STA to provide up-to-date commute information in Vacaville.

Reduces GHG By:

- Increasing convenience of public transit.
- Encouraging public transit as a viable alternative mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: High

Costs from staff time needed to coordinate with STA and to provide a link to the relevant commute information.

Action Items and Responsible Parties:

Public Works Department staff:

- Add a prominent link on the City's website to the STA Commuter Info website.
- Coordinate with STA on commute information in Vacaville.

Implementation Schedule: 2014–2015

TR-20 School Transit Options

Support efforts by the school districts to improve transit options for students, which could include reinstatement of school busing or working with the Solano Transportation Authority to provide free or subsidized bus passes to students in Vacaville.

Reduces GHG By:

- Providing incentives for public transit use.
- Increasing convenience of public transit and creating new long-time users.
- Encouraging public transit as a viable alternative mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

City costs would stem from staff time needed to coordinate with school districts and the STA to improve transit options. Potential cost savings to residents from reduced fuel costs, and other vehicle-maintenance costs.

Action Items and Responsible Parties:

Public Works Department staff:

- Work with the school districts and STA to improve transit options.

Implementation Schedule: 2014–2015

TR-21 Public Transit for Schools

Continue to market, promote, and educate students and parents about the benefits of using public transit as a mode of travel to school, considering the comments and concerns of the Vacaville and Travis School Districts.

Reduces GHG By:

- Encouraging students to use transit as a viable mode of transportation.
- Creating new long-time users of public transit.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

City costs would stem from staff time needed to coordinate with school districts, as well as provide promotional materials and conduct student outreach. Potential cost savings to residents from reduced fuel costs, and other vehicle-maintenance costs.

Action Items and Responsible Parties:

Public Works Department staff:

- Continue coordinating with school districts on outreach activities to promote transit use by students.

Implementation Schedule: Ongoing

TR-22 Safe Routes to School

Coordinate with local schools and the school district to improve walking and biking access to school by providing input and staff support for Safe Routes To School grant applications and implementation of projects.

Reduces GHG By:

- Increasing safe walking and biking opportunities for school-age children to get to and from school.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: High

Costs from staff time needed to coordinate with local schools and school districts to apply for grants and implement projects. Residents will save money by decreasing the need to drive their children to and from school, thereby saving time, fuel, and other vehicle-related costs. The City could benefit from indirect long-term cost savings by reducing traffic congestion and air pollution.

Action Items and Responsible Parties:

Public Works Department staff, Local Schools, and School Districts:

- Apply for Safe Routes To School grants.
- Implement Safe Routes To School projects.

Implementation Schedule: 2014–2015

TR-23 SCHOOL BUSING

Encourage the State of California to reinstate school busing.

REDUCES GHG BY:

- Encouraging alternative transportation options for school-age children to get to and from school.
- Reducing automobile use and associated fossil-fuel consumption.

COST EFFECTIVENESS: HIGH

According to the National Center for Education Statistics, the average annual cost of school busing is $941 per student,[2,3] which includes labor and vehicle expenses. However, such costs vary widely and are highly dependent on the geography of individual school districts. Rural districts and some urban districts with higher costs of living and wages would tend to have higher school busing costs than suburban school districts, such as Vacaville's. Vacaville's traffic model estimates that median trip lengths for school-related trips range from 1 to 3 miles, depending on the school type. Using a 2-mile one-way trip distance estimate, the total trip distance per day would be 8 miles. Multiplied by the 2013 IRS mileage reimbursement rate of 56.5 cents per mile, this equates to approximately $4.50 per school day for vehicle costs.[4] Assuming the driver travels about ½ mile per minute plus time to walk to and from the car, the total driver time per school day is about 20 minutes. With an average time value of $11 per hour,[5] the time costs per school day are about $3.67. The State of California requires a minimum of 175 school days per year for public schools;[6] therefore, the total annual vehicle and time costs for transporting a single student to school by a privately operated vehicle is approximately $1,430. Therefore, school buses represent, on average, a more cost-effective method of transporting students to school than privately operated vehicles.

ACTION ITEMS AND RESPONSIBLE PARTIES:

City Manager's Office and City Council:

- Lobby the State to require school districts to provide busing to school for all students.

School Districts:

- Reinstitute busing programs that provide service to all students.

IMPLEMENTATION SCHEDULE: 2014–2015

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[2] National Center for Education Statistics, Fast Facts, http://nces.ed.gov/fastfacts/display.asp?id=67, accessed on August 12, 2013.

[3] Bureau of Labor Statistics – CPI Inflation Calculator, http://www.bls.gov/data/inflation_calculator.htm, accessed on August 12, 2013.

[4] CalChamber – IRS Announces 2013 Mileage Reimbursement Rates, http://www.calchamber.com/headlines/pages/11272012-irsannounces2013mileagereimbursementrates.aspx, accessed on August 12, 2013.

[5] The median household income in Solano County is $70,000. There are 2,080 work hour per year, so the median household income equates to $33.65 per hour. When using hourly income as a measure of people's value of travel time, typically 1/3 to ½ of the hourly income is used, which equates to $11 per hour.

[6] California Watch – Districts consider an even shorter school year, http://californiawatch.org/daily report/districts-consider-even-shorter-school-year-10023, accessed on August 12, 2013.

TR-24 Transit Stop Amenities

Implement improvements to transit stops, such as real-time transit information and shelters, where demand warrants and funding allows, and access for passengers arriving by foot, and require transit stop improvements as conditions of approval for nearby development as appropriate.

Reduces GHG By:

- Increasing comfort and convenience of public transit.
- Encouraging the use of transit as a viable mode of transportation.
- Reducing automobile use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed from efforts to initiate and oversee transit stop improvements, as well as the need to craft and adopt development standards to implement measure requirements.

Action Items and Responsible Parties:

Public Works Department staff:

- Implement transit stop improvements and pedestrian access where demand warrants and funding allows.
- Amend the Land Use and Development Code to include measure TR-24.
- Review proposed development applications and environmental documents for consistency with measure TR-24.

Developers/Property owners:

- Design and construct transit stop improvements as part of new development.

Implementation Schedule: 2014–2015

TR-25 Traffic Flow Improvements

Continue to implement strategies to improve signalization, incident responsiveness, traveler information systems (such as wayfinding and real-time traveler information), and active traffic management to smooth traffic flow as budget and staff levels allow.

Reduces GHG By:

- Improving traffic management and reducing congestion.
- Increasing automobile efficiency and reducing associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed to implement strategies and costs of materials associated with measure TR-25.

Action Items and Responsible Parties:

Public Works Department staff:

- Continue to implement strategies from measure TR-25 that will smooth traffic flow.

Implementation Schedule: Ongoing

TR-26 Impact Fees for Alternative Transportation

Continue to include pedestrian, bicycle and transit facilities in projects funded by Vacaville's transportation impact fee program, and consider including specific improvements to pedestrian, bicyclist and transit facilities as part of the Transportation Impact Fee updates if a nexus between those improvements and new development can be demonstrated.

Reduces GHG By:

- Providing financial support for the implementation of other transportation measures.
- Promoting alternative modes of transportation as viable choices within Vacaville.

Cost Effectiveness: Unknown

City costs would stem from staff time needed to draft and adopt implementing ordinances to allow transportation impact fees to be used for pedestrian, bicyclist, and transit facilities. Residents could potentially realize indirect benefits through improved convenience and safety for transit riders, pedestrians, and bicyclists.

Action Items and Responsible Parties:

Public Works Department staff:

- Conduct a nexus study and revise the transportation impact fee program to cover alternative transportation.

Implementation Schedule: 2014–2015

TR-27 Electric Loading Docks

Require electric loading docks for large developments with 100 or more employees that receive deliveries by refrigerated trucks.

Reduces GHG By:

- Decreasing the delivery truck engine use and reducing diesel use.
- Increasing the opportunity for renewable energy source use.

Cost Effectiveness: Unknown

City costs would stem from staff time needed to craft and adopt City ordinances to implement measure requirements. Businesses that receive refrigerated stock would incur costs for electrical system installation under the measure.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure TR-27.
- Review proposed development applications and environmental documents for consistency with measure TR-27.

Developers/Property owners:

- Design and construct electric loading docks for large developments that receive deliveries by refrigerated trucks.

Implementation Schedule: 2014–2015

GREEN BUILDING

The green building measures would not result in measureable reductions in GHG emissions in Vacaville beyond the reductions accounted for in the adjusted BAU forecast described in Chapter 3 (e.g. Title 24 standards) and the measures in other sectors of this Energy and Conservation Action Strategy. Therefore, the matrix does not show a quantified percent of total GHG reductions for these non-quantified measures, and it does not list any assumptions. However, they are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville. A summary of the implementation items for each green building measure is provided in Table 5-3.

How Green Building Measures Reduce GHGs

Green building measures would reduce GHG emissions because they would decrease the energy and water used in buildings, resulting in lower demand for both electricity and natural gas. Similarly, storing, treating, and conveying the water used in buildings requires energy for both construction and operation of water-system infrastructure. (For additional discussion of water-related energy use, see the introduction to the section on water and wastewater.) Because much of our energy—whether for construction, electricity, heating, water, or cars and trucks—currently comes from GHG-producing fossil fuels, direct and indirect decreases in energy use lead to reduced GHG emissions.

Other Benefits of Green Building Measures

Green building includes a diverse range of practices that offer different ways to achieve the same goal of energy conservation. The reduced energy and water use associated with green building practices reduces other environmental impacts from using up these important resources and improves the long-term reliability of water and energy sources. Additionally, some green building practices alleviate both urban heat-island effects and stormwater runoff, making communities more livable and resilient in the face of both typical and extreme weather. Green building practices can also contribute directly to human health and wellbeing by reducing indoor air pollution and increasing access to natural light. Certain green building practices such as green roofs, bioswales, and living walls can even provide habitat and foraging opportunities for urban wildlife. Finally, through this array of benefits, green building provides an opportunity to create connections between the natural and built environments and residents.

TABLE 5-3 **GREEN BUILDING MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
GB-1	Allow greater permitting-related development flexibility and other incentives for LEED-Silver, Build It Green, GreenPoint or equivalent rating; for example, by giving green projects priority in plan review, processing, and field inspection services.	--			High	City/Development	2014–2015
GB-2	Require measures that reduce energy use through solar orientation by taking advantage of shade, prevailing winds, landscaping, and sun screens, unless prohibited by topographical conditions or other site-specific constraints.	--			Moderate	City/Development	2015–2020
GB-3	Provide links to programs and information about green building, including training and technical assistance, on the City's website.	--			Unknown	City	2015–2020
GB-4	Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop green building policies and programs that are optimized on a regional scale.	--			High	City/Other Agencies	2014–2015
GB-5	Develop a "heat island" mitigation plan that includes guidelines for cool roofs, cool pavements, and strategically placed shade trees.	--			High	City/Development	2014–2015

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GB-1 Incentives for Green Building Certification

Allow greater permitting-related development flexibility and other incentives for LEED-Silver, Build It Green, GreenPoint, or equivalent rating; for example, by giving green projects priority in plan review, processing, and field inspection services.

Reduces GHG By:

- Providing incentives that promote the use of clean energy and reduced energy demand.
- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: High

Costs from staff time needed to draft and adopt implementing language and for processing permitting or other ministerial incentives. Developers/property owners would potentially save money on permitting costs and faster approval/construction times.

Action Items and Responsible Parties:

Community Development Department staff:

- Establish incentives for LEED-Silver, Build-It-Green, or GreenPoint or equivalent rating.
- Review development project applications to consider whether projects meet the incentives' certification/rating requirements, and then follow through with the incentives (e.g. by prioritizing the project above others that do not meet the incentive's requirements).

Implementation Schedule: 2014–2015

GB-2 Solar Orientation

Require measures that reduce energy use through solar orientation by taking advantage of shade, prevailing winds, landscaping, and sun screens, unless prohibited by topographical conditions or other site-specific constraints.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.
- Supporting increased use of carbon-storing biomass (trees and plants).

Cost Effectiveness: Moderate

Costs to the City from staff time needed to craft and adopt implementing ordinances for solar orientation requirements. Developers/property owners would potentially incur higher costs during development design, or for construction or materials; however, these costs could be partially or entirely offset by future energy savings.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure GB-2.
- Review development plans and environmental documents for consistency with measure GB-2.

Developers/Property owners:

- Design and construct new projects to take advantage of shade, prevailing winds, landscaping, and sun screens.

Implementation Schedule: 2015–2020

GB-3 Green Building Information and Technical Assistance

Provide links to programs and information about green building, including training and technical assistance, on the City's website.

Reduces GHG By:

- Providing information to property owners, development professionals, schools, and special districts that enable the viable use of alternative energy sources.
- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: Unknown

Costs to the City from staff time needed for updates to the City's website. Potential cost savings for residents and businesses through the expertise and information offered by the green building programs. Long term savings for the City, residents, and businesses from reduced energy costs.

Action Items and Responsible Parties:

Community Development Department and Public Works Department staff:

- Provide links to programs and information about green building on the City's website.

Implementation Schedule: 2015–2020

GB-4 Regional Green Building Programs

Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop green building policies and programs that are optimized on a regional scale.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: High

Costs of measure GB-4 would stem from additional staff-time for coordination activities and could range from high to low, depending on the approach taken. Successfully achieving regionally coordinated policies and economies of scale could offer significant cost-savings to the City and to property owners or businesses who must navigate multiple public processes.

Action Items and Responsible Parties:

Community Development Department staff:

- Coordinate, as applicable, with other agencies for regional green building initiatives.

Implementation Schedule: 2014–2015

GB-5 Heat Island Mitigation Plan

Develop a "heat island" mitigation plan that includes guidelines for cool roofs, cool pavements, and strategically placed shade trees.

Reduces GHG By:

- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.
- Supporting increased use of carbon-storing biomass (trees and plants).

Cost Effectiveness: High

Since the adopted plan would offer guidelines rather than establish requirements, this measure would impose no new costs. Due to the voluntary nature of the program and geographical variation in tree-planting benefits, it is not possible to precisely quantify potential costs or savings. However, studies have found that every dollar invested in urban trees can result in returns of $1.37 to $3.09 (2005 dollars). Additionally, urban tree planting has been found to reduce GHG emissions.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop and adopt a heat island mitigation plan.

Developers/Property owners:

- Incorporate heat island mitigation guidelines into site and building designs.

Implementation Schedule: 2014–2015

RENEWABLE ENERGY AND LOW CARBON FUELS

As shown in Table 5-1, the renewable energy and low carbon fuels measures would reduce GHG emissions in Vacaville by 20 $MTCO_2e$. Table 5-4 provides a summary of the GHG emission reductions and implementation items for each renewable energy and low carbon fuels measure.

How Renewable Energy and Low Carbon Fuels Measures Reduce GHGs

Renewable energy and low carbon fuels measures are intended to limit and eventually eliminate the use of fossil fuels as energy sources. Carbon in fossil fuels largely remains bonded to other substances and isolated deep within the earth's crust. Burning fossil fuels to produce energy releases the carbon stored within the fossil fuel, mainly as carbon dioxide, the most common greenhouse gas. Low-carbon fuels are those which incorporate or are entirely composed of fuels whose production is carbon-neutral. Carbon-neutral fuels are created by processes which absorb as much carbon as will be released when the fuels are later burned. Fossil fuels, on the other hand, are carbon-intense because the process of extracting these fuels does not absorb any of the carbon that will be released when those fuels are burned. Increasing the use of renewable and carbon-neutral energy sources, such as solar, wind, and biomass (trees and plants) would reduce GHG emissions.

Other Benefits of Energy and Low Carbon Fuels Measures

Reduced energy use and alternative fuels serve to reduce other pollutants alongside GHGs. The extraction of conventional fossil fuels such as oil, coal, and natural gas also has impacts on the environment, including pollution and habitat disruption, which can be lessened through the increased use of renewable energy. Additionally, and perhaps most importantly, fossil fuels are a finite resource, subject to long-term shortages and short-term price volatility. Renewable energy, while not unlimited, will be continually replenished very long into the future; using renewable energy can thus insulate communities from volatile energy costs. Finally, by creating jobs and allowing energy needs to be met on a more local level, renewable energy and low carbon fuels add to the resilience and economic vitality of communities.

TABLE 5-4 **RENEWABLE ENERGY AND LOW CARBON FUELS MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
RE-1	Require that new or major rehabilitations of commercial, office, or industrial development greater than or equal to 10,000 square feet in size incorporate solar or other renewable energy generation to provide 15 percent or more of the project's energy needs unless prohibited by topographical conditions or other site-specific constraints. Major rehabilitations are defined as additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area. Remove regulatory barriers to incorporating renewable energy generation.	20 GHG	100%	<1%	High	City/Development	2014–2015
RE-2	Encourage residential projects of ten units or more to participate in the California Energy Commission's New Solar Homes Partnership, which provides rebates to developers of six units or more who offer solar power in 50 percent of new units and is a component of the California Solar Initiative, or a similar program with solar power requirements equal to or greater than those of the California Energy Commission's New Solar Homes Partnership.	--			High	City/Development	2014–2015
RE-3	Work with PG&E to develop an Alternative Energy Development Plan that: ➤ Establishes citywide measurable goals. ➤ Identifies the allowable and appropriate alternative energy facility types within the city, such as solar photovoltaic (PV) on residential and commercial roofs and wind turbines for home use. ➤ Proposes phasing and timing of alternative energy facility and infrastructure development. ➤ Establishes development review protocol for new alternative energy projects. ➤ Reviews City policies and ordinances to address alternative energy production. ➤ Identifies optimal locations and the best means to avoid noise, aesthetic, and other potential land use compatibility conflicts (e.g., installing tracking solar PV or angling fixed solar PV in a manner that reduces glare to surrounding land uses).	--			Unknown	City/PG&E	2015–2020
RE-4	Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop alternative energy policies and programs that are optimized on a regional scale. As part of this measure, explore creation of a community choice aggregation program with the County of Solano.	--			High	City/Other Agencies	2014–2015
RE-5	Require that all new buildings be constructed to allow for the easy, cost-effective installation of future solar energy systems, unless prohibited by topographical conditions or other site-specific constraints. "Solar ready" features should include: proper solar orientation (i.e. south-facing roof area sloped at 20° to 55° from the horizontal); clear access on the south sloped roof (i.e. no chimneys, heating vents, plumbing vents, etc.); electrical conduit installed for solar electric system wiring; plumbing installed for solar hot water system; and space provided for a solar hot water storage tank.	--			High	City/Development	2014–2015
RE-6	Encourage the installation of solar photovoltaic arrays in new parking lots and replacement in existing parking lots.	--			High	City/Development	2014–2015

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QUANTIFIED MEASURES

RE-1 RENEWABLE ENERGY GENERATION IN PROJECTS

Require that new or major rehabilitations of commercial, office, or industrial development greater than or equal to 10,000 square feet in size incorporate solar or other renewable energy generation to provide 15 percent or more of the project's energy needs unless prohibited by topographical conditions or other site-specific constraints. Major rehabilitations are defined as additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area. Remove regulatory barriers to incorporating renewable energy generation.

GHG EMISSIONS REDUCTION: 20 $MTCO_2e$ per year

PERCENT OF TOTAL GHG REDUCTION: Less than 1 percent

REDUCES GHG BY:

- Increasing use of clean energy/carbon-neutral energy sources.
- Reducing demand of energy from fossil fuels.
- Decreasing overall energy use.

GHG REDUCTION ASSUMES:

- 4.5 non-residential buildings will be constructed/remodeled over the next eight years (0.6 per year) that will include PV, increasing to 20 by 2035.

COST EFFECTIVENESS: HIGH

City costs would stem from staff time needed to draft and implement new or major rehabilitations requirements consistent with measure RE-1. Total materials and labor costs would vary by site, system characteristics and size. Energy savings from photovoltaic systems in Vacaville currently recover installation costs after about 15 years of operation.[7] Anticipated system lifetimes of 20 years or more and low maintenance costs enhance the long-term savings from photovoltaic systems.[8]

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Amend the Land Use and Development Code to incorporate measure RE-1.
- Review architectural plans and environmental documents for consistency with measure RE-1.

Developers/Property owners:

- Design and construct applicable projects to incorporate solar or other renewable energy generation to provide 15 percent or more of the project's energy needs.

IMPLEMENTATION SCHEDULE: 2014–2015

[7] FindSolar Solar Calculator, http://www.findsolar.com/, accessed on May 21, 2012.

[8] Barbose, Galen, et al., 2011, Report: *Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010*, Lawrence Berkeley National Laboratory.

NON-QUANTIFIED MEASURES

The following measures (RE-2 through RE-6) would not result in a measureable reduction in GHG emissions in Vacaville beyond the other measures modeled for this sector. Therefore, the matrix does not show a quantified percent of total GHG reductions for the non-quantified measures, and it does not list any assumptions. However, they support measure RE-1 and are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville.

RE-2 New Solar Homes Partnership

Encourage residential projects of ten units or more to participate in the California Energy Commission's New Solar Homes Partnership, which provides rebates to developers of six units or more who offer solar power in 50 percent of new units and is a component of the California Solar Initiative, or a similar program with solar power requirements equal to or greater than those of the California Energy Commission's New Solar Homes Partnership.

Reduces GHG By:

- Increasing use of clean energy/carbon-neutral energy sources.
- Reducing demand of fossil fuels.
- Decreasing overall energy use.

Cost Effectiveness: High

Costs from staff time needed to draft and adopt the enabling ordinance for measure RE-2. Costs to developers and potentially homeowners to install solar panels, and PG&E to provide rebates for solar installations. Savings on energy costs for homeowners.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to incorporate measure RE-2.

Developers/Property owners:

- Design and construct residential projects to have solar power in 50 percent of new units.

Implementation Schedule: 2014–2015

RE-3 Alternative Energy Development Plan

Work with PG&E to develop an Alternative Energy Development Plan that:

- Establishes citywide measurable goals.
- Identifies the allowable and appropriate alternative energy facility types within the city, such as solar photovoltaic (PV) on residential and commercial roofs and wind turbines for home use.
- Proposes phasing and timing of alternative energy facility and infrastructure development.
- Establishes development review protocol for new alternative energy projects.
- Reviews City policies and ordinances to address alternative energy production.
- Identifies optimal locations and the best means to avoid noise, aesthetic, and other potential land use compatibility conflicts (e.g. installing tracking solar PV or angling fixed solar PV in a manner that reduces glare to surrounding land uses).

GHG Emissions Reduction: This measure would not in and of itself result in measurable GHG emissions reductions, but would support measure RE-1, which reduces GHG emissions by 20 $MTCO_2e$.

Reduces GHG By:

- Providing tools to the City that enable the viable use of alternative energy sources.
- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: Unknown

Costs from staff time needed to coordinate with PG&E to draft and adopt the Alternative Energy Development Plan consistent with measure RE-3. Potential reduced costs to the City and developers associated with the approval of alternative energy installations.

Action Items and Responsible Parties:

Community Development Department staff:

- Work with PG&E to develop the Alternative Energy Development Plan. As part of this process, the City will identify which types of alternative energy facilities are appropriate in Vacaville and where, identify means to address potential land use compatibility conflicts, and establish a development review process for new alternative energy projects.
- Review and update existing City policies and ordinances to address alternative energy production and the findings of the Alternative Energy Development Plan.

Implementation Schedule: 2015–2020

RE-4 Regional Alternative Energy Programs

Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop alternative energy policies and programs that are optimized on a regional scale. As part of this measure, explore creation of a community choice aggregation program with the County of Solano.

GHG Emissions Reduction: This measure would not in and of itself result in measurable GHG emissions reductions, but would rather serve to support measure RE-1, which reduces GHG emissions by 20 $MTCO_2e$.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: High

Costs from staff time needed for coordination activities consistent with measure RE-4. Potential cost savings to the City and regional businesses who must navigate multiple public processes.

Action Items and Responsible Parties:

Community Development Department staff:

- Coordinate, as applicable, with other agencies for regional alternative energy initiatives.

Implementation Schedule: 2014–2015

RE-5 Solar Ready Features

Require that all new buildings be constructed to allow for the easy, cost-effective installation of future solar energy systems, unless prohibited by topographical conditions or other site-specific constraints. "Solar ready" features should include: proper solar orientation (i.e. south-facing roof area sloped at 20° to 55° from the horizontal); clear access on the south sloped roof (i.e. no chimneys, heating vents, plumbing vents, etc.); electrical conduit installed for solar electric system wiring; plumbing installed for solar hot water system; and space provided for a solar hot water storage tank.

GHG Emissions Reduction: This measure would not in and of itself result in measurable GHG emissions reductions, but supports measure RE-1, which reduces GHG emissions by 20 $MTCO_2e$.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.

Cost Effectiveness: High

Costs from staff time needed to draft and adopt implementing ordinances for "solar ready" requirements consistent with measure RE-5. Varying estimates are available for per-home costs of solar-readiness, ranging from $280–$380 to $500–$1,000. These would be offset by energy savings.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure RE-5.
- Review architectural plans and environmental documents for consistency with measure RE-5.

Developers/Property owners:

- Design and construct new buildings to allow for the easy, cost-effective installation of future solar energy systems.

Implementation Schedule: 2014–2015

RE-6 Solar Arrays in Parking Lots

Encourage the installation of solar photovoltaic arrays in new parking lots and replacement in existing parking lots.

GHG Emissions Reduction: This measure would not in and of itself result in measurable GHG emissions reductions, but supports measure RE-1, which reduces GHG emissions by 20 $MTCO_2e$.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting less overall energy use.

Cost Effectiveness: High

Costs from staff time needed to draft and adopt supportive policies relating to parking lot solar arrays consistent with measure RE-6. Costs to businesses or developers would be voluntary if they elect to replace existing diesel generators or install new solar generators.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure RE-6.
- Review proposed development applications and environmental documents for consistency with measure RE-6.

Developers/Property owners:

- Design and construct new projects with solar photovoltaic arrays in new parking lots.
- Update existing parking lots with solar photovoltaic arrays.

Implementation Schedule: 2014–2015

ENERGY CONSERVATION

As shown in Table 5-1, the energy conservation measures would reduce GHG emissions in Vacaville by 550 $MTCO_2e$. A summary of the GHG emission reductions and implementation items for each energy conservation measure is provided in Table 5-5.

How Energy Conservation Measures Reduce GHGs

As discussed in introductions to the sections on the green building and renewable energy and low carbon fuels sectors, current energy sources tend to be carbon-intense fossil fuels. Therefore, until all energy is derived from renewable or carbon-neutral sources, limiting energy use through conservation and efficiency will remain a key approach to limiting GHG emissions.

Other Benefits of Energy Conservation Measures

In addition to reducing GHGs, energy conservation measures offer much the same sustainability benefits as those for renewable energy and low-carbon fuels. Reduced energy use reduces other pollutants alongside GHGs, while also saving on energy costs and lowering overall energy demand. The extraction of conventional fossil fuels such as oil, coal, and natural gas also has impacts on the environment, including pollution and habitat disruption. By cutting demand for fossil fuels, energy conservation helps reduce these impacts. Additionally, doing more with less energy improves overall efficiency, and can serve to strengthen local economies.

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TABLE 5-5 **ENERGY CONSERVATION MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
EC-1	Mandate the use of energy-efficient appliances in new development that meet Energy Star standards and the use of energy-efficient lighting technologies that meet or exceed Title 24 standards.	10 GHG	2%	<1%	High	City/Development	2014–2015
EC-2	Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following: ➤ Conduct outreach to educate the public about available rebates and other incentives from energy providers. ➤ Promote the purchase of ENERGY STAR appliances. ➤ Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures. ➤ Offer a halogen torchiere lamp exchange to community members. ➤ Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization. ➤ Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target. ➤ Promote individualized energy management planning and related services for large energy users. ➤ Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.	70 GHG	13%	<1%	Unknown	City/PG&E	2015–2020
EC-3	Require all new development and major rehabilitation (i.e. additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area) projects to incorporate any combination of the following strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape, which includes roads, sidewalks, courtyards, parking lots, and driveways: shaded within five years of occupancy; paving materials with a Solar Reflectance Index (SRI) of at least 29; open grid pavement system; and parking spaces underground, under deck, under roof, or under a building. Any roof used to shade or cover parking must have an SRI of at least 29.	220 GHG	40%	<1%	Unknown	City/Development	2015–2020
EC-4	Continue to replace City street lights with LED, induction, or other energy-efficient lighting, and require similar energy-efficient street lights in new development.	250 GHG	45%	<1%	High	City/Development	Ongoing
EC-5	Continue to support the Yolo Solano Air Quality Management District's lawnmower exchange program for residents to exchange conventional gas-powered lawnmowers for electric and rechargeable battery-powered lawnmowers.	--			Unknown	City	Ongoing
EC-6	Seek partnerships with local utilities and private entities to share resources and promote energy conservation.	--			Unknown	City	2014–2015
EC-7	Continue to offer innovative, low-interest financing for energy efficiency and renewable energy projects for existing and new development through the PACE program.	--			Unknown	City	Ongoing

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QUANTIFIED MEASURES

EC-1 ENERGY-EFFICIENT APPLIANCES AND LIGHTING

Mandate the use of energy-efficient appliances in new development that meet Energy Star standards and the use of energy-efficient lighting technologies that meet or exceed Title 24 standards.

GHG EMISSIONS REDUCTION: 10 MTC02e per year

PERCENT OF TOTAL GHG REDUCTION: Less than 1 percent

REDUCES GHG BY:

- Decreasing overall energy use.
- Conserving energy.

GHG REDUCTION ASSUMES:

- Developers would provide energy-efficient appliances or residents would purchase new appliances that meet the Title 25 Energy Code.

COST EFFECTIVENESS: HIGH

Costs from staff time needed to draft, adopt, and implement ordinances to enact measure EC-1. Requirements for EnergyStar appliances and fixtures are expected to potentially add an estimated $1,280 to the base cost of outfitting a typical home with conventional appliances and fixtures.[9] However, over the lifetime of these items, the total value of energy savings would likely more than repay additional purchase costs.[10]

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure EC-1.
- Review proposed development applications and environmental documents for consistency with measure EC-1.

Developers/Property owners:

- Include energy efficient appliances that meet Energy Star standards and the use of energy-efficient lighting technologies that meet or exceed Title 24 standards in new development construction.

IMPLEMENTATION SCHEDULE: 2014–2015

[9] Each house is assumed to have the following appliances, with the attendant extra costs from EnergyStar compliance: AC unit, $556; washer/dryer, $258; refrigerator, $30; dishwasher, $12; ten indoor light fixtures, $32 each; two outdoor light fixtures, $17 each; 25 total light bulbs, $2.80 apiece. This results in a total added cost of $1280 per house. These estimates are all based on appliance cost estimates provided by the EnergyStar program (see following footnote).

[10] EnergyStar Potential Savings Calculation Spreadsheets, 2009–2011, http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing, accessed April 10, 2012.

EC-2 PROMOTION OF ENERGY CONSERVATION

Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following:

- Conduct outreach to educate the public about available rebates and other incentives from energy providers.
- Promote the purchase of ENERGY STAR appliances.
- Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures.
- Offer a halogen torchiere lamp exchange to community members.
- Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization.
- Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR *Portfolio Manager Tool*. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target.
- Promote individualized energy management planning and related services for large energy users.
- Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.

GHG EMISSIONS REDUCTION: 70 MTC02e per year

PERCENT OF TOTAL GHG REDUCTION: Less than 1 percent

REDUCES GHG BY:

- Providing tools to the City that enables the viable use of alternative energy sources.
- Providing tools to the City that directly reduces energy demand.
- Providing incentives and education to the community that promotes efficient energy use.
- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting less overall energy use.

GHG REDUCTION ASSUMES:

- A portion of the existing residential uses would purchase new energy-efficient appliances which meet the Title 25 Energy Code.

COST EFFECTIVENESS: UNKNOWN
Costs to the City could result from staff time to create promotional materials and conduct public outreach.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Community Development Department staff:

- Coordinate with PG&E to promote various existing PG&E programs that conserve energy, as well as to develop new PG&E programs.

IMPLEMENTATION SCHEDULE: 2015–2020

EC-3 Heat Gain Reduction

Require all new development and major rehabilitation (i.e. additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area) projects to incorporate any combination of the following strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape, which includes roads, sidewalks, courtyards, parking lots, and driveways: shaded within five years of occupancy; paving materials with a Solar Reflectance Index (SRI) of at least 29; open grid pavement system; and parking spaces underground, under deck, under roof, or under a building. Any roof used to shade or cover parking must have an SRI of at least 29.

GHG Emissions Reduction: 220 MTC02e per year

Percent of Total GHG Reduction: Less than 1 percent

Reduces GHG By:

- Decreasing overall energy use.
- Conserving energy.
- Increasing carbon-storing biomass (trees and plants).

GHG Reduction Assumes:

- 15 percent increase in energy efficiency.
- 3.4 percent of energy use from existing jobs would be affected by 2020.
- 6.4 percent of energy use from existing non-residential buildings would be affected by 2035.

Cost Effectiveness: Unknown

No additional costs to City as the requirements of measure EC-3 are met through compliance with Title 24.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include measure EC-3.
- Review proposed development applications and environmental documents for consistency with measure EC-3.

Developers/Property owners:

- Design and construct applicable new development and major rehabilitation with approved strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape.

Implementation Schedule: 2015–2020

EC-4 Energy-Efficient Street Lights

Continue to replace City street lights with LED, induction, or other energy-efficient lighting, and require similar energy-efficient street lights in new development.

GHG Emissions Reduction: 250 $MTCO_2e$ per year.

Percent of Total GHG Reduction: Less than 1 percent

Reduces GHG By:

- Decreasing overall energy use.
- Conserving energy.
- Reducing energy demand from fossil fuels.

GHG Reduction Assumes:

- 36 percent decrease in per-fixture energy use.
- 7.3 year lighting turnover.
- 100 percent replacement in ten years.

Cost Effectiveness: High

Costs from staff time needed to draft, adopt, and implement ordinances to enact measure EC-4. Costs to City and developers to install LED lighting; however, the LED streetlights costs continue to fall precipitously and life-cycle costs are now less than those of conventional lighting technology.

Action Items and Responsible Parties:

Public Works Department staff:

- Amend the Land Use and Development Code to include measure EC-4.
- Review proposed development applications and environmental documents for consistency with measure EC-4.

Developers/Property owners:

- Design and construct new projects to include LED, induction, or other energy-efficient lighting for City street lights.

Implementation Schedule: Ongoing

NON-QUANTIFIED MEASURES

The following measures (EC-5 through EC-7) would not result in a measureable reduction in GHG emissions in Vacaville beyond the other measures modeled in this sector. Therefore, the matrix does not show a quantified percent of total GHG reductions for the non-quantified measures, and it does not list any assumptions. However, they support measures EC-1 through EC-4 and are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville.

EC-5 LAWNMOWER EXCHANGE PROGRAM

Continue to support the Yolo Solano Air Quality Management District's lawnmower exchange program for residents to exchange conventional gas-powered lawnmowers for electric and rechargeable battery-powered lawnmowers.

GHG EMISSIONS REDUCTION: Measure EC-5 would result in indirect GHG emissions reductions that support measures EC-1 through EC-4, which reduce GHG emissions by 550 $MTCO_2e$.

REDUCES GHG BY:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.
- Promoting incentives that enable the viable use of alternative energy sources.

COST EFFECTIVENESS: UNKNOWN

Costs from staff time needed for programmatic support provided to the Yolo Solano Air Quality Management District consistent with measure EC-5. Potential costs to participating residents from home upgrades to if exterior or garage electrical outlets are required to be installed; however, this cost is voluntary and energy expense savings could off-set this cost over time.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Support YSAQMD's program consistent with measure EC-5, for example by promoting it on the City's website.

IMPLEMENTATION SCHEDULE: Ongoing

EC-6 Partnerships for Energy Conservation

Seek partnerships with local utilities and private entities to share resources and promote energy conservation.

GHG Emissions Reduction: Measure EC-6 would result in indirect GHG emissions reductions that support measures EC-1 through EC-4, which reduce GHG emissions by 550 $MTCO_2e$.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.
- Promoting partnerships that enable the viable use of alternative energy sources.

Cost Effectiveness: Unknown

Staff time costs to make contacts and coordinate with local utilities and private entities consistent with measure EC-6.

Action Items and Responsible Parties:

Community Development Department staff:

- Seek partnerships, as appropriate, to share resources and promote energy conservation.

Implementation Schedule: 2014–2015

EC-7 Financing for Energy Efficiency and Renewable Energy

Continue to offer innovative, low-interest financing for energy efficiency and renewable energy projects for existing and new development through the PACE program.

GHG Emissions Reduction: Measure EC-7 would result in indirect GHG emissions reductions that support measures EC-1 through EC-4, which reduce GHG emissions by 550 $MTCO_2e$.

Reduces GHG By:

- Supporting increased use of clean energy/carbon-neutral energy sources.
- Supporting reduced energy demand from fossil fuels.
- Supporting reduced overall energy use.
- Promoting incentives that enable the viable use of alternative energy sources.

Cost Effectiveness: Unknown

Administrative costs to the City resulting from staff time needed to continue to implement the PACE program. Any costs to property owner would be minimal and voluntary.

Action Items and Responsible Parties:

Community Development Department staff:

- Continue to implement the PACE program.
- Continue to conduct outreach to promote and implement the PACE program.

Implementation Schedule: Ongoing

WATER AND WASTEWATER

As shown in Table 5-1, the water and wastewater measures would reduce GHG emissions in Vacaville by 1,450 $MTCO_2e$. A summary of the GHG emission reductions and implementation items for each water and wastewater measure is provided in Table 5-6.

For many of the water and wastewater measures, the cost effectiveness cannot be reasonably determined. However, it should be noted that the content of these measures may be viewed as a potentially necessary individual component of a broader strategy for water-use reduction.

How Water and Wastewater Measures Reduce GHGs

Water and wastewater measures serve to decrease GHG emissions primarily through reduced energy needs for water storage, pumping, and treatment, as well as through reduced fugitive GHG emissions from wastewater and sewage. The provision of water through a municipal supply requires elaborate and extensive infrastructure. Beyond the energy needed for the everyday operations of this infrastructure, its construction and ongoing maintenance also generates energy demand. Thus, by reducing water usage, these measures serve to decrease both these routine demands for energy and the long-term demand for energy related to the upkeep, replacement, and expansion of water-system infrastructure. As discussed above, much of this energy is currently derived from carbon-intense fossil fuel sources. Therefore, lessening the water use which currently relies on carbon-intense energy sources is the main mechanism by which these measures would serve to reduce GHG emissions. Additionally, decreased water use means subsequent decreases in quantities of wastewater. Since wastewater requires additional energy to treat and can itself release GHGs through natural degradation processes, decreased generation of wastewater also serves to reduce GHG emissions.

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TABLE 5-6 **WATER AND WASTEWATER MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
WW-1	Support the conservation measures outlined in the City's Urban Water Management Plan and implement the City's Water Efficient Landscape requirements through the following sub-measures:	1,450 GHG	100%	2%			
	A. For all new development, require all water use and efficiency measures to comply with City Codes.				Unknown	City/Development	Ongoing
	B. At least every five years, review and update the City's Water Efficient Landscape requirements with improved conservation programs and incentives for non-residential customers.				Unknown	City/Development	2015–2020
	C. Continue to offer conservation programs and incentives to large landscape customers per the Urban Water Management Plan.				Unknown	City/Developers/ Water Customers	Ongoing
	D. Implement water efficient residential programs identified in the current Urban Water Management Plan. Continue to coordinate with local water purveyors to achieve consistent standards and review and approval processes for implementation.				Unknown	City/Water Providers	2014–2015
	E. Expand the public information and school education program to promote water conservation and its benefits in coordination with efforts of local water purveyors. Conduct public education and outreach to reduce watering of non-vegetated surfaces and promote the use of pervious paving materials.				Unknown	City	2014–2015
	F. Encourage the use of non-potable water and recovered residential rainwater for irrigation purposes.				Unknown	City	2015–2020
	G. Continue to meter with commodity rates all new connections and retrofits of existing connections. Continue to provide information to customers about their water use.				Unknown	City	Ongoing

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OTHER BENEFITS OF WATER AND WASTEWATER MEASURES

Beyond the energy savings discussed above, these measures yield other sustainability benefits as well. Though fresh water is a renewable resource, the amount available at a particular time and place is finite. Wiser use of water makes communities more resilient in the face of drought or other water shortages, and can reduce or delay the need for infrastructure improvements or expansions. Reduced urban water use also allows more water to be left in natural waterways, offering benefits for wildlife, agriculture, and recreation. Finally, some of the measures which help to reduce water use and wastewater generation, such as green roofs, xeriscaping, and bioswales, also serve to provide habitat to urban wildlife.

WW-1 WATER CONSERVATION

Support the conservation measures outlined in the City's Urban Water Management Plan and implement the City's Water Efficient Landscape requirements through the following sub-measures.

Water and wastewater sub-measures WW-1A through WW-1G support measure WW-1 and when combined reduce GHG emissions in Vacaville by 1,450 $MTCO_2e$ or 2 percent of the total GHG emission reductions. Therefore, the matrix does not show a quantified percent of total GHG reductions for each sub-measure, and it does not list any assumptions.

WW-1A WATER USE AND EFFICIENCY REQUIREMENTS

For all new development, require all water use and efficiency measures to comply with City Codes.

GHG EMISSIONS REDUCTION: Sub-measure WW-1A is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

REDUCES GHG BY:

- Supporting the City's ongoing efforts to manage water sustainably.
- Decreasing overall energy demand related to water use.
- Conserving energy and water.
- Reducing energy demand from fossil fuels related to water use.

COST EFFECTIVENESS: UNKNOWN
Staff time to reconcile water use and efficiency measures with City codes.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Community Development Department staff:

- Review landscape plans and environmental documents for consistency with sub-measure WW-1A.

IMPLEMENTATION SCHEDULE: Ongoing

WW-1B Water Efficient Landscape Requirements Update

At least every five years, review and update the City's Water Efficient Landscape requirements with improved conservation programs and incentives for non-residential customers.

GHG Emissions Reduction: Sub-measure WW-1B is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Ensuring the City has up-to-date tools that support its ongoing efforts to conserve water, reduce water use, and subsequently reduce overall energy demand related to water use and energy demand from fossil fuels related to water use.

Cost Effectiveness: Unknown
Costs from staff time needed to draft, adopt, and implement ordinance updates.

Action Items and Responsible Parties:
Community Development Department staff:

- Periodically review the existing Water Efficient Landscape requirements, and update it to include improved conservation programs and incentives consistent with sub-measure WW-1B.

Developers/Property owners:

- Illustrate compliance with the City's Urban Water Management Plan and Water Efficient Landscape requirements in development applications and implement applicable features upon project approval.

Implementation Schedule: 2015–2020

WW-1C Water Conservation Programs and Incentives

Continue to offer conservation programs and incentives to large landscape customers per the Urban Water Management Plan.

GHG Emissions Reduction: Sub-measure WW-1C is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Supporting the City's ongoing efforts to manage water sustainably.
- Providing incentives that promote the conservation of water and subsequently reduce overall energy demand related to water use and energy demand from fossil fuels related to water use.

Cost Effectiveness: Unknown

No new costs to City to support and continue the ongoing implementation of the current Urban Water Management Plan.

Action Items and Responsible Parties:

Community Development Department staff:

- Continue the conservation and incentive programs outlined in the Urban Water Management Plan.

Developers/Property owners:

- Illustrate compliance with the City's Urban Water Management Plan and Water Efficient Landscape requirements in development applications and implement applicable features upon project approval.

Implementation Schedule: Ongoing

WW-1D Water Efficient Programs and Standards

Implement water efficient residential programs identified in the current Urban Water Management Plan. Continue to coordinate with local water purveyors to achieve consistent standards and review and approval processes for implementation.

GHG Emissions Reduction: Sub-measure WW-1D is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Supporting the City's ongoing efforts to manage water sustainably.
- Increasing convenient compliance procedures through consistent standards and review and approval processes that support water conservation and subsequently reduce overall energy demand related to water use and energy demand from fossil fuels related to water use.

Cost Effectiveness: Unknown

No new costs to City to support and continue the ongoing implementation of the current Urban Water Management Plan.

Action Items and Responsible Parties:

Community Development Department staff:

- Implement the residential programs outlined in the Urban Water Management Plan and continue coordination with local water purveyors.

Implementation Schedule: 2014–2015

WW-1E Water Conservation Outreach

Expand the public information program to promote water conservation and its benefits in coordination with efforts of local water purveyors. Conduct public education and outreach to reduce watering of non-vegetated surfaces and promote the use of pervious paving materials.

GHG Emissions Reduction: Sub-measure WW-1E is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Providing training and education to ensure efficient water use.
- Conserving water and subsequently reducing overall energy demand related to water use and energy demand from fossil fuels related to water use.

Cost Effectiveness: Unknown

Staff time and materials needed to coordinate with local water purveyors and conduct public education and outreach campaigns.

Action Items and Responsible Parties:

Community Development Department staff:

- Expand its public information program to promote water conservation, and conduct outreach, such as through information on the City's website or inserts with the water bill, to reduce watering of non-vegetated surfaces and promote pervious paving.

Implementation Schedule: 2014–2015

WW-1F Non-Potable Water for Irrigation

Encourage the use of non-potable water for irrigation purposes.

GHG Emissions Reduction: Sub-measure WW-1F is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Supporting the use of alternative water sources for irrigation, subsequently reducing overall energy demand related to water treatment.
- Decreasing overall energy use.
- Conserving energy.

Cost Effectiveness: Unknown

Staff time and materials needed to promote the use of recycled water for irrigation. Any costs or savings to developers/homeowners would be voluntary and variant.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include sub-measure WW-1F.

Implementation Schedule: 2015–2020

WW-1G Water Service

Continue to meter all new connections and retrofits of existing connections with commodity rates. Continue to provide information to customers about their water use.

GHG Emissions Reduction: Sub-measure WW-1G is a component of the overall measure WW-1, which reduces GHG emissions by 1,450 $MTCO_2e$.

Reduces GHG By:

- Providing data for the City to measure water use and subsequently target areas where water conservation can be improved.

Cost Effectiveness: Unknown

Costs from staff time needed to coordinate with water purveyors to achieve conservation pricing goals. Potential costs and savings for homeowners related to adopted rate structures or other conservation methods and what actions individual homeowners choose.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Continue its current metering practices and continue to provide information about water use to water customers.

Implementation Schedule: Ongoing

SOLID WASTE

As shown in Table 5-1, the solid waste measures would reduce GHG emissions in Vacaville by 7,770 $MTCO_2e$. A summary of the GHG emission reductions and implementation items for each solid waste measure is provided in Table 5-7.

For many of the solid waste measures, the cost effectiveness cannot be reasonably determined. However, the content of these individual measures may be viewed as a potentially necessary individual component of a broader strategy to reduce the waste stream.

How Solid Waste Measures Reduce GHGs

Solid waste measures serve to reduce GHG emissions primarily by the lessening the need for energy-using processes surrounding the fabrication and disposal of consumer products, as well as by serving to limit or recapture the GHGs given off when such materials degrade in landfills. The production of consumer goods involves resource extraction, refinement, manufacturing, transportation, and other processes, all of which consume energy. As discussed above, current methods of energy generation tend to produce GHG emissions. By seeking to promote more limited purchasing and greater reuse and recycling of materials and goods, the solid waste measures serve to decrease the need for energy-consuming production and disposal processes, and thus reduce GHG emissions. Additionally, the breakdown of certain materials in landfill can release even more powerful GHG emissions, such as methane. By seeking to limit or recapture such gasses, the solid waste measures serve to further reduce GHG emissions.

Other Benefits of Solid Waste Measures

Similar to the variety of ways in which measures to reduce solid waste serve to reduce GHG emissions, these measures offer other broad sustainability benefits as well. Perhaps most importantly, by encouraging recycling, solid waste measures serve to decrease demand for virgin materials and other inputs to production. This decreases resource extraction and related environmental impacts, such as pollution and habitat disruption. Similarly, composting—an essential approach to waste reduction—recycles nutrients within the waste stream, thus further conserving resources and supporting local agriculture. Other key sustainability benefits come from reductions in demand for the processing and storage of solid waste. Some solid waste may contain toxic or harmful compounds, and nearly all waste requires certain handling techniques to ensure its safe disposal; encouraging greater reuse and more conscientious disposal techniques reduces risks to people and the environment from hazardous materials. Finally, decreasing solid waste reduces the space needed for landfills, conserving land and prolonging the lifetime of existing facilities.

TABLE 5-7 **SOLID WASTE MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
SW-1	Support waste reduction through the following sub-measures:	7,770 GHG	100%	12%			
	A. Continue to require at least 50 percent diversion (i.e. reuse or recycling) of non-hazardous construction waste from disposal, consistent with CALGreen - the Statewide Green Building code.				High	City/Development	Ongoing
	B. Require all new and existing multi-family developments that are redeveloping or remodeling to provide recycling areas for their residents. Allow a reduction in the parking requirement if necessary to allow adequate space for the recycling area.				High	City/Development	2014–2015
	C. Continue to promote recycling and waste diversion in Vacaville through marketing efforts to increase participation by residents and businesses. As part of this program, continue to conduct through the City's Recycling Coordinator public education and outreach about reuse and recycling, including existing programs for appliance disposal, yard debris and kitchen waste collection and composting, waste to energy, and zero waste programs. Where applicable, coordinate recycling outreach efforts with the City's contracted solid waste hauler Recology Vacaville Solano (RVS).				Unknown	City	Ongoing
	D. Encourage the use of salvaged and recycled-content materials and other materials that have low production energy costs for building materials, hard surfaces, and non-plant landscaping. Require sourcing of construction materials locally, as feasible.				Unknown	City/Development	2015–2020
	E. Investigate the provision of recycling containers Downtown and in City-owned parks.				Moderate to High	City	2015–2020

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SW-1 WASTE REDUCTION

Support waste reduction through the following sub-measures.

Solid waste sub-measures SW-1A through SW-1E support measure SW-1 and when combined reduce GHG emissions in Vacaville by 7,770 MTC02e, or 12 percent of the total GHG emission reductions. The modeling conservatively assumes a 66 percent waste diversion rate (approximately 12 percent increase) based on historic trends in waste disposal in the city. Therefore, the matrix does not show a quantified percent of total GHG reductions for each sub-measure, and it does not list any assumptions.

SW-1A Construction Waste Diversion

Continue to require at least 50 percent diversion (i.e. reuse or recycling) of non-hazardous construction waste from disposal, consistent with CALGreen - the Statewide Green Building code.

GHG Emissions Reduction: Sub-measure SW-1A is a component of the overall measure SW-1, which reduces GHG emissions by 7,770 MTC02e.

Reduces GHG By:

- Supporting alternatives to solid waste disposal in landfills, such as reuse and recycling.
- Supporting greater reuse and alternative solid waste disposal.
- Supporting reduced solid waste in landfills.
- Supporting energy conservation and reduced energy use related to solid waste disposal.

Cost Effectiveness: High

No new costs to the City. Potential savings to developers through recycling various construction materials.

Action Items and Responsible Parties:

Community Development Department staff:

- Review proposed construction and demolition permit applications for consistency with measure SW-1A.

Developers/Property owners:

- Illustrate compliance with at least 50 percent diversion of non-hazardous construction waste from disposal in development applications and implement applicable features upon project approval.

Implementation Schedule: Ongoing

SW-1B Recycling Areas in Multi-Family Developments

Require all new and existing multi-family developments that are redeveloping or remodeling to provide recycling areas for their residents. Allow a reduction in the parking requirement if necessary to allow adequate space for the recycling area.

GHG Emissions Reduction: Sub-measure SW-1B is a component of the overall measure SW-1, which reduces GHG emissions by 7,770 MTC02e.

Reduces GHG By:

- Supporting alternatives to solid waste disposal in landfills through recycling.
- Supporting reduced solid waste in landfills.
- Supporting energy conservation and reduced energy use related to solid waste disposal.
- Supporting convenient disposal for recyclable items.
- Providing incentives that support alternatives to solid waste disposal in landfills.

Cost Effectiveness: High

Costs from staff time needed to draft, adopt, and implement enabling ordinances for the sub-measure SW-1B's requirements. Potential costs to property owners/developers from the need for increased space, management, or number of receptacles to accommodate recycling.

Action Items and Responsible Parties:

Community Development Department staff:

- Amend the Land Use and Development Code to include sub-measure SW-1B.
- Review proposed development applications and environmental documents for consistency with sub-measure SW-1B.

Developers/Property owners:

- Design and construct redeveloping, remodeling, and existing multi-family developments projects to provide recycling areas for their residents.

Implementation Schedule: 2014–2015

SW-1C Waste Reduction Outreach

Continue to promote recycling and waste diversion in Vacaville through marketing efforts to increase participation by residents and businesses. As part of this program, continue to conduct through the City's Recycling Coordinator public education and outreach about reuse and recycling, including existing programs for appliance disposal, yard debris and kitchen waste collection and composting, waste to energy, and zero waste programs. Where applicable, coordinate recycling outreach efforts with the City's contracted solid waste hauler Recology Vacaville Solano (RVS).

GHG Emissions Reduction: Sub-measure SW-1C is a component of the overall measure SW-1, which reduces GHG emissions by 7,770 MTC02e.

Reduces GHG By:

- Providing educational tools to community members and business owners that enable recycling as a viable alternative to solid waste disposal.
- Supporting alternatives to solid waste disposal in landfills through reuse and recycling.
- Supporting reduced solid waste disposal in landfills.
- Supporting energy conservation and reduced energy use related to solid waste disposal.

Cost Effectiveness: Unknown

Costs from staff time needed to create promotional materials and conduct public outreach regarding waste diversion. Any costs or savings to developers/homeowners would be voluntary and variant.

Action Items and Responsible Parties:

Community Development and Public Works Department staff:

- Continue the City's educational and outreach programs about waste reduction consistent with sub-measure SW-1C.

Implementation Schedule: Ongoing

SW-1D Salvaged, Recycled-Content, and Local Construction Materials

Encourage the use of salvaged and recycled-content materials and other materials that have low production energy costs for building materials, hard surfaces, and non-plant landscaping. Require sourcing of construction materials locally, as feasible.

GHG Emissions Reduction: Sub-measure SW-1D is a component of the overall measure SW-1, which reduces GHG emissions by 7,770 MTC02e.

Reduces GHG By:

- Conserving energy and reducing energy use related to solid waste disposal and production and transport of new materials.
- Increasing alternatives to solid waste disposal in landfills through reuse and recycling.
- Reducing solid waste in landfills.
- Reducing heavy-duty vehicle use and associated fossil-fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed to creating promotional materials and conducting public outreach regarding the use of salvaged, recycled, and locally-produced materials. Any costs to property owners/developers from use of locally sourced building materials would be voluntary. Potential increased revenue to local business and the tax base.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop informational materials and outreach to encourage the use of salvaged and recycled materials.
- Amend the Land Use and Development Code to require the sourcing of construction materials locally as feasible consistent with sub-measure SW-1D.
- Review proposed development applications and environmental documents for consistency with measure SW-1D.

Developers/Property owners:

- Design and construct new and remodeling projects to use salvaged and recycled-content materials and other materials that have low production energy costs for building materials, hard surfaces, and non-plant landscaping, and use local construction materials, as feasible.

Implementation Schedule: 2015–2020

SW-1E Downtown Recycling Containers

Investigate the provision of recycling containers Downtown and in City-owned parks.

GHG Emissions Reduction: Sub-measure SW-1E is a component of the overall measure SW-1, which reduces GHG emissions by 7,770 MTC02e.

Reduces GHG By:

- Providing the opportunity to community members and visitors to recycle while in the Downtown and City parks.
- Increasing alternatives to solid waste disposal in landfills through recycling.
- Decreasing solid waste disposal in landfills.
- Conserving energy and reducing energy use related to solid waste disposal.
- Increasing convenient disposal for recyclable items.

Cost Effectiveness: Moderate to High

Costs to the City include administration of municipal waste collection from public receptacles, as well as from the provision and ongoing maintenance of those receptacles. Potential cost savings as need for landfill decreases over time.

Action Items and Responsible Parties:

Public Works Department staff:

- Install recycling containers in the Downtown and parks, as needed and deemed appropriate.

Implementation Schedule: 2015–2020

PARKS, OPEN SPACE, AND AGRICULTURE

The parks, open space, and agriculture measures would not result in measureable reductions in GHG emissions in Vacaville. Therefore, the matrix does not show a quantified percent of total GHG reductions for these non-quantified measures, and it does not list any assumptions. However, they are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville. A summary of the implementation items for each parks, open space, and agriculture measure is provided in Table 5-8.

Since projected GHG emissions reductions from individual parks, open space, and agriculture measures are not available, it is not practical to provide estimates of cost-effectiveness for those measures.

How Parks, Open Space, and Agriculture Measures Reduce GHGs

The primary mechanism through which parks, open space, and agriculture measures serve to reduce GHGs is through the sequestration (long-term storage) of carbon in biomass such as trees and soil. For parks, open space, and agriculture measures, GHG emissions reductions are largely incidental to the other sustainability benefits they offer and would be relatively minor.

Other Benefits of Parks, Open Space, and Agriculture Measures

In addition to providing opportunities for recreation and improved public health, regional and urban parks and open spaces create wildlife habitat and help mitigate urban heat-island effects. Community gardens similarly make multiple contributions to overall sustainability by helping to improve public health, increasing local food production and thus reducing the distance food must travel, and providing additional habitat and foraging opportunities for wildlife.

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TABLE 5-8 **PARKS, OPEN SPACE, AND AGRICULTURE MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
OS-1	Continue to identify and inventory potential community garden and urban farm sites in existing parks, public easements, right-of-ways, and schoolyards, and develop a program to establish pesticide-free community gardens in appropriate locations.	--			Unknown	City	2015–2020
OS-2	Encourage significant new residential developments over 50 units to include space that can be used to grow food.	--			Unknown	City	2015–2020
OS-3	Establish a process through which a neighborhood can propose and adopt a site as a community garden.	--			Unknown	City/ Neighborhoods	2015–2020
OS-4	Continue to support the Vacaville Farmers' Market as a source for locally-grown food.	--			Unknown	City	Ongoing
OS-5	Review the City's existing open space development impact fee, and consider incorporating trail requirements into the fee program.	--			Unknown	City	2014–2015

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OS-1 Community Garden and Urban Farm Sites Inventory

Continue to identify and inventory potential community garden and urban farm sites in existing parks, public easements, right-of-ways, and schoolyards, and develop a program to establish pesticide-free community gardens in appropriate locations.

Reduces GHG By:

- Increasing locations for carbon-storing biomass (trees and plants).
- Supporting the provision of areas that naturally reduce the urban heat-island effects, thus conserving energy and reducing energy demand.
- Supporting opportunities for convenient pesticide-free food.
- Supporting reduced farm equipment use required for mechanized farming methods.
- Supporting reduced automobile and long-haul truck use for the transport of food, and associated fossil–fuel consumption.

Cost Effectiveness: Unknown

Costs from staff time needed to continue identifying and inventorying potential sites consistent with measure OS-1. Potential savings to participating residents.

Action Items and Responsible Parties:

Community Services and Public Works Department staff:

- Continue to inventory potential community garden sites and develop the associated community garden programs consistent with measure OS-1.

Implementation Schedule: 2015–2020

OS-2 Garden Areas in New Development

Encourage significant new residential developments over 250 units to include space that can be used to grow food.

Reduces GHG By:

- Supporting more locations for carbon-storing biomass (trees and plants).
- Supporting the provision of areas that naturally reduce the urban heat-island effects, thus conserving energy and reducing energy demand.
- Supporting opportunities for convenient pesticide-free food.
- Supporting reduced farm equipment use required for mechanized farming methods.
- Supporting reduced automobile and long-haul truck use for the transport of food, and associated fossil–fuel consumption.

Cost Effectiveness: Unknown

City costs would result from staff time to develop informational materials and conduct outreach during the project review process.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop informational materials and conduct outreach during the project review process to encourage development applicants to include garden areas in large residential projects.

Implementation Schedule: 2015–2020

OS-3 Community Garden Process

Establish a process through which a neighborhood can propose and adopt a site as a community garden.

Reduces GHG By:

- Supporting more locations for carbon-storing biomass (trees and plants).
- Supporting the provision of areas that naturally reduce the urban heat-island effects, thus conserving energy and reducing energy demand.
- Supporting opportunities for convenient pesticide-free food.
- Supporting reduced farm equipment use required for mechanized farming methods.
- Supporting reduced automobile and long-haul truck use for the transport of food, and associated fossil–fuel consumption.

Cost Effectiveness: Unknown

Staff time to draft and adopt a process for the establishment of new community garden sites. Potential costs for residents who voluntarily choose to take advantage of this new program to create new community garden sites.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop a process for the establishment of new community garden sites consistent with measure OS-3.

Implementation Schedule: 2015–2020

OS-4 VACAVILLE FARMERS' MARKET

Continue to support the Vacaville Farmers' Market as a source for locally-grown food.

REDUCES GHG BY:

- Supporting opportunities for convenient pesticide-free food.
- Supporting reduced automobile and long-haul truck use for the transport of food, and associated fossil–fuel consumption.

COST EFFECTIVENESS: UNKNOWN

City costs would include materials and staff time needed to support the Farmers' Market through outreach and institutional support.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Continue to support the Farmers' Market through outreach and institutional support.

IMPLEMENTATION SCHEDULE: Ongoing

OS-5 Development Impact Fee for Trails

Review the City's existing open space development impact fee, and consider incorporating trail requirements into the fee program.

Reduces GHG By:

- Supporting reduced automobile use and associated fossil-fuel consumption.
- Supporting convenient walking and bicycling opportunities.
- Supporting walking and bicycling as viable alternative modes of transportation.

Cost Effectiveness: Unknown

Costs from staff time needed to review the City's existing open space development impact fee, and draft additional language consistent with measure on OS-5.

Action Items and Responsible Parties:

Community Development Department staff:

- Review the existing fee program, conduct a nexus study, and incorporate trail requirements into the open space fee as appropriate.

Implementation Schedule: 2014–2015

PURCHASING

The purchasing measure would not result in measureable reductions in GHG emissions in Vacaville. Therefore, the matrix does not show a quantified percent of total GHG reductions for this non-quantified measure, and it does not list any assumptions. However, it is important in helping to reach the City's overall goal of reducing GHG emissions. A summary of the implementation items for the purchasing measure is provided in Table 5-9.

Since a projected GHG emissions reduction from this measure is not available, it is not practical to provide an estimate of cost-effectiveness for this measure.

How Purchasing Measures Reduce GHGs

The GHG reduction mechanism of the purchasing measures is similar to, and in some ways an extension of, that of the solid waste measures. Careful purchasing decisions can help ensure that the acquired products are less likely to become and/or generate waste and were produced using fewer resources, more efficient processes, and thus less energy. As discussed above, actions which limit energy use, most notably energy use from fossil fuels, serve to reduce GHG emissions.

GHG emission reductions from this measure cannot be readily quantified because such reductions relate to what are known as lifecycle emissions, which are the emissions generated by the activities and processes associated with materials extraction and manufacturing for consumer products. Such emissions are extremely difficult to quantify due to the complexity of the systems which produce these goods. The production of consumer goods has far-reaching impacts in regard to energy, resources, and the natural environment. In this way, the purchasing measure touches on all of these issues. By promoting reduced or more conscientious purchasing of consumer products, it is able to broadly increase sustainability.

TABLE 5-9 **PURCHASING MEASURE**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
P-1	Develop policies, incentives, and design guidelines that encourage the public and private purchase and use of durable and nondurable items, including building materials, made from recycled materials or renewable resources.	--			Unknown	City	2015–2020

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P-1 Purchasing of Recycled Materials

Develop policies, incentives, and design guidelines that encourage the public and private purchase and use of durable and nondurable items, including building materials, made from recycled materials or renewable resources.

Reduces GHG By:

- Providing tools and incentives that promote the best practices for purchasing goods.
- Supporting reduced energy related to solid waste disposal.
- Supporting reduced solid waste in landfills.
- Supporting reused and recycled goods as an alternative to new goods.
- Supporting energy conservation related to solid waste disposal and production and transport of new materials.

Cost Effectiveness: Unknown

City costs would stem from staff time and materials needed to develop policies, incentives, and design guidelines consistent with measure P-1.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop policies, incentives, and guidelines to encourage the purchase of items made from recycled or renewable resources.

Implementation Schedule: 2015–2020

COMMUNITY ACTION

The community action measures would not result in measureable reductions in GHG emissions in Vacaville. Therefore, the matrix does not show a quantified percent of total GHG reductions for the non-quantified measures, and it does not list any assumptions. However, they are important in helping to reach the City's overall goal of reducing GHG emissions in Vacaville. A summary of the implementation items for each community action measure is provided in Table 5-10.

Since projected GHG emissions reductions from individual community action measures are not available, it is not practical to provide estimates of cost-effectiveness for those measures.

How Community Action Measures Reduce GHGs

The infeasibility of quantifying the emissions reductions from community action measures stems directly from the broad ways in which they contribute to sustainability. While community action measures in and of themselves would not direct contribute to decreased GHGs or improved sustainability, these measures would serve to facilitate the other measures in this Energy and Conservation Action Strategy by informing the public about actions they can take to improve sustainability, and by encouraging residents and businesses to take those actions.

TABLE 5-10 **COMMUNITY ACTION MEASURES**

Measure Number	Measure Text	GHG ($MTCO_2e$) and VMT Reduction (Per Year)	% of Total Reduction for this Sector	% of Total Reduction	Cost Effectiveness	Responsible Party	Implementation Schedule
CA-1	Develop and implement an outreach plan to engage local businesses in GHG emissions reduction programs.	--			Unknown	City/Local Businesses	2015–2020
CA-2	Establish and maintain a "sustainability information center" at City Hall to inform the public and distribute available brochures, and provide information on sustainability on the City's website.	--			Unknown	City	2015–2020
CA-3	Continue to conduct outreach to encourage residents to shop locally and support local business.	--			Unknown	City	Ongoing

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CA-1 Local Business Participation

Develop and implement an outreach plan to engage local businesses in GHG emissions reduction programs.

Reduces GHG By:

- Providing relevant data to local businesses to implement strategies that reduce GHG emissions.
- Encouraging local businesses to implement strategies that reduce GHG emissions.

Cost Effectiveness: Unknown

City costs would stem from staff time and materials needed to develop and implement an outreach plan consistent with measure CA-1.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop and implement an outreach plan for local businesses consistent with measure CA-1.

Implementation Schedule: 2015–2020

CA-2 Sustainability Information Center

Establish and maintain a "sustainability information center" at City Hall to inform the public and distribute available brochures, and provide information on sustainability on the City's website.

Reduces GHG By:

- Providing relevant data to the public that supports the implementation of strategies that reduce GHG emissions.
- Encouraging the public to apply best practices that reduce GHG emissions.

Cost Effectiveness: Unknown

City costs would stem from the staff time and materials needed to establish and maintain a "sustainability information center" at City Hall consistent with measure CA-2.

Action Items and Responsible Parties:

Community Development Department staff:

- Develop outreach materials, establish and maintain the sustainability information center, and regularly update the City's website with sustainability information.

Implementation Schedule: 2015–2020

CA-3 Support for Local Businesses

Continue to conduct outreach to encourage residents to shop locally and support local business.

Reduces GHG By:

- Encouraging the public to apply best practices that reduce GHG emissions.
- Supporting reduced automobile and long-haul truck use for the transport of goods.

Cost Effectiveness: Unknown

City costs would stem from the staff time and materials needed to continue outreach efforts to support local businesses consistent with measure CA-3 and no additional costs would occur. Potential increased revenue to local business and the tax base.

Action Items and Responsible Parties:

Community Development Department staff:

- Continue conducting outreach to support local businesses consistent with measure CA-3.

Implementation Schedule: Ongoing

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6 MUNICIPAL MEASURES, IMPLEMENTATION, AND MONITORING

This chapter presents the municipal greenhouse gas (GHG) emissions reduction measures that the City of Vacaville will implement. These measures were developed with community involvement, including a Community Workshop held on March 17, 2012 and a Steering Committee meeting held on March 22, 2012.

The measures are divided into the following nine GHG emission sectors:

1. Transportation and Land Use
2. Green Building
3. Renewable Energy and Low Carbon Fuels
4. Energy Conservation
5. Water and Wastewater
6. Solid Waste
7. Parks, Open Space, and Agriculture
8. Purchasing

The municipal measures will decrease GHG emissions from City operations. However, because the City's operations represent such a small percentage of the total GHG emissions in Vacaville, as discussed in Chapter 2, the overall GHG emissions reductions would be minimal, and were therefore not quantified. Although these measures would have a minimal reduction in GHG emissions in Vacaville overall, they demonstrate that the City is committed to improving the quality of life for residents and visitors of Vacaville and the surrounding area.

This chapter presents the municipal measures and their implementation information, including action items, responsible parties, and a schedule for implementation. Since projected GHG emissions reductions from individual municipal measures are not available, it is generally not practical to provide estimates of cost-effectiveness for those measures in the matrix below. Some municipal measures, however, present clear-cut cost saving opportunities for the City. It is possible to automatically classify such measures as cost-effective, irrespective of resulting GHG reductions. All municipal measures with cost savings potential and therefore moderate to high cost effectiveness are analyzed below. For all other municipal operations measures, the cost-effectiveness cannot reasonably be determined.

The implementation schedule separates measures into two main time periods for implementation: 2014 to 2015 and 2015 to 2020. Phases indicate when implementation of the measure begins. Overall maintenance of the program will extend well beyond the allotted phase. The implementation schedule prioritizes measures based on cost-effectiveness and/or

feasibility. Some reduction strategies are expected to be implemented on a later timeline due to obstacles of available data, technology, or finances.

TRANSPORTATION AND LAND USE

A summary of the implementation items for each transportation and land use reduction measure is provided in Table 6-1.

TABLE 6-1 TRANSPORTATION AND LAND USE MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
TR-1	When repaving roadways under the City's roadway repaving schedule, consider adding new bikeways.	Unknown	2014-2015
TR-2	Install additional electric vehicle charging stations at City Hall and other appropriate municipal parking lots for public use as warranted by demand and as funding allows.	Unknown	2015-2020
TR-3	Continue to add pedestrian count-down equipment when signals are modified, and include pedestrian count-down equipment with new signal construction.	Unknown	2014-2015
TR-4	To the extent possible, develop and implement a plan to replace existing City-owned vehicles that are at the end of their utility with alternative-fuel vehicles, where warranted by the vehicle's purpose and ability to fulfill that purpose using alternative fuel, and where available funding allows for the procurement of alternative-fuel vehicles. The plan should also include additional electric vehicle charging stations in City-owned lots for City employee and/or in public-use parking lots, as warranted by demand and as funding allows.	Moderate	2014-2015
TR-5	Establish a fuel conservation program for the City's vehicle fleet and require driver training for fuel conservation for all employees who use fleet vehicles.	High	2014-2015
TR-6	Continue to use compressed natural gas buses for the City's bus fleet, so long as the cost remains competitive with other alternatives.	Unknown	2014-2015
TR-7	Develop a commute benefits program for City employees so that the City can lead by example. Such a program may contain elements such as preferential parking for vanpools and carpools, a commuter tax benefit program for those who take transit or bike to work, and a guaranteed ride home provision.	Unknown	2015-2020

TR-1 BIKEWAY REPAVING

When repaving roadways under the City's roadway repaving schedule, consider adding new bikeways.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Revise the repaving schedule to include bikeways as deemed appropriate consistent with municipal measure TR-1.

IMPLEMENTATION SCHEDULE: 2014-2015

TR-2 ELECTRIC VEHICLE CHARGING STATIONS

Install additional electric vehicle charging stations at City Hall and other appropriate municipal parking lots for public use as warranted by demand and as funding allows.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Study the demand for electric vehicle charging stations at City Hall and other municipal parking lots, and install new stations as warranted by demand and as funding allows, consistent with municipal measure TR-2.

IMPLEMENTATION SCHEDULE: 2015-2020

TR-3 COUNT-DOWN PEDESTRIAN SIGNAL EQUIPMENT

Continue to add pedestrian count-down equipment when signals are modified, and include pedestrian count-down equipment with new signal construction.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Continue to add pedestrian count-down equipment to signal modification plans and include pedestrian count-down equipment with new signal construction consistent with municipal measure TR-3.

IMPLEMENTATION SCHEDULE: 2014-2015

TR-4 ALTERNATIVE-FUELED VEHICLES

To the extent possible, develop and implement a plan to replace existing City-owned vehicles that are at the end of their utility with alternative-fuel vehicles, where warranted by the vehicle's purpose and ability to fulfill that purpose using alternative fuel, and where available funding allows for the procurement of alternative-fuel vehicles. The plan should also include additional electric vehicle charging stations in City-owned lots for City employee and/or in public-use parking lots, as warranted by demand and as funding allows.

COST EFFECTIVENESS: MODERATE
Costs to the City would stem from the staff time needed to draft, adopt, and administer modified vehicle replacement policies, as well as from the actual cost of vehicle replacement and maintenance.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- To the extent possible, develop and implement a plan to replace the City's fleet with alternative fueled-vehicles where the vehicle purpose is applicable to alternative fuel use, and consider the need for additional electric vehicle charging stations based on the addition of any electric vehicles consistent with municipal measure TR-4.

IMPLEMENTATION SCHEDULE: 2014-2015

TR-5 FUEL CONSERVATION PROGRAM

Establish a fuel conservation program for the City's vehicle fleet and require driver training for fuel conservation for all employees who use fleet vehicles.

COST EFFECTIVENESS: HIGH
Costs to the City would stem from the staff time needed to draft, adopt, and administer the program and subsequent training. City could experience potential long-term savings on fuel and vehicle maintenance, which could offset any up-front costs.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Develop a fuel conservation program consistent with municipal measure TR-5.
- Require City employees to participate in fuel conservation training.

IMPLEMENTATION SCHEDULE: 2014-2015

TR-6 Compressed Natural Gas Buses

Continue to use compressed natural gas buses for the City's bus fleet, so long as the cost remains competitive with other alternatives.

Action Items and Responsible Parties:
Public Works Department staff:

- Ensure that it continues to use compressed natural gas buses for the City's bus fleet consistent with municipal measure TR-6.

Implementation Schedule: 2014-2015

TR-7 City Employee Trip Reduction Program

Develop a commute benefits program for City employees so that the City can lead by example. Such a program may contain elements such as preferential parking for vanpools and carpools, a commuter tax benefit program for those who take transit or bike to work, and a guaranteed ride home provision.

Action Items and Responsible Parties:
Community Development and Public Works Department staff:

- Develop a commute benefits program, and implement the program components.

Implementation Schedule: 2015-2020

GREEN BUILDING

A summary of the implementation items for each green building measure is provided in Table 6-2.

TABLE 6-2 GREEN BUILDING MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
GB-1	Encourage major new municipal buildings and facilities to meet LEED Silver, Build-It-Green, or GreenPoint standards, or achieve a comparable rating from a different rating system.	High	2014-2015
GB-2	Train all planning, plan review, and building inspection staff in green building materials, techniques, and practices.	Unknown	2014-2015

GB-1 GREEN CERTIFICATION IN MUNICIPAL BUILDINGS

Encourage major new municipal buildings and facilities to meet LEED Silver, Build-It-Green, or GreenPoint standards, or achieve a comparable rating from a different rating system.

COST EFFECTIVENESS: HIGH

Staff-time costs to potentially draft and adopt implementing language for this measure would be low to moderate depending on the degree of detail in adopted guidelines. Building to LEED standards has generally been shown to add $3 to $5 per square foot to building costs. For LEED Silver certification specifically, overall building costs are on average 2.1 percent higher than for a similar, conventional building. It has been found, however, that these costs are far outweighed by quantifiable financial benefits accrued over the lifetime of a LEED-certified building. For energy-use alone, the 20-year Net Present Value of a LEED building is $5.79 per square foot, which is greater than the increase in per-square-foot cost. Even greater cost savings would likely accumulate over the anticipated lifetime of a LEED building, which extends well beyond 20 years. In addition to the more precisely estimable savings from reductions in waste, energy needs, and water use, worker productivity and health gains add to the cost savings associated with LEED and other green buildings. Given its overall net cost savings this measure is deemed highly cost-effective.[1]

[1] Kats, Greg, 2003, *Report: The Costs and Financial Benefits of Green Buildings.*

ACTION ITEMS AND RESPONSIBLE PARTIES:
Community Development Department staff:

- Consider the feasibility of pursuing LEED, Build-It-Green, or GreenPoint standards when planning new municipal buildings and facilities, and pursue them as appropriate, consistent with municipal measure GB-1.

IMPLEMENTATION SCHEDULE: 2014-2015

GB-2 GREEN BUILDING TRAINING

Train all planning, plan review, and building inspection staff in green building materials, techniques, and practices.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Either provide training for its plan review and building inspection staff or send such staff to training programs held by outside agencies consistent with municipal measure GB-2.

IMPLEMENTATION SCHEDULE: 2014-2015

RENEWABLE ENERGY AND LOW CARBON FUELS

A summary of the implementation items for each renewable energy and low carbon fuels measure is provided in Table 6-3.

TABLE 6-3 RENEWABLE ENERGY AND LOW CARBON FUELS MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
RE-1	Conduct a solar feasibility study and install solar panels on appropriate City facilities.	High	2015-2020
RE-2	Install solar water heating at appropriate City facilities.	High	2014-2015

RE-1 SOLAR ENERGY FOR CITY FACILITIES

Conduct a solar feasibility study and install solar panels on appropriate City facilities.

COST EFFECTIVENESS: HIGH

Staff-time costs for this measure are anticipated to be moderate and would stem from the need to either undertake or commission a solar feasibility study. Should the City opt to have such a study performed by a third party, this could represent an additional cost. However, by identifying optimal locations, a feasibility study would serve to improve the cost effectiveness of solar installations. This would ensure that those solar panels which are installed offer the greatest return on investment, thus offering long-run cost savings to the City. Therefore, this measure is deemed highly cost-effective.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Public Works Department staff:

- Conduct the solar feasibility study, and based on the results of that study, install solar panels on appropriate City facilities consistent with municipal measure RE-1.

IMPLEMENTATION SCHEDULE: 2015-2020

RE-2 SOLAR WATER HEATING AT CITY FACILITIES

Install solar water heating at appropriate City facilities.

COST EFFECTIVENESS: HIGH

Staff-time costs for this measure are anticipated to be low and would stem from the need to initiate oversee the installation of solar water heating systems. Solar water heaters offer good potential for overall cost-effectiveness.[2] Costs for solar water heating systems in an institutional setting vary greatly depending upon the size of the building served and anticipated demands on the system. For reference, the National Renewable Energy Laboratory estimates that costs for domestic solar water heating systems range between approximately $2,200 and $5,850. This value depends largely upon whether the system is active or passive.[3] Despite the high initial cost, solar water heaters in institutional settings have been demonstrated to result in long-term cost savings.[4]

ACTION ITEMS AND RESPONSIBLE PARTIES:

Public Works Department staff:

- Install tankless and/or solar water heating at appropriate facilities consistent with municipal measure RE-2.

IMPLEMENTATION SCHEDULE: 2014-2015

[2] EnergyStar, *Save Money and More with ENERGY STAR Qualified Solar Water Heaters*, http://www.energystar.gov/index.cfm?c=solar_wheat.pr_savings_benefits, accessed on May 1, 2012.

[3] National Renewable Energy Laboratory, Department of Energy, 1996, *Solar Water Heating.* (Value converted to from 1996 to 2012 dollars.)

[4] Federal Energy Management Program, 2004, *Heating Water with Solar Energy Costs Less at the Phoenix Federal Correctional Institution.*

ENERGY CONSERVATION

A summary of the implementation items for each energy conservation measure is provided in Table 6-4. Since energy conservation measures EC-1 through EC-6 would all serve to reduce energy use related to municipal operations, all six of these measures have the potential to be highly cost effective. However, without precise estimates of measure costs or, more importantly, energy savings, it is not feasible to conclusively establish the cost-effectiveness of these measures. Nevertheless, given the level of cost effectiveness generally demonstrated by most energy conservation measures, it is predicted that implementation of measures EC-1 through EC-6 would be highly cost effective.

TABLE 6-4 ENERGY CONSERVATION MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
EC-1	Continue to periodically conduct, with assistance from Pacific Gas & Electric (PG&E), thorough energy audits of all City facilities to identify cost-effective opportunities for conservation.	High	On-Going
EC-2	Encourage the installation of reflective roofing on City facilities.	High	2015-2020
EC-3	Establish energy efficiency standards for City facilities and provide employees with guidelines, instructions, and requirements for the efficient use of facilities.	High	2014-2015
EC-4	Continue to participate in peak electricity demand reduction programs and undertake peak demand measures at City facilities.	High	2014-2015
EC-5	As outdated electronic appliances and office equipment in City facilities are retired, replace them with energy-efficient models.	High	2014-2015
EC-6	Continue to retrofit City street lights to LED, induction, or other energy efficient lighting.	High	2014-2015

EC-1 Energy Audit of City Facilities

Continue to periodically conduct, with assistance from Pacific Gas & Electric (PG&E), thorough energy audits of all City facilities to identify cost-effective opportunities for conservation.

Action Items and Responsible Parties:
Public Works Department staff:

- Coordinate with PG&E to conduct energy audits of City facilities consistent with municipal measure EC-1.

Implementation Schedule: On-Going

EC-2 Reflective Roofing on City Facilities

Encourage the installation of reflective roofing on City facilities.

Action Items and Responsible Parties:
Public Works Department staff:

- Install reflective roofing on City facilities consistent with municipal measure EC-2 as needed, or as roofs are replaced.

Implementation Schedule: 2015-2020

EC-3 Energy Efficiency Standards for City Facilities

Establish energy efficiency standards for City facilities and provide employees with guidelines, instructions, and requirements for the efficient use of facilities.

Action Items and Responsible Parties:
Community Development and Public Works Department staff:

- Develop and adopt energy efficiency standards for City facilities and educate City staff on efficient use of facilities consistent with municipal measure EC-3.

Implementation Schedule: 2014-2015

EC-4 Peak Electricity Demand Reduction

Continue to participate in peak electricity demand reduction programs and undertake peak demand measures at City facilities.

Action Items and Responsible Parties:
Public Work Department staff:

- Reduce electricity demands in peak periods and participate in peak electricity demand reduction programs consistent with municipal measure EC-4.

Implementation Schedule: 2014-2015

EC-5 Energy-Efficient Appliances and Office Equipment

As outdated electronic appliances and office equipment in City facilities are retired, replace them with energy-efficient models.

Action Items and Responsible Parties:
Community Development Department staff:

- Establish a policy to replace appliances and equipment with energy-efficient models when existing equipment becomes outdated and requires replacement consistent with municipal measure EC-5.

Implementation Schedule: 2014-2015

EC-6 Street Light Retrofits

Continue to retrofit City street lights to LED, induction, or other energy efficient lighting.

Action Items and Responsible Parties:
Public Works Department staff:

- Continue to retrofit street lights consistent with municipal measure EC-6.

Implementation Schedule: 2014-2015

WATER AND WASTEWATER

A summary of the implementation items for each water and wastewater measure is provided in Table 6-5.

TABLE 6-5 WATER AND WASTEWATER MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
WW-1	Continue to install water-conserving fixtures in all new City facilities and retrofit existing City facilities with water-conserving fixtures as funding allows.	High	On-Going
WW-2	Continue to install weather-based evapotranspiration (ET) controller irrigation systems at large landscape areas where appropriate and cost effective.	High	On-Going
WW-3	Continue to install drought-tolerant native landscaping at new City facilities and evaluate the cost effectiveness of replacing existing landscaping with drought-tolerant native landscaping, where appropriate.	High	On-Going
WW-4	Encourage the use of recycled water or other non-potable water for City landscaping, including parks and medians, where available.	Unknown	Per DWR[a]
WW-5	Continue to evaluate co-generation facilities for future use at the Easterly Wastewater Treatment Plant.	Unknown	On-Going
WW-6	Continue to improve the efficiency of lighting systems at the Easterly Wastewater Treatment Plant through the following: ➤ Install efficient lighting and lighting control systems. ➤ Install LEDs for outdoor lighting. ➤ Establish limited hours of outdoor lighting.	High	2014-2015
WW-7	Continue to enhance a landscape buffer for the Easterly Wastewater Treatment Plant, including extensive tree plantings.	Unknown	On-Going

TABLE 6-5 WATER AND WASTEWATER MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
WW-8	Continue to implement the planned water-efficient landscaping at the Easterly Wastewater Treatment Plant, including: ➤ Efficient landscaping as prescribed by City Landscape Standards. ➤ Potential use of reclaimed water for landscape irrigation.	High	On-Going

[a] Per DWR indicates that this measure is dependent on the California Department of Water Resources, which has not yet identified an implementation schedule.

WW-1 WATER-CONSERVING FIXTURES IN CITY FACILITIES

Continue to install water-conserving fixtures in all new City facilities and retrofit existing City facilities with water-conserving fixtures as funding allows.

COST EFFECTIVENESS: HIGH

Staff-time costs for this measure are anticipated to be low and would stem from the need to initiate and manage the installation of water-efficient fixtures. In other institutional settings, water-conserving fixtures have been shown to result in substantial cost savings that can offer simple payback times of as little as 2.12 years–as in the case of the Portland, Oregon Veterans' Affairs Medical Center.[5] While overall City operations in Vacaville can generally be expected to have lower water-use than a typical medical facility, the success of the Portland conservation program nonetheless indicates a strong potential for long-term savings for the City.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Public Works Department staff:

- Install water-conserving fixtures in new City facilities and retrofit existing facilities as appropriate consistent with municipal measure WW-1.

IMPLEMENTATION SCHEDULE: On-Going

[5] Federal Energy Management Program, 2009, *Case Study: Veterans Affairs Medical Center in Portland, Oregon.*

WW-2 IRRIGATION FOR CITY FACILITIES

Continue to install weather-based evapotranspiration (ET) controller irrigation systems at large landscape areas where appropriate and cost effective.

COST EFFECTIVENESS: HIGH

Since this measure is already in the process of being implemented, additional staff-time costs to the City would be very low. Costs of evapotranspiration (ET) controller systems vary by the size and type of system; however, Solano County undertook and reported on a four-city ET controller installation project in 2005, and found the total cost of the project to be $273,000. Water cost savings from the project were estimated at approximately $65,000 annually for the four cities combined. Therefore, ET control systems offer significant cost-saving opportunities and could have potential simple payback periods of as short as five years.[6] This measure is already being implemented, would carry low additional costs, and could substantially reduce water costs for the City.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Utilities & Public Works Department staff:

- Continue to install weather-based ET controller irrigation systems in large landscaped areas consistent with municipal measure WW-2.

IMPLEMENTATION SCHEDULE: On-Going

WW-3 DROUGHT-TOLERANT LANDSCAPING FOR CITY FACILITIES

Continue to install drought-tolerant native landscaping at new City facilities and evaluate the cost effectiveness of replacing existing landscaping with drought-tolerant native landscaping, where appropriate.

COST EFFECTIVENESS: HIGH

The City could potentially experience significant savings from landscaping that is less water intense. Such landscaping has strong potential to result in long-term cost savings for the City.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Public Works Department staff:

- Install new and replace existing landscaping as directed, consistent with municipal measure WW-3.

IMPLEMENTATION SCHEDULE: On-Going

[6] Solano County Water Agency, 2005, 2005 Annual Report, *Grant E-67020, Evapotranspiration Controller System Project*, http://www.rainmaster.com/PDF/SolanoCounty_WaterAgency_ET_Controller_Project.pdf, accessed on June 11, 2012.

WW-4 Recycled Water Irrigation for City Facilities

Encourage the use of recycled water or other non-potable water for City landscaping, including parks and medians, where available.

Action Items and Responsible Parties:
Public Works Department staff:

- Install necessary infrastructure and use recycled water or other non-potable water for City landscaping where appropriate consistent with municipal measure WW-4.

Implementation Schedule: This measure is dependent on the California Department of Water Resources, which has not yet identified an implementation schedule.

WW-5 Co-Generation Facilities at Easterly Wastewater Treatment Plant

Continue to evaluate co-generation facilities for future use at the Easterly Wastewater Treatment Plant.

Action Items and Responsible Parties:
Utilities Department staff:

- Continue to design co-generation facilities for the EWWTP consistent with municipal measure WW-5.

Implementation Schedule: On-Going

WW-6 Lighting at Easterly Wastewater Treatment Plant

Continue to improve the efficiency of lighting systems at the Easterly Wastewater Treatment Plant through the following:

- Install efficient lighting and lighting control systems.
- Install LEDs for outdoor lighting.
- Establish limited hours of outdoor lighting.

Cost Effectiveness: High
Since this measure is already being implemented, additional staff-time costs are anticipated to be minimal. Up-front costs of new lighting systems would likely be offset by long-term energy savings.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Utilities Department staff:

- Continue to improve the efficiency of lighting systems at the EWWTP by installing efficient lighting and lighting control systems, installing LEDs for outdoor lighting, and establishing limited hours of outdoor lighting consistent with municipal measure WW-6.

IMPLEMENTATION SCHEDULE: 2014-2015

WW-7 LANDSCAPE BUFFER AT EASTERLY WASTEWATER TREATMENT PLANT

Continue to enhance a landscape buffer for the Easterly Wastewater Treatment Plant, including extensive tree plantings.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Continue to enhance the landscape buffer for the EWWTP consistent with municipal measure WW-7.

IMPLEMENTATION SCHEDULE: On-Going

WW-8 WATER-EFFICIENT LANDSCAPING AT EASTERLY WASTEWATER TREATMENT PLANT

Continue to implement the planned water-efficient landscaping at the Easterly Wastewater Treatment Plant, including:

- Efficient landscaping as prescribed by City Landscape Standards.
- Potential use of reclaimed water for landscape irrigation.

COST EFFECTIVENESS: HIGH
See analysis for measure WW-3, above.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Continue to plant water-efficient landscaping at the Easterly WWTP consistent with municipal measure WW-8.

IMPLEMENTATION SCHEDULE: On-Going

SOLID WASTE

A summary of the implementation items for each solid waste measure is provided in Table 6-6.

TABLE 6-6 SOLID WASTE MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
SW-1	Continue to promote and provide training for recycling by City staff via the City's Recycling Coordinator.	Unknown	On-Going
SW-2	Continue to require all City departments and facilities to reuse office supplies, furniture, and computers before buying new materials. Encourage City departments and facilities to purchase products that are made with high levels of post-consumer recycled content and have limited packaging.	High	2014-2015
SW-3	Continue to incorporate the use of CNG or other appropriate alternative-fuel vehicles into contracts for solid waste collection as contract negations allow.	Unknown	On-Going

SW-1 RECYCLING COORDINATORS

Continue to promote and provide training for recycling by City staff via the City's Recycling Coordinator.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Continue to use the City's Recycling Coordinator to promote recycling.

IMPLEMENTATION SCHEDULE: On-Going

SW-2 Reuse and Recycled Content Materials

Continue to require all City departments and facilities to reuse office supplies, furniture, and computers before buying new materials. Encourage City departments and facilities to purchase products that are made with high levels of post-consumer recycled content and have limited packaging.

Cost Effectiveness: High
Costs to the City would be low to moderate and would stem mainly from staff time to create and administer office materials reuse and buying guidelines. Costs for recycled-content products and products with limited packaging are not anticipated to differ substantially from those for conventional products or those with more packaging. Moreover, by emphasizing the reuse of office materials, the City stands to experience both short- and long-term cost savings.

Action Items and Responsible Parties:
Community Development and Public Works Department staff:

- Establish a purchasing policy encouraging recycled content and packaging consistent with municipal measure SW-2.

Implementation Schedule: 2014-2015

SW-3 Solid Waste Collection Fleet

Continue to incorporate the use of CNG or other appropriate alternative-fuel vehicles into contracts for solid waste collection as contract negations allow.

Action Items and Responsible Parties:
Public Works Department staff:

- Continue to prioritize negotiations for the use of CNG or other alternative fueled vehicles for solid waste collection.

Implementation Schedule: On-Going

PARKS, OPEN SPACE, AND AGRICULTURE

A summary of the implementation items for each parks, open space, and agriculture measure is provided in Table 6-7.

TABLE 6-7 PARKS, OPEN SPACE, AND AGRICULTURE MEASURES

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
OS-1	Develop a City program for maximizing carbon sequestration on municipal property through tree planting in parks, at other City facilities, and along streets.	High	2015-2020
OS-2	Develop an adopt-a-tree program, in which community members can sponsor City tree planting by offsetting upfront costs.	Unknown	2015-2020

OS-1 TREE PLANTING ON MUNICIPAL PROPERTY

Develop a City program for maximizing carbon sequestration on municipal property through tree planting in parks, at other City facilities, and along streets.

COST EFFECTIVENESS: HIGH

Staff-time costs from this measure would be low to moderate and would stem from the need to draft, adopt, and implement a tree-planting program. Other costs from this measure would arise from tree-planting material and labor expenses. Despite these costs, urban trees have been shown to generate long-term savings well in excess of their up-front and ongoing costs.

ACTION ITEMS AND RESPONSIBLE PARTIES:

Community Development Department staff:

- Develop a tree planting program consistent with municipal measure OS-1.

IMPLEMENTATION SCHEDULE: 2015-2020

OS-2 ADOPT-A-TREE PROGRAM

Develop an adopt-a-tree program, in which community members can sponsor City tree planting by offsetting upfront costs.

ACTION ITEMS AND RESPONSIBLE PARTIES:
Public Works Department staff:

- Develop an adopt-a-tree program consistent with municipal measure OS-2.

IMPLEMENTATION SCHEDULE: 2015-2020

PURCHASING

A summary of the implementation items for each purchasing measure is provided in Table 6-8.

TABLE 6-8 **PURCHASING MEASURES**

Measure Number	Measure Text	Cost Effectiveness	Implementation Schedule
P-1	Continue to encourage the City to hire locally for its services where feasible.	Unknown	On-Going
P-2	When requesting proposals or applications for contracts, professional service agreements, or grants, request that proposals or applications include information about the sustainability practices of the organization, and use such information as a partial basis for proposal evaluations.	Unknown	2015-2020
P-3	Incorporate a "life-cycle costing" approach into City purchasing considerations, such as by evaluating whether energy-efficient products would result in long-term savings which outweigh potentially higher initial costs.	Unknown	2015-2020

P-1 LOCAL HIRING

Continue to encourage the City to hire locally for its services where feasible.

ACTION ITEMS AND RESPONSIBLE PARTIES:
City Manager's Office staff:

- Continue to implement a local hiring program for services consistent with municipal measure P-1.

IMPLEMENTATION SCHEDULE: On-Going

P-2 Sustainability Criteria in Proposal Selection Process

When requesting proposals or applications for contracts, professional service agreements, or grants, request that proposals or applications include information about the sustainability practices of the organization, and use such information as a partial basis for proposal evaluations.

Action Items and Responsible Parties:
City Manager's Office staff:

- Develop a proposal and application sustainability requirement consistent with municipal measure P-2.

Implementation Schedule: 2015-2020

P-3 Life-Cycle Costing Approach in Purchasing

Incorporate a "life-cycle costing" approach into City purchasing considerations, such as by evaluating whether energy-efficient products would result in long-term savings which outweigh potentially higher initial costs.

Action Items and Responsible Parties:
City Manager's Office staff:

- Incorporate a life-cycle costing approach into purchasing policies consistent with municipal measure P-3.

Implementation Schedule: 2015-2020

7 FUNDING, ADAPTATION, AND MONITORING

This chapter presents information about funding for projects and staffing necessary to implement this Energy and Conservation Action Strategy, as well as how this Strategy should be monitored and adapted over time.

IMPLEMENTATION FUNDING

One of the main barriers to seeing through an implementation plan is lack of available funds and City staff. There are multiple grant and loan programs through State, federal, and regional sources to combat climate change. With the establishment of this Energy and Conservation Action Strategy, Vacaville is in a position to apply for funding to implement the supporting measures in a timely fashion. Funding sources may include the Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG), as a well as State and federal agencies with similar programs.

One federal funding source is the American Recovery and Reinvestment Act of 2009 (ARRA). As part of this program the US Department of Energy administered Energy Efficiency Conservation Block Grants, and in September 2009, Vacaville received an $849,000 allocation for energy efficiency audits at City facilities, as well as replacement of heating, ventilation, and air conditioning (HVAC) system components and controls.[1] While another federal stimulus package is not anticipated in the near future, the Department of Energy or another federal department may continue to occasionally offer funding or grants for similar projects. Other federal funding may be available through the EPA, which offers a wide selection of grants at varying time intervals. Some grants which Vacaville could potentially seek during their respective application periods include:

- Non-Construction Market-Based Approaches to Reducing GHG Emissions through Energy Efficiency in Homes & Buildings grants.
- Community Action for a Renewed Environment (CARE) grants.
- Solid Waste Assistance grants.
- Source Reduction Assistance grants.

Federal transportation funding also offers important opportunities for funding projects under this Energy and Conservation Action Strategy. Like the Department of Energy, the

[1] U.S. Department of Energy, Solution Center – Project Map, http://www1.eere.energy.gov/wip/solutioncenter/project_map/projects.aspx, accessed on June 12, 2012.

Federal Transit Administration (FTA) was another source of ARRA funds and may continue to offer funding for transportation- and transit-related initiatives under the Energy and Conservation Action Strategy. In the years 2009 and 2010, Vacaville received three large ARRA grants totaling $2,860,059 from the FTA. These grants were issued to cover bus replacement, creation of new intermodal stations, and installation of electronic fare-boxes.[2] Though the FTA has closed out its ARRA funding, other federal grants, loans, or awards may be available to pursue transportation projects. Transportation Investment Generating Economic Recovery (TIGER) is a competitive grant program begun under ARRA and administered by the US Department of Transportation (USDOT). This program was continued for fiscal year 2013 and may be renewed in future years, pending congressional action. The federal Safe Routes to School (SRTS) program offers another potential funding source for transportation projects which improve the safety of walking and bicycle routes to local schools. Additionally, federal Transportation Enhancements (TE) funding has been used in recent years to support bicycle and pedestrian facilities projects. Lastly, the Transportation Infrastructure Finance and Innovation Act (TIFIA) offers direct loans, loan guarantees, and other forms of credit assistance for transportation projects. Such federal credit programs could be utilized in support of transit infrastructure projects under this Energy and Conservation Action Strategy. Though the availability of these programs and funding options will largely depend on forthcoming legislation and funding allocations, federal transportation initiatives will likely remain a crucial source of support for implementation of this Strategy.

California State departments, such as CalRecycle and the California Energy Commission, have at times offered grants or other funding for climate or sustainability programs. Pursuant to Senate Bill (SB) 1754, the California Alternative Energy and Advanced Transportation Financing Authority offers programs that, among other things, support distributed generation of renewable energy, as well as energy or water efficiency improvements. Additionally, California's implementation of GHG Cap and Trade programs could offer new sources of funding. While it remains uncertain how program revenues would be allocated, some proposals, such as that to create a GHG Reduction Account, could lead to funding availability for local governments. Also at the State level, Assembly Bill (AB) 2466 mandates that local governments be paid for the excess renewable energy they generate, offering another potential revenue stream.

[2] Federal Transit Administration, 2010, *ARRA Grants Awarded*, http://www.fta.dot.gov/about/12350_10536.html, accessed on June 12, 2012.

Beyond the grants and programs offered by the State, there are also a variety of local or regional agencies and programs that have the potential to offer additional funding or support. As part of its regional planning efforts, MTC provides multiple grant opportunities under its Climate Initiatives Program. MTC has also previously offered multiple grant cycles for planning efforts in Priority Development Areas (PDAs). Since there are areas in Vacaville that are designated as PDAs, the City could be eligible to pursue these funds for mixed-use development planning. Additionally, as part of the recently-passed One Bay Area Plan, the MTC will be offering grant awards from the One Bay Area Grants program, as well from the now fully-funded Climate Innovative Grants program. There may also be opportunities to pursue funding through private charitable organizations, such as the Hewlett Foundation, which offers grants through its Bay Area Communities and Energy & Climate programs.

With the funding from federal programs, current State legislation and programs, and grant opportunities like those above, Vacaville is likely to receive assistance in seeing through its climate action goals and measures.

PLAN ADAPTATION, RE-INVENTORY, AND MONITORING

This Energy and Conservation Action Strategy represents Vacaville's communitywide response to the threat of climate change at the time of this document's preparation. The field of climate action planning is rapidly evolving. Over the next decade, new information about climate change science and risk is likely to emerge, new GHG reduction strategies and technologies will be developed, and State and federal legislation are likely to advance. Therefore, in order to remain relevant and to be as effective as possible, the Energy and Conservation Action Strategy must evolve over time.

The City's Community Development Department will primarily be responsible for continually monitoring the City's progress towards meeting the GHG emissions reduction target, with significant assistance from the Public Works Department. The Energy and Conservation Action Strategy, as a whole, will be reviewed and modified in 2019 to evaluate implementation and achievement of measure reductions and to identify potential updates. It is also anticipated that this Energy and Conservation Action Strategy will be updated at some point to address emissions beyond 2020, in which case regular reviews will continue every five years beyond 2020.

As part of the monitoring evaluation, the City will re-inventory their GHG emissions. The process of conducting a re-inventory will allow the City to monitor progress and report results toward local emissions reduction targets and identify opportunities to integrate new or improved measures into the emissions reduction plan. If forecast target reductions are not being met, the Community Development Department will determine which measures are not achieving the target and which measures are exceeding the target. As new technology comes online each year, the Community Development Department will consider improvements to climate science, explore new opportunities for GHG reduction and climate adaptation, and determine what innovations can be implemented to help reduce emissions to reach reduction targets.

8 GLOSSARY AND ACRONYMS

The following glossary and acronym list provide definitions of commonly used terms and acronyms. Many of the definitions are from the California Air Resources Board (CARB) December 2008 *Climate Change Scoping Plan Appendices*.

GLOSSARY

Alternative daily cover (ADC)
Material used as a temporary overlay to cover an exposed landfill face to reduce insects and vermin. Typical ADC materials include green materials, sludge, ash and kiln residue, compost, construction and demolition debris, and special foams and fabric.

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

Average trip length
The average distance ridden for an unlinked passenger trip (UPT) by time period (weekday, Saturday, Sunday) computed as passenger miles traveled (PMT) divided by unlinked passenger trips (UPT).[2]

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.[3]

Benzene
Benzene is a colorless liquid formed from both human-made activities and natural processes. Benzene is widely used in the United States and ranks in the top 20 chemicals used. Two

[1] City of Benicia, undated. *Climate Action Plan*, page 93.

[2] Federal Transit Administration, National Transit Database Glossary, http://www.ntdprogram.gov/ntdprogram/Glossary.htm, accessed on August 30, 2012.

[3] City of Benicia, undated. *Climate Action Plan*, page 93.

natural sources of benzene are volcanoes and forest fires. Benzene is a natural part of crude oil, gasoline, and cigarette smoke. Benzene is one of the major components of JP-8 fuel. Industry is the main source of benzene in the environment. Emissions from burning coal and oil, benzene waste and storage operations, motor vehicle exhaust, and evaporation from gasoline service stations can cause benzene levels in the air to increase. In the air, benzene reacts with other chemicals and breaks down within a few days. Benzene in water and soil breaks down more slowly. Benzene in the environment does not build up in plants or animals.

Biogas

Also known as biomenthane, swamp gas, landfill gas, or digester gas—biogas is the gaseous product of anaerobic digestion (decomposition without oxygen) of organic matter.[4] In addition to providing electricity and heat, biogas is useful as a vehicle fuel. When processed to purity standards, biogas is called renewable natural gas and can substitute for natural gas as an alternative fuel for natural gas vehicles. Biogas is usually 50 percent to 80 percent methane and 20 percent to 50 percent carbon dioxide with traces of gases such as hydrogen, carbon monoxide, and nitrogen.

Biomass

Biomass is any plant-derived organic matter.[5] Biomass available for energy on a sustainable basis includes herbaceous and woody energy crops, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, and other waste materials including some municipal wastes. Biomass is a very heterogeneous and chemically complex renewable resource.

California Energy Commission (CEC)

The CEC is a five-person commission appointed by the Governor, with Senate confirmation, which acts as the state of California's primary energy policy and planning agency.[6] The CEC is tasked with forecasting future energy needs; promoting energy efficiency and conservation by setting the state's appliance and building efficiency standards; supporting public interest energy research that advances energy science and technology

[4] US Department of Energy Alternative Fuels Data Center, http://www.afdc.energy.gov/fuels/emerging_biogas.html, accessed on September 6, 2012.

[5] National Renewable Energy Laboratory Glossary of Biomass Terms, http://www.nrel.gov/biomass/glossary.html#B, accessed on September 6, 2012.

[6] California Energy Commission, http://www.energy.ca.gov/commission/, accessed on September 6, 2012.

through research, development and demonstration programs; developing renewable energy resources and alternative renewable energy technologies for buildings, industry and transportation; licensing thermal power plants 50 megawatts or larger; and planning for and directing State response to energy emergencies.

Carbon dioxide equivalent
The amount of carbon dioxide by weight that would produce the same global warming impact as a given weight of another GHG, based on the best available science, including from the Intergovernmental Panel on Climate Change.[7]

Carbon intensity
The intensity of an energy supply, defined as the amount of carbon emitted per unit of energy.

Carbon sequestration
The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation, and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases or from processing fossil fuels to produce hydrogen- and carbon dioxide-rich fractions and long-term storage in underground depleted oil and gas reservoirs, coal seams, and saline aquifers.

Climate Action Team
The Secretary of Cal/EPA leads the Climate Action Team made up of representatives from State agencies, boards, and departments. The CAT members work to coordinate statewide efforts to implement global warming emission reduction programs and the state's Climate Adaptation Strategy. The CAT is also responsible for reporting on the progress made toward meeting the statewide GHG targets that were established by Executive Order S-3-05 and further defined under the Global Warming Solutions Act of 2006 (AB 32).

Climate Registry
A national nonprofit registry that provides tools and resources to help calculate, verify, report, and manage GHG emissions in a publicly transparent and credible way.[8]

[7] California Air Resources Board Glossary of Air Pollution Terms, http://www.arb.ca.gov/html/gloss.htm, accessed on August 30, 2012.

Corporate Average Fuel Economy (CAFE)
First enacted by Congress in 1975, the Corporate Average Fuel Economy (CAFE) program and related standards are meant to reduce energy consumption by increasing the fuel economy of cars and light trucks.[9]

Fossil fuels
Fuels such as coal, oil, and natural gas; so-called because they are the remains of ancient plant and animal life.[10]

Global Warming Potential (GWP)
The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a GHG to that from emission of one kilogram of carbon dioxide over a period of time (usually 100 years).

Greenhouse effect
The warming effect of the Earth's atmosphere. Light energy from the sun which passes through the Earth's atmosphere is absorbed by the Earth's surface and re-radiated into the atmosphere as heat energy. The heat energy is then trapped by the atmosphere, creating a situation similar to that which occurs in a car with its windows rolled up. A number of scientists believe that the emission of CO_2 and other gases into the atmosphere may increase the greenhouse effect and contribute to global warming.[11]

Greenhouse gas (GHG)
Any gas that absorbs infra-red radiation in the atmosphere. GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and hydrofluorocarbons (HFCs).

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[8] The Climate Registry Mission, http://www.theclimateregistry.org/about/mission/, accessed on August 30, 2012.

[9] National Highway Traffic Safety Administration, CAFE – Fuel Economy, http://www.nhtsa.gov/fuel-economy, accessed on September 6, 2012.

[10] California Air Resources Board Glossary of Air Pollution Terms, http://www.arb.ca.gov/html/gloss.htm, accessed on August 30, 2012.

[11] California Air Resources Board Glossary of Air Pollution Terms, http://www.arb.ca.gov/html/gloss.htm, accessed on August 30, 2012.

Gross vehicle weight rating
The weight specified by the manufacturer as the loaded weight of a single vehicle. The loaded weight of the vehicle includes passengers, options, and cargo.[12]

Heavy duty vehicle
Any motor vehicle (including buses) having a gross vehicle weight rating of greater than 8,500 pounds, or curb weight of more than 6,000 pounds, or a basic vehicle frontal area in excess of 45 square feet.[13]

Metric ton of carbon dioxide equivalent
A metric measure used to compare the emissions from various GHGs based upon their global warming potential. Carbon dioxide equivalents are commonly expressed as "metric tons of carbon dioxide equivalents ($MTCO_2E$)."

"Pavley" standards
The Pavley law or standards are the common name for the 2002 Assembly Bill (AB) 1493 containing regulations to reduce GHGs from passenger vehicles.[14] Initially, the US EPA reviewed and then denied California's request to implement the Pavley regulations. As of 2009, California was granted the authority to implement the Pavley regulations.

Renewable portfolio standard (RPS)
A regulation requiring utility companies in California to increase the production of renewable energy from solar, wind, or biomass, or geothermal sources.[15]

Service Population
Within a particular area, the service population would be the group of people eligible to receive or have access to a particular service or utility.

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[12] US Environmental Protection Agency Importing Vehicles and Engines into the US Glossary: Terms and Acronyms, http://www.epa.gov/oms/imports/glossary.htm#hdvhdt, accessed on August 30, 2012.

[13] US Environmental Protection Agency Importing Vehicles and Engines into the US Glossary: Terms and Acronyms, http://www.epa.gov/oms/imports/glossary.htm#hdvhdt, accessed on August 30, 2012.

[14] California Air Resources Board Clean Car Standards – Pavley, Assembly Bill 1493, http://www.arb.ca.gov/cc/ccms/ccms.htm, accessed on September 6, 2012.

[15] City of Santa Rosa, 2012, *Climate Action Plan*, page 7-3.

Sphere of influence (SOI)
A planning tool used by cities to identify the potential future municipal boundary. In most cases, the SOI includes the area just beyond a city's boundary and includes territory and neighborhoods surrounding the city. An SOI allows cities to plan in cooperation with other agencies for public services such as police, fire, parks, roads, and flood control. LAFCOs designate SOIs based on the identification of the probable ultimate boundaries of each city.

Stationary sources
Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit air pollutants.[16]

Sustainability
Based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations. Sustainability is important to making sure that we have and will continue to have; the water, materials, and resources to protect human health and our environment.[17]

Sustainable communities' strategy (SCS)
The land use element of each MPO's Regional Transportation Plan as required by SB 375. The SCS will demonstrate how the region will achieve the 2020 and 2035 VMT and GHG reduction targets for the region set by CARB.[18]

Urban growth boundary
A regulatory line drawn around a city, county, or metropolitan area, outside of which little or no development can occur within a given time frame, usually 20 to 30 years.[19]

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[16] California Air Resources Board Glossary of Air Pollution Terms, http://www.arb.ca.gov/html/gloss.htm, accessed on August 30, 2012.

[17] US Environmental Protection Agency Sustainability Basic Information, http://www.epa.gov/sustainability/basicinfo.htm, accessed on August 30, 2012.

[18] City of Santa Rosa, 2012, *Climate Action Plan*, page 7-9.

[19] Association of Bay Area Governments Urban Growth Boundaries and Urban Limit Lines, http://www.abag.ca.gov/jointpolicy/Urban%20Growth%20Boundaries%20and%20Urban%20Limit%20Lines.pdf, accessed on August 30, 2012.

Urban sprawl
The extension of low-density residential, commercial, and industrial development into areas beyond a city's boundaries that occurs in an unplanned or uncoordinated manner.[20]

Vehicle miles traveled (VMT)
The miles traveled by motor vehicles over a specified length of time (e.g., daily, monthly, or yearly) or over a specified road or transportation corridor.[21]

Vinyl chloride
A colorless gas which burns easily and is not stable at high temperatures. It has a mild, sweet odor. It is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down. Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials. Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride.[22]

ACRONYMS

ABAG	Association of Bay Area Governments
ADC	Alternative daily cover
ARRA	American Recovery and Reinvestment Act of 2009
BAAQMD	Bay Area Air Quality Management District
BCDC	Bay Area Conservation and Development Commission
Cal/EPA	California Environmental Protection Agency
CARB	California Air Resources Board
CARE	Community Action for a Renewed Environment
CEC	California Energy Commission
ECAS	Energy and Conservation Action Strategy

[20] National Oceanic and Atmospheric Association State of the Coast, Urban Sprawl, http://stateofthecoast.noaa.gov/population/urbansprawl.html, accessed on August 30, 2012.

[21] California Air Resources Board Glossary of Air Pollution Terms, http://www.arb.ca.gov/html/gloss.htm, accessed on August 30, 2012.

[22] Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Toxic Substances Portal – Vinyl Chloride, http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=281&tid=51#bookmark02, accessed on August 30, 2012.

EPA	US Environmental Protection Agency
FTA	Federal Transit Administration
GHG	Greenhouse gas
GWP	Global Warming Potential
LCFS	Low Carbon Fuel Standard
LGOP	Local Government Operation Protocol
$MTCO_2e$	Metric tons of carbon dioxide equivalents
MTC	Metropolitan Transportation Commission
PG&E	Pacific Gas & Electric
PMT	Passenger miles traveled
SCS	Sustainable communities' strategy
SRTS	Safe Routes to School
STA	Solano Transportation Authority
TE	Transportation Enhancements
TIFIA	Transportation Infrastructure Finance and Innovation Act
TIGER	Transportation Investment Generating Economic Recovery
UPT	Unlinked passenger trip
USDOT	US Department of Transportation
VMT	Vehicle miles traveled
YSAQMD	Yolo Solano Air Quality Management District

APPENDIX A

COMMUNITY WORKSHOP SUMMARY

Workshop Summary

Vacaville General Plan Update
Community Workshop #4 – Climate Action Plan
March 17, 2012

Community Workshop #4 was focused on understanding what a Climate Action Plan (CAP) is, why the City is preparing one, and what types of measures should be included in the CAP. This workshop took place on Saturday, March 17, 2012 at the McBride Senior Center. Seven members of the public and four Steering Committee members attended the workshop. The workshop began with a presentation about climate change and legislation requiring the reduction of greenhouse gases. The presentation was followed by questions and a discussion about climate change and the need for a CAP. The group then discussed potential greenhouse gas (GHG) reduction strategies to include in the CAP. The discussion is summarized below by topic.

General Comments on CAP:

- Many Vacaville residents are not interested in the CAP, as evidenced by the low turnout, while others are likely opposed to it. Given this attitude, how can the CAP be effective?
- Several workshop participants don't agree with the notion that climate change is happening, and/or that it is caused by human activity. However, the group agreed that the City needs to do something in order to comply with State law and avoid a lawsuit and a General Plan legal challenge.
- The building community and the City don't have the financial resources to implement "green" policies, especially in this economy. However, the building community can agree to reasonable, practical measures, such as Build-It-Green, energy efficiency, planting trees, and a lawnmower exchange program.
- How can the City reduce GHG emissions while still promoting growth in the General Plan Update?
- Air quality is more important to Vacaville residents than GHG emissions because it has a more direct impact. Solano County has some of the worst air pollution in the country. The CAP will focus on reducing carbon dioxide emissions, but we should instead focus on ozone and other criteria air pollutants that have adverse health impacts.
- A separate community group should be formed to develop a new set of measures to reduce GHG emissions.
- The City should focus on a limited amount of realistic measures. Numerous measures are a waste of time if they can't be implemented due to their cost.
- When considering which measures to include in the CAP, evaluate if the measures will result in long term costs to the City.

Comments on Land Use and Community Design Measures

- There should only be the one Town Square in Vacaville located in the Downtown. A second town square in the East of Leisure Town Road Growth Area would not work economically.
- Support for bicycle/pedestrian through-connections.
- Mixed use works in the Downtown, but not elsewhere in the city. Local-serving commercial can work in other areas, although major grocery stores will want freeway access.
- Support for telecommuting. Can the City assist with the infrastructure needs of telecommuters, for example by requiring access to high internet speeds in the Building Code for new development?
- Affordable housing doesn't work in Vacaville.

- In this economy, accessory units don't work, but they are supported. Consider removing the owner-occupied requirement for accessory units.
- Allow flexibility in residential setbacks to promote higher density while still maintaining the look of a traditional neighborhood (e.g. the Chelsea lots in Southtown). The smaller lawns can have an added water conservation benefit.
- Promote infill and high density development around transit areas and in the Downtown through reduced fees and expedited permit review.

Comments on Transportation Measures

- Encourage residents to purchase four-cylinder and/or electric cars, similar to past efforts to promote electric vehicle purchases in the city.
- Support for high-quality bicycle parking.
- Encourage traffic circles in place of stop signs.
- Extend City Coach bus service times to 8:00 pm for commuters.

Comments on Green Building Measures

- LEED does not work financially for developers. Build-It-Green only costs developers about $3,000 to $5,000 per house, while LEED certification costs $10,000 to $15,000 per house. Meritage Homes supports Build-It-Green.
- Cement substitutes and recycling building materials should be voluntary.
- Support for tax and fee credits for green building.

Comments on Renewable Energy and Low Carbon Fuels Measures

- "Green" energy (e.g. solar and wind) costs more than traditional energy sources, and solar panels have many environmental impacts, including the use of toxic materials and creation of solid waste. However, one commenter still would like some measures to target solar energy in the CAP because solar helps to improve air quality.
- Support for permit fee waivers for solar installations.
- Support for incentives for parking lot solar.
- Wind turbines have significant biological impacts (on birds) and are not cost-effective. In addition, wind turbines have aesthetic, solid waste, safety, and noise impacts. While there is support for wind energy, wind turbines are not supported.

Comments on Water and Wastewater Measures

- Methane gas should be captured and converted to energy to fuel the Wastewater Treatment Plant's energy needs.
- Promote xeriscape (i.e. landscaping to minimize water use).

Comments on Solid Waste Measures

- Methane gas should be captured and converted to energy to fuel the landfill's energy needs (although the landfills are located outside of Vacaville).

Comments on Open Space Measures

- The City should institute a tree-planting program.
- Avoid agricultural land conversion.

APPENDIX B

BASELINE INVENTORY AND 2020 FORECASTS TECHNICAL DOCUMENTATION

Summary of Vacaville's GHG Emissions

		2008		2020 BAU			2035 BAU			2020 Adjusted			2035 Adjusted	
	2005 STA Inventory for Vacaville	MTons*	Percent	MTons*	Percent	Increase MTons from 2008	MTons*	Percent	2020 Adjusted MTons	MTons*	Percent	Increase MTons from 2008	MTons*	Percent
Transportation***	193,893	598,040	63%	808,140	67%	210,100	1,070,390	70%	639,785	639,790	68%	41,750	794,760	70%
Residential	122,551	153,210	16%	172,440	14%	19,230	196,470	13%	131,940	131,940	14%	-21,270	147,360	13%
Purchased Electricity	54,964	66,760		75,140		8,380	85,610		35,726	35,730		-31,030	38,940	
Natural Gas	67,587	86,450		97,300		10,850	110,860		96,214	96,210		9,760	108,420	
Commercial/Industria/Municipal	112,381	156,390	16%	174,510	15%	18,120	197,160	13%	126,873	126,870	13%	-29,520	140,050	12%
Purchased Electricity	59,482	79,820		89,090		9,270	100,680		42,602	42,600		-37,220	46,160	
Natural Gas	52,899	76,570		85,420		8,850	96,480		84,270	84,270		7,700	93,890	
Water/Wastewater****	18,342	10,680	1%	12,780	1%	2,100	15,410	1%	8,687	8,690	0.9%	-1,990	10,760	1.0%
Electricity	NA	7,460		8,370		910	9,520		4,280	4,280		-3,180	4,870	
Fugitive	NA	690		770		80	870		769	770		80	870	
Municipal	NA	2,530		3,640		1,110	5,020		3,638	3,640		1,110	5,020	
Waste*****	51,820	19,030	2%	21,370	2%	2,340	24,300	2%	21,372	21,370	2%	2,340	24,300	2%
Offroad Equipment from STA Inventory	11,994	11,990	1%	13,470	1%	1,480	15,310	1%	12,121	12,120	1%	130	13,780	1%
Industrial (Permitted)**	0	25,620		25,620			25,620		25,617	25,620			25,620	
Total (with Permitted)	**0**	974,960		1,228,330			1,544,660		966,395	966,400			1,156,630	
Total (without Permitted)	**510,981**	**949,340**	**100%**	**1,202,710**	**100%**	**253,370**	**1,519,040**	**100%**	**940,777**	**940,780**	**100%**	**-8,560**	**1,131,010**	**100%**
2020 Target: 21.7% Below BAU				941,722						941,722				
GHG Reductions Needed				260,988						-942				
Local Reductions										-63,472			-72,262	
TOTAL with Reductions					**Percent Change**		**1,519,040**	**Percent Change**	**940,777**	**877,308**			**1,058,748**	
Short of 21.7% Goal										**-64,414**				
Population	87,340			98,300	26.69%		112,000	60.01%	98,300	98,300			112,000	
Employment	30,248			33,738			38,100		33,738	33,738			38,100	
Service Population	117,588			132,038			150,100		132,038	132,038			150,100	
				14,450										
MTons/SP	8.07			9.11			10.12		7.13	7.13			7.54	
MTons/SP with Reductions									7.13	6.64			7.05	

*Inventory is rounded to the tens place.

** Not included in Target setting since permitted (industrial) sources of GHG emissions are under the jurisdiction of YSAQMD and not the City of Vacaville.

*** Daily vehicles miles traveled (VMT) multiplied by 347 days/year to account for reduced traffic on weekends and holidays. This assumption is consistent with the California Air Resources Board's (CARB) methodology within the Climate Change Scoping Plan Measure Documentation Supplement.

**** Excludes GHG emissions from wastewater generated by land uses outside of the City but treated at the City's wastewater treatment plant. Baseline treatment plant annual MTCO2e emissions were estimated to be 4,688 in 2008 and 7,775 in 2035. 2020 MTCO2e emissions estimated using linear regression.

***** Excludes GHG emissions from waste disposed of in the City but generated by land uses outside of the City. The 2008 emissions estimate is significantly lower than the total presented in the 2005 analysis because 2008 inlcudes 75% landfill gas capture rate. The Landfill gas capture efficiency is based on the California Air Resources Board's (CARB) Local Government Operations Protocol (LGOP), Version 1.1. Because the landfill gas captured is not under the jurisdiction of Vacaville, the landfill gas emissions from the capture system are not included in Vacaville's inventory. Only fugitive sources of GHG emissions from landfill are included.

Energy - Purchase Electricity and Natural Gas

Pacific Gas & Electric - Emission Factors

	Intensity factor				CO_2e
Electricity	lbs CO_2/MWH	MTons CO_2/MWh	CH4 MTons/MWH	N2O MTons/MWH	MTons/MWh
2005	489	0.222	0.000013	0.000005	0.224
2006	456	0.207	0.000013	0.000005	0.209
2007	636	0.288	0.000013	0.000005	0.290
2008	641	0.291	0.000013	0.000005	0.293
2009	575	0.261	0.000013	0.000005	0.263
2010	559	0.254	0.000013	0.000005	0.256
3-Year Average (2006-2008) based on PG&E Request	577	0.262	0.000013	0.000005	**0.263**
2020 (CO_2)	290	0.133	0.000013	0.000005	**0.135**
Source: Pacific Gas & Electric (PG&E). 2012, April. Community Wide GHG Inventory Report for Vacaville 2003 to 2010. The Intensity factor is based on an average of Kwh and CO2			CH_4 and N_2O intensity based on California E-Grid data (CH_4 = 0.029 lbs/MWH; N_2O = 0.011 lbs/MWH)		

Note: The 2020 emissions rate is estimated by PG&E. It includes reductions from 33% Renewable Portfolio Standard (RPS), Cap-and-Trade, and other regulatory reductions for High Global Warming Potential (HGWP) gases such as reductions of SF_6.

Natural Gas	Intensity factor				CO_2e
	lbs CO_2/Therm	MTons CO_2/Therm	CH4 MTons/Therm	N2O MTons/Therm	MTons/Therm
All Years	11.7	0.00531	0.00005	0.000001	**0.00667**
CO2 intentsiy based on PG&E's third-party-verified GHG inventory submitted to the California Climate Action Registry (CCAR)6 (2003-2008) or The Climate Registry (TCR) (2009).			CH4 and N2O intensity based on Table G.3 of the LGOP for residential and non-residential (CH4: 0.005 kg/MMBtu; N2O: 0.0001 kg/MMBtu)		

General Conversion Factors

kg to MTons	0.001
Mmbtu to Therm	0.1
killowatt hrs to megawatt hrs	0.001
lbs to Tons	2000
Tons to Mton	0.9071847

Source: California Air Resources Board (CARB). 2010. Local Government Operations Protocol. Version 1.1. Appendix F, Standard Conversion Factors

	Global Warming Potentials (GWP)
CO2	1
CH4	21
N2O	310

Souce: Intergovernmental Panel on Climate Change (IPCC). 2001. Third Assessment Report: Climate Change 2011.

Vacaville Electricity & Natural Gas Use (based on a 3-year average, 2006 to 2008)

Electricity	2008 (avg) Kwh/Year	2020 Kwh/Year	2035 Kwh/Year
Residential	253,500,590	285,311,519	325,075,179
Commercial	273,743,688	305,326,095	344,804,104
Municipal	29,342,050	32,947,742	37,454,857
Total	556,586,329	623,585,356	707,334,140

Electricity	2008 (avg) CO_2e MTons/Year	2020 CO_2e MTons/Year	2035 CO_2e MTons/Year
Residential	66,764	75,142	85,615
Commercial	72,096	80,413	90,811
Municipal	7,728	8,677	9,864
Total	146,588	164,233	186,290

Natural Gas	2008 (avg) Therms/Year	2020 Therms/Year	2035 Therms/Year
Residential	12,966,918	14,594,093	16,628,061
Commercial	11,224,750	12,519,774	14,138,554
Municipal	260,574	292,595	332,621
Total	24,452,243	27,406,462	31,099,236

Natural Gas	2008 CO_2e MTons/Year	2020 CO_2e MTons/Year	2035 CO_2e MTons/Year
Residential	86,451	97,299	110,860
Commercial/Industrial	74,836	83,470	94,262
Municipal	1,737	1,951	2,218
Total	163,024	182,720	207,340

Summary	CO_2e MTons/Year	CO_2e MTons/Year	CO_2e MTons/Year
Residential	153,215	172,441	196,474
Commercia/Industrial*	156,396	174,511	197,155
Total	309,611	346,953	393,629

*includes Municipal

Adjusted Forecast - 2020 PG&E CO2 Intensity

least 20 percent by December 30, 2010. The California Air Resources Board (CARB) has now approved an even higher goal of 33 percent by 2020. Investor-owned utilities, such as PG&E are also required to participate in CARB's Cap-and-Trade program and reduce High Global Warming Potential (HGWP) gases, such as reductions of SF6.

Source: Pacific Gas & Electric (PG&E). 2011, April 8. Greenhouse Gas Emission Factors Info Sheet.
http://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf

Note: Energy and Building reductions in the measures below are based on the PG&E 2020 GHG Intensity. (i.e., applied RPS then accounted for additional reductions)

Electricity	2008 CO_2e MTons/Year	2020 Adjusted CO_2e MTons/Year	2035 Adjusted CO_2e MTons/Year
Residential	66,764	38,467	43,828
Commercial	72,096	41,165	46,488
Municipal	7,728	4,442	5,050
Total	146,588	84,074	95,365
GHG Reductions	0	80,159	90,925

Adjusted Forecast - Title 24 Cycle Updates to the California Building Code

The 2008 Building and Energy Efficiency standards (Title 24, Part 6) are approximately 15 percent more energy efficient than the 2005 Building and Energy Efficiency standards, which were in place at the time of CARB's Scoping Plan. The 2014 Building and Energy Efficiency Standards become effective January 1, 2014 and are 25% more energy efficient than the 2008 Building and Energy Efficiency Standards for residential building and 30% more energy efficient thant the 2008 Standards for non-residential buildings.

Local Measures that support Statewide Energy Reductions

GB-1	Allow greater permitting-related development flexibility and other incentives for LEED-Silver, Build It Green, or GreenPoint or equivalent rating, for example by giving green projects priority in plan review, processing, and field inspection services.
GB-2	Require measures that reduce energy use through solar orientation by taking advantage of shade, prevailing winds, landscaping, and sun screens, unless prohibited by topographical conditions or other site-specific constraints.
GB-3	Provide links to programs and information about green building, including training and technical assistance, on the City's website.
GB-4	Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop green building policies and programs that are optimized on a regional scale.
GB-5	Develop a "heat island" mitigation plan that includes guidelines for cool roofs, cool pave-ments, and strategically placed shade trees.
EC-3	Require all new development and major rehabilitation (i.e. additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area) projects to incorporate any combination of the following strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape, which includes roads, sidewalks, courtyards, parking lots, and driveways: shaded within five years of occupancy; paving materials with a Solar Reflectance Index (SRI) of at least 29; open grid pavement system; and parking spaces underground, under deck, under roof, or under a building. Any roof used to shade or cover parking must have an SRI of at least 29.
EC-6	Seek partnerships with local utilities and private entities to share resources and promote energy conservation.

Reductions

13% Non-Residential Natural Gas Reduction (2008 Building and Energy Efficiency Standards)
10% Residential Natural Gas Reduction (2008 Building and Energy Efficiency Standards)
40% Energy Efficiency Standards + Title 25 Appliance Energy Efficiency Standards

Electricity	2008 (avg) **Kwh/Year**	New Buildings 2020 **Kwh/Year**	New Building 2035 **Kwh/Year**	Total 2020 **Kwh/Year**	Total 2035 **Kwh/Year**
Residential	253,500,590	19,086,557	23,858,196	272,587,147	296,445,343
Commercial	273,743,688	18,949,444	23,686,805	292,693,132	316,379,937
Municipal	29,342,050	2,163,415	2,704,269	31,505,466	34,209,734
Total	556,586,329	40,199,416	50,249,270	596,785,745	647,035,015

Electricity	2008 w/2020 **CO_2e MTons/Year**	2020 **CO_2e MTons/Year**	2035 **CO_2e MTons/Year**	Total 2020 **CO_2e MTons/Year**	Total 2035 **CO_2e MTons/Year**
Residential	34,178	2,573	3,217	36,751	39,968
Commercial	36,907	2,555	3,194	39,462	42,655
Municipal	3,956	292	365	4,248	4,612
Total	75,041	5,420	6,775	80,460	87,235

Natural Gas	2008 (avg) **Therms/Year**	New Buildings 2020 **Therms/Year**	New Building 2035 **Therms/Year**	Total 2020 **Therms/Year**	Total 2035 **Therms/Year**
Residential	12,966,918	1,464,457	1,830,571	14,431,375	16,261,946
Commercial	11,224,750	1,126,671	1,408,339	12,351,421	13,759,760
Municipal	260,574	27,858	34,822	288,432	323,255
Total	24,452,243	2,618,986	3,273,732	27,071,228	30,344,961

Natural Gas	2008 w/2020 **CO_2e MTons/Year**	New Buildings 2020 **CO_2e MTons/Year**	New Building 2035 **CO_2e MTons/Year**	Total 2020 **CO_2e MTons/Year**	Total 2035 **CO_2e MTons/Year**
Residential	86,451	9,764	12,204	96,214	108,419
Commercial/Industrial	74,836	7,512	9,389	82,347	91,737
Municipal	1,737	186	232	1,923	2,155
Total	163,024	17,461	21,826	180,485	202,311

Summary	**2008 CO_2e MTons/Year**	**2020 BAU CO_2e MTons/Year**	**2035 BAU CO_2e MTons/Year**	**Adjusted 2020 CO_2e MTons/Year**	**Adjusted 2035 CO_2e MTons/Year**
Residential	153,215	172,441	196,474	132,965	148,387
Commercia/Industrial*	156,396	174,511	197,155	127,980	141,159
Total	309,611	346,953	393,629	260,945	289,546
Reduction from BAU				-86,008	-104,083
			Reductions from Title 24	-5,848	-13,158

*includes Municipal

Adjusted Forecast - SMART Grid

electric grid in the state. Pursuant to Senate Bill 17, the CPUC developed requirements for a Smart Grid deployment plan. In July 2011, California Utilities filed with

Local Measures that support Statewide Energy Reductions

Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following:
- Conduct outreach to educate the public about available rebates and other incentives from energy providers.
- Promote the purchase of ENERGY STAR appliances.
- Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures.
- Offer a halogen torchiere lamp exchange to community members.
- Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization.
- Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target.
- Promote individualized energy management planning and related services for large energy users.

EC-2 - Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.

EC-6 Seek partnerships with local utilities and private entities to share resources and promote energy conservation.

EC-7 Continue to offer innovative, low-interest financing for energy efficiency and renewable energy projects for existing and new development through the PACE program.

Reduction in Energy Consumption

	Low	High	% Reduction
Residential	1%	10%	3%
Commercial/Office	1%	10%	3%

http://energyenvironment.pnnl.gov/news/pdf/PNNL-19112_Revision_1_Final.pdf. Table 3.3 Estimated Direct Impacts of the Conservation Effect of Consumer

Energy Savings Applied to Existing Land Uses Only

Electricity	2008 (avg) Adjusted **Kwh/Year**	New Buildings 2020 **Kwh/Year**	New Building 2035 **Kwh/Year**	Total 2020 **Kwh/Year**	Total 2035 **Kwh/Year**
Residential	245,895,573	19,086,557	23,858,196	264,982,130	288,840,326
Commercial	265,531,378	18,949,444	23,686,805	284,480,822	308,167,627
Municipal	29,342,050	2,163,415	2,704,269	31,505,466	34,209,734
Total	540,769,001	40,199,416	50,249,270	580,968,417	631,217,687

Electricity	2008 w/2020 (Adjusted) **CO_2e MTons/Year**	New Buildings 2020 **CO_2e MTons/Year**	New Building 2035 **CO_2e MTons/Year**	Total 2020 **CO_2e MTons/Year**	Total 2035 **CO_2e MTons/Year**
Residential	33,152	2,573	3,217	35,726	38,942
Commercial	35,800	2,555	3,194	38,355	41,548
Municipal	3,956	292	365	4,248	4,612
Total	72,908	5,420	6,775	78,328	85,103

For Natural Gas for the Adjusted Forecast - see Title 24 Updates

Summary	**2008 BAU CO_2e MTons/Year**	**2020 BAU CO_2e MTons/Year**	**2035 BAU CO_2e MTons/Year**	**Adjusted 2020 CO_2e MTons/Year**	**Adjusted 2035 CO_2e MTons/Year**
Residential	153,215	172,441	196,474	131,940	147,361
Commercia/Industrial*	156,396	174,511	197,155	126,873	140,052
Total	309,611	346,953	393,629	258,813	287,413
Reduction from BAU				-88,140	-106,216
*includes Municipal			Reductions from Smart Grid	-2,133	-2,133

California Natural Gas Use by End Use

Source: California Energy Commission.Residential End Use Survey. http://energyalmanac.ca.gov/naturalgas/residential_use.html

Residential	Annual Energy % Total	Non-Title 24	Title 24
Water Heating	44%		44%
Space Heating	44%		44%
Pools, Spas, Misc.	2%	2%	
Clothes Dryers	3%	3%	
Cooking	7%	7%	
Total	100%	12%	88%

Source: California Energy Commission. 2006, March. California Commercial End-Use Survey. Prepared by Itron. CEC-300-2006-005. http://www.energy.ca.gov/2006publications/CEC-300-2006-005/CEC-300-2006-005.PDF

Commercial	Annual Energy % Total	Non-Title 24	Title 24
Water Heating	31.8%		32%
Heating	36.4%		36%
Cooling	1.5%	2%	
Process	5.9%	6%	
Miscellaneous	1.8%	2%	
Cooking	22.6%	23%	
Total	100%	32%	68%

California Electricity Consumption by End Use

Source: Brown, Richard E. and Koomey, Jonathan G., 2002, May. *Electricity Use in California: Past Trends and Present Usage Patterns.* University of California, Berkeley (UCB), Energy analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory. lBL-47992. http://enduse.lbl.gov/Projects/CAdata.html

	Annual Energy TWh	Annual Energy % Total	% of Sector	Non-Title 24	Title 24
Commercial					
Air Conditioning	13.8	5%	15%		15%
Interior Lighting	30.3	12%	34%		34%
Other	19.9	8%	22%	22%	
Ventilation	9.1	4%	10%		10%
Refrigeration	6.5	3%	7%	7%	
Office Equipment	1.6	1%	2%	2%	
Domestic Hot Water	0.5	0%	1%		1%
Exterior Lighting	5.0	2%	6%		6%
Cooking	0.6	0%	1%	1%	
Space Heating	2.1	1%	2%		2%
Total Commercial	*89.5*	*36%*	100%	*32%*	*68%*
Residential					
Air Conditioning	4.8	2%	6%		6%
Miscellaneous	24.6	10%	33%	33%	
Refrigerator	13.7	5%	18%	18%	
Cooking	3.6	1%	5%	5%	
Dryer	5.7	2%	8%	8%	
Pools & Spas	4.1	2%	5%	5%	
Domestic Hot Water	4.2	2%	6%		6%
Television	3.4	1%	5%	5%	
Freezer	2.5	1%	3%	3%	
Dishwasher	2.0	1%	3%	3%	
Waterbed Heater	2.1	1%	3%	3%	
Clothes Washer	0.7	0%	1%	1%	
Space Heating	0.4	2%	1%		1%
Total Residential	*75.4*	*30%*	100%	83%	12%
Industrial					
Assembly	33	13%	62%	62%	
Process	14	6%	26%	26%	
Other	6.1	2%	11%	11%	
Total Industrial	*53.5*	*21%*	100%	99%	
Agricultural					
Total Industrial	*17.8*	*7%*	100%	100%	
Transport & Street Lighting					
Total Transport & Lighting	*15.3*	*6%*	100%	100%	
Total Statewide	251.6	100%			

Off-Road Emissions

Solano Transportation Agency Greenhouse Gas Inventory

GHG Emissions Summary

City of Vacaville

COMMUNITY-WIDE

Emission Sector	Subsector	Emissions (MT CO_2e/yr)	Percent	2020 BAU Emissions (MT CO2e/yr)	2020 Adjusted for LCFS	2035 BAU Emissions (MT CO2e/yr)	2020 Adjusted for LCFS
Off-Road Equipment	TOTAL	**11,994**	2%	**13,468**	12,121	**15,310**	13,779
	Construction	8,097	2%	9,092	8,182	10,335	9,302
	Lawn and Garden	851	0%	955	860	1,086	977
	Light Commercial	1,649	0%	1,852	1,667	2,105	1,895
	Industrial	1,397	0%	1,569	1,258	1,784	1,605

Year 2020 Adjusted	2020 MTons of CO2e	Notes
Industrial Equipment	1,412	With LCFS (10% reduction)
Construction Equipment	8,182	With LCFS (10% reduction)
Lawn&Garden Equipmen	860	With LCFS (10% reduction)
Light Commercial Equipn	1,667	With LCFS (10% reduction)
TOTAL	12,121	MTons

Year 2035 Adjusted	2035 MTons of CO2e	Notes
Industrial	1,605	With LCFS (10% reduction)
Construction Equipment	9,302	With LCFS (10% reduction)
Lawn&Garden Equipmen	977	With LCFS (10% reduction)
Light Commercial Equipn	1,895	With LCFS (10% reduction)
TOTAL	13,779	MTons

Local Measures that support Statewide Other Reductions

EC-5	Continue to support the Yolo Solano Air Quality Management District's lawnmower ex-change program for residents to exchange conventional gas-powered lawnmowers for electric and rechargeable battery-powered lawnmowers.
OS-1	Continue to identify and inventory potential community garden and urban farm sites in existing parks, public easements, right-of-ways, and schoolyards, and develop a program to establish pesticide-free community gardens in appropriate locations.
OS-2	Encourage significant new residential developments over 250 units to include space that can be used to grow food.
OS-3	Establish a process through which a neighborhood can propose and adopt a site as a community garden.
OS-4	Continue to support the Vacaville Farmers' Market as a source for locally-grown food.
OS-5	fee program.
P-1	Develop policies, incentives, and design guidelines that encourage the public and private purchase and use of durable and nondurable items, including building materials, made from recycled materials or renewable resources.
CA-1	Develop and implement an outreach plan to engage local businesses in GHG emissions reduction programs.
CA-2	Establish and maintain a “sustainability information center” at City Hall to inform the public and distribute available brochures, and provide information on sustainability on the City's website.
CA-3	Continue to conduct outreach to encourage residents to shop locally and support local business.

Source: LSA 2012. Based on EMFAC2011	Daily VMT	Tons/Day CO2	MTons/Day CO2	MTons/Year CO2 BAU	Tons/Day CO2 (Pavley+LCFS)	MTons/Day CO2 (Pavley+LCFS)	MTons/Year CO2 (Pavley+LCFS)
2008	3,075,131	1,899.8	1,723.5	598,044	1,899.8	1,723.5	598,044
2020	3,913,894	2,567.2	2,328.9	808,137	2,032.4	1,843.8	639,785
2020 w/ECAS	3,585,434	2,351.8	2,133.5	740,327	1,861.9	1,689.1	586,104

*** Daily vehicles miles traveled (VMT) multiplied by 347 days/year to account for reduced traffic on weekends and holidays. This assumption is consistent with the California Air Resources Board's (CARB) methodology within the Climate Change Scoping Plan Measure Documentation Supplement.

Water and Wastewater

	2008 avg	2020	2035	2008 avg	2020	2035
	Cubic Feet Per year			Million Gallons Per Year		
Water	866,582,697	973,072,538	1,106,184,839	6,482	7,279	8,275
Wastewater	390,341,186	438,308,184	498,266,932	2,920	3,279	3,727

	2008 avg	2020	2035	2008 avg	2020	2035
	Acre-Feet/Year			Liters Per/Year		
Water	19,894	22,339	25,395	24,536,218,323	27,551,346,587	31,320,256,917
Wastewater	8,961	10,062	11,439	11,052,028,370	12,410,154,658	14,107,812,518

Wastewater use is estimated based on 2008 data; however, it is correct to say that wastewater fluctuates up and down from year to year, partially dependent on the amount and timing of precipitation.

GHG Emissions	2008	2020	2035	Adjusted 2020	Adjusted 2035
	MTons/Year				
Energy	7,458	8,374	9,520	4,280	4,865
Fugitive	685	769	875	769	875
Easterly Treatment Plant*	2,531	3,638	5,021		
Total Water/Wastewater	10,674	12,781	15,416	5,049	5,740

*GHG Inventory for Project EIR, Easterly Wastewater treatment Plant, Ryan Hougham, E.I.T, December 29, 2009

General Conversion Factors

Cubic Feet to Gallons	7.480519	
killowatt hrs to megawatt hrs	0.001	
million gallons to AF	0.3259	325851.429
gallons to Liters	3.785	
lbs to Tons	2000	
Tons to Mton	0.9071847	

Source: California Air Resources Board (CARB). 2010. Local Government Operations Protocol. Version 1.1. Appendix F, Standard Conversion Factors

Wastewater - Fugitive Emissions

WASTEWATER: Wastewater in Vacaville is collected, transported, and treated by the Easterly Wastewater treatment Plant. The majority of wastewater is treated to secondary levels and then discharged into Old Alamo Creek.

Fugitive Emissions from Wastewater Associated with Aerobic and Anaerobic Process

CH4 - Microorganisms can biodegrade soluble organic material in wastewater under aerobic (presense of oxygen) or anaerobic (absense of oxygen) conditions. Aneorbic conditions result in the production of CH4.

N2O - Treatment of domestc wastwater during both nitrification and denitrification of the nitrogen present leads to the formation of N2O, usually in the form of urea, ammonia, and proteins. These compounds are converted to nitrate through the aerobic process of nitrification. Denitrification occus under anoxic conditions (without free oxygen), and incolves the biological conversion of nitrate into dinitrogen. N2O can be an intermediate product of both processes, but more often is associated with denitrification.

Notes: Waste Discharge facilities in compliance with the United States Environmental Protection Agency's Clean Water Standards do not typically result in CH4 emissions. However, poorly-operated aerobic wastewater treatment systems can result in the generation of CH4. Because wastewater treatment systems are assumed to operate in compliance with state and federal laws pertaining to water quality, CH4 emissions from centralized aerobic treatments are not included in the inventory.

Fugitive Emissions - Process Emissions from WWTP with Nitrification/Denitrification

LGOP Version 1.1. Equation 10.9.

N2O = Wastewater x 10^-6 x Nload x EF effluent x 10^3

	2008	2020	2035
wastewater (Liters)=	11,052,028,370	12,410,154,658	14,107,812,518
10^-6 =	1.00E-06	conversion factor; kg/mg	
N Load	40.00	mg/L of wastewater	USEPA 2008
EF effluent	0.01	kg//N2O/kg N	
10^-3 =	1.00E-03	conversion factor: MTons/kg	

	2008	2020	2035
		MTons	
N2O	2.210	2.482	2.822
CO2e =	685	769	875

Source: California Air Resources Board (CARB). 2010, May. Local Government Operations Protocol (LGOP), Version 1.1. The LGOP protocol provides default values for all the terms except the Nitrogen Load, which is assumed to be 40 mg of N per Liter of wastewater effluent based on USEPA methodology outlined in the CalEEMod program manual. South Coast Air Quality Management District (SCAQMD). 2011. California Emissions Estimator Model (CalEEMod), Version 2011.1.1. User's Manual. USEPA. 2008. Page 8-12. USEPA cites Metcalf & Eddy, Inc., 1991, "Wastewater Engineering: Treatment Disposal, and Reuse," 3rd Ed. McGraw Hill Publishing.

Water and Wastewater - Embodied Energy (electricity)

East Bay Municipal Utility District (EBMUD)

Water Supply and Conveyance	Water Treatement	Water Distribution	Total Water	Wastewater Treatment
		kWhr/million gallons		
2,117	111	1,272	3,500	1,911

Source: California Energy Commission (CEC). 2006, December. Refining Estimates of Water-Related Energy Use in California. CEC-500-2006-118. Prepared by Navigant Consulting, Inc. Based on the electricity use for Northern California

Pacific Gas & Electric - Emission Factors

	Intensity factor				CO_2e
	lbs CO_2/MWH	MTons CO_2/MWh	CH4 MTons/MWH	N2O MTons/MWH	MTons/MWh
2005	489	0.222	0.000013	0.000005	0.224
2006	456	0.207	0.000013	0.000005	0.209
2007	636	0.288	0.000013	0.000005	0.290
2008	641	0.291	0.000013	0.000005	0.293
2009	575	0.261	0.000013	0.000005	0.263
2010	559	0.254	0.000013	0.000005	0.256
erage (2006-2008) based on PG&E	578	0.262	0.000013	0.000005	**0.264**
2020 (CO_2)	290	0.133	0.000013	0.000005	**0.135**
Source: Pacific Gas & Electric (PG&E). 2011, April. Greenhouse Gas Emissions Factors Info Sheet. *CO2 intentsiy for 2010 and earlier is based on PG&E's third-party-verified GHG inventory submitted to the California Climate Action Registry (CCAR) (2003-2008) or The Climate Registry (TCR).			Source: CH_4 and N_2O intensity based on California E-Grid data (CH_4 = 0.029 lbs/MWH; N_2O = 0.011 lbs/MWH)		

Note: The 2020 emissions rate is estimated by PG&E. It includes reductions from 33% Renewable Portfolio Standard (RPS), Cap-and-Trade, and other regulatory reductions for High Globa Warming Potential (HGWP) gases such as reductions of SF_6.

2011 GHG Emissions from Water Use - Purchased Energy

Energy Associated with Water Use	2008 MwH/Year	2020	2035
Water	22,689	25,477	28,962
Wastewater	5,580	6,266	7,123
Total Water/Wastewater	28,269	31,743	36,085

Indirect GHG Emissions from Energy Associated with Water	2008 MTons/Year	2020	2035
Water	5,986	6,721	7,641
Wastewater	1,472	1,653	1,879
Total Water/Wastewater	7,458	8,374	9,520

Adjusted Forecast - 2020 PG&E CO2 Intensity

Under the RPS, certain retail sellers of electricity were required to increase the amount of renewable energy each year by at least 1 percent in order to reach at least 20 percent by December 30, 2010. The California Air Resources Board (CARB) has now approved an even higher goal of 33 percent by 2020. Investor-owned utilities, such as PG&E are also required to participate in CARB's Cap-and-Trade program and reduce High Global Warming Potential (HGWP) gases, such as reductions of SF6.

Source: Pacific Gas & Electric (PG&E). 2011, April 8. Greenhouse Gas Emission Factors Info Sheet.
http://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf

Indirect GHG Emissions from Energy Associated with Water	2008 MTons/Year	Adjusted 2020	Adjusted 2035
Water	5,986	3,435	3,905
Wastewater	1,472	845	960
Total Water/Wastewater	7,458	4,280	4,865

APPENDIX C

GHG EMISSIONS REDUCTIONS MEASURES MODELING DATA

Summary of Vacaville's GHG Reductions

Measures		MTons 2020	MTons 2035
Land Use and Transportation			
State Measures	*Pavley and LCFS (included in the ABAU)*	*168,350*	*275,630*
LU and TR (combined)		53,682	53,682
Electricity and Natural Gas Reductions			
State Measures	*Title 24 Cycle Updates, 33% RPS, SmartGrid (included in ABAU)*	*88,140*	*106,216*
	Total Local	570	890
RE-1	Require that new or major rehabilitations of commercial, office, or industrial development greater than or equal to 10,000 square feet in size incorporate solar or other renewable energy generation to provide 15 percent or more of the project's energy needs unless prohibited by topographical conditions or other site-specific constraints. Major rehabilitations are defined as additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area. Remove regulatory barriers to incorporating renewable energy generation.	20	110
EC-3	Require all new development and major rehabilitation (i.e. additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area) projects to incorporate any combination of the following strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape, which includes roads, sidewalks, courtyards, parking lots, and driveways: shaded within five years of occupancy; paving materials with a Solar Reflectance Index (SRI) of at least 29; open grid pavement system; and parking spaces underground, under deck, under roof, or under a building. Any roof used to shade or cover parking must have an SRI of at least 29.	220	420
EC-1	Mandate the use of energy-efficient appliances in new development that meet Energy Star standards and the use of energy-efficient lighting technologies that meet or exceed Title 24 standards.	10	10
EC-2	Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following: - Conduct outreach to educate the public about available rebates and other incentives from energy providers. - Promote the purchase of ENERGY STAR appliances. - Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures. - Offer a halogen torchiere lamp exchange to community members. - Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization. - Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target. - Promote individualized energy management planning and related services for large energy users. - Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.	70	100
EC-4	Continue to replace City street lights with LED, induction, or other energy-efficient lighting, and require similar energy-efficient street lights in new development.	250	250
Waste & Recycling Reductions			
SW-1		7,770	15,990
Water and Wastewater Reductions			
	33% RPS (included in ABAU)	*4,095*	*4,655*
WW-1		1,450	1,700
Other Emissions Sources			
	LCFS (included in the ABAU)	*1,347*	*1,531*
State Scoping Plan Reductions		*261,932*	*388,032*
Local Reductions		63,472	72,262

Energy & Green Buildings Measures

Electricity	Residential 2020		Non-Residential 2020		Residential 2035		Non-Residential 2035	
	Existing Kwh	New Kwh	Existing Kwh	New Kwh	Existing Kwh	New Kwh	Existing Kwh	New Kwh
Title 24	30,655,416	2,379,491	200,316,251	14,342,590	30,655,416	2,974,364	200,316,251	17,928,238
Non-Title 24	203,499,784	15,795,771	94,227,710	6,746,679	203,499,784	19,744,714	94,227,710	8,433,349
	234,155,200	18,175,262	294,543,960	21,089,269	234,155,200	22,719,078	294,543,960	26,361,587

Natural Gas	Residential 2020		Non-Residential 2020		Residential 2035		Non-Residential 2035	
	Existing Therms	New Therms	Existing Therms	New Therms	Existing Therms	New Therms	Existing Therms	New Therms
Title 24	11,410,888	1,288,722	7,832,991	787,389	11,410,888	1,610,903	7,832,991	984,236
Non-Title 24	1,556,030	175,735	3,652,333	367,140	1,556,030	219,669	3,652,333	458,925
	12,966,918	1,464,457	11,485,325	1,154,529	12,966,918	1,830,571	11,485,325	1,443,161

Sources: Brown, Richard E. and Koomey, Jonathan G., 2002, May. Electricity Use in California: Past Trends and Present Usage Patterns. University of California, Berkeley (UCB), Energy analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory. lBL-47992. http://enduse.lbl.gov/Projects/CAdata.html; California Energy Commission. Residential End Use Survey. http://energyalmanac.ca.gov/naturalgas/residential_use.html; and California Energy Commission. 2006, March. California Commercial End-Use Survey. Prepared by Itron. CEC-300-2006-005.

Renewable Energy Generation - New or Existing Non-Residential

RE-1	Require that new or major rehabilitations of commercial, office, or industrial development greater than or equal to 10,000 square feet in size incorporate solar or other renewable energy generation to provide 15 percent or more of the project's energy needs unless prohibited by topographical conditions or other site-specific constraints. Major rehabilitations are defined as additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area. Remove regulatory barriers to incorporating renewable energy generation.	Reduces GHGs by:	25
Support Measures			
EC-2	Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following: - Conduct outreach to educate the public about available rebates and other incentives from energy providers. - Promote the purchase of ENERGY STAR appliances. - Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures. - Offer a halogen torchiere lamp exchange to community members. - Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization. - Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target. - Promote individualized energy management planning and related services for large energy users. - Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.	Supports RE-1	
RE-3	- Establishes citywide measurable goals; - Identifies the allowable and appropriate alternative energy facility types within the city, such as solar photovoltaic (PV) on residential and commercial roofs and wind turbines for home use; - Proposes phasing and timing of alternative energy facility and infrastructure development; - Establishes development review protocol for new alternative energy projects; - Reviews City policies and ordinances to address alternative energy production;	Supports RE-1	
RE-4	Coordinate with other local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop alternative energy policies and programs that are optimized on a regional scale.	Supports RE-1	
RE-5	Require that all new buildings be constructed to allow for the easy, cost-effective installation of future solar energy systems, unless prohibited by topographical conditions or other site-specific constraints. "Solar ready" features should include: proper solar orientation (i.e. south-facing roof area sloped at 20° to 55° from the horizontal); clear access on the south sloped roof (i.e. no chimneys, heating vents, plumbing vents, etc.); electrical conduit installed for solar electric system wiring; plumbing installed for solar hot water system; and space provided for a solar hot water storage tank.	Supports RE-1	
RE-6	Encourage the installation of solar photovoltaic arrays in new parking lots and re-placement in existing parking lots.	Supports RE-1	
EC-6	Continue to offer innovative, low-interest financing for energy efficiency and renewable energy projects for existing and new development through the PACE program.	Supports RE-1	
Non-Residential:	Assumes 4.5 non-residential buildings constructed/remodeled over the next 8 years (0.6 per year) that will include PV (20 by 2035).		4.5

			Power Offset			2020
Non-Residential	40,472	kwh/unit/year	182,004	kwh	25	GHG MTons
			Power Offset			2035
Non-Residential	40,472	kwh/unit/year	809,440	kwh	109	GHG MTons

Source: California Energy Commission (CEC). 2012. Clean Power Estimator. http://www.gosolarcalifornia.org/tools/clean_power_estimator.php. Based on a 25,000 Watt-ac PV system (commercial or 25.0 kw-ac system) in zip code 95687 and the number of units forecast to be built.

Existing Non-Residential Building Retrofits

EC-3	Require all new development and major rehabilitation (i.e. additions of 25,000 square feet of office/retail commercial or 100,000 square feet of industrial floor area) projects to incorporate any combination of the following strategies to reduce heat gain for 50 percent of the non-roof impervious site landscape, which includes roads, sidewalks, courtyards, parking lots, and driveways: shaded within five years of occupancy; paving materials with a Solar Reflectance Index (SRI) of at least 29; open grid pavement system; and parking spaces underground, under deck, under roof, or under a building. Any roof used to shade or cover parking must have an SRI of at least 29.	avg non-residential square feet/year 2006-2009	389,761	Reduces GHGs by:	222 MTCO2e
					average of all buildings is greater than 100,000 sq ft
Support Measures		avg non-res permits/avg non-residential sq ft=			109,573

	Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following: - Conduct outreach to educate the public about available rebates and other incentives from energy providers. - Promote the purchase of ENERGY STAR appliances. - Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures. - Offer a halogen torchiere lamp exchange to community members. - Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization. - Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target. - Promote individualized energy management planning and related services for large energy users.			jobs generated through new non-res permits
EC-2	- Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.	Supports EC-3	974	(assumes 400 sq ft/job)
EC-6	Continue to offer innovative, low-interest financing for energy efficiency and renewable energy projects for existing and new development through the PACE program.	Supports EC-3	28,500	total avg. Jobs 2006-2009
			3.4%	of jobs affected

Assumes	15%	percent increase in energy efficiency
Assumes	3.4%	of energy use from existing jobs would be affected by 2020.
Assumes	6.4%	of energy use from existing non-residential buildings would be affected by 2035.

Based on building permits from 2006 to 2009. Average non-residential square footage is 109,573, generating 974 new jobs. There was 28,500 new jobs between 2006 to 2009 (or 3.4% of employees work in buildings that would be classified as major rehabilitations or new projects)

	Electricity Ratio for 1% over Title 24	Natural Gas Ratio for 1% over Title 24
Residential (avg)	0.08	0.90
multi-family	0.12	0.88
single-family	0.04	0.91
Non-Residential	0.23	0.71
Commercial	0.26	0.72
Office	0.36	0.95
Industrial	0.06	0.46

Source: California Air Pollution Control Officer's Association (CAPCOA). 2010, August. Quantifying Greenhouse Gas Mitigation Measures. Table BE-1.1 and BE-1.2, Climate Zone 5.

		2020			2035		
Electricity	Title 24 Kwh from Existing (pRE-1005 Title 24)	Kwh from existing non-residential that would improve energy efficiency	Kwh Reductions with 15% improvement	GHG Reductions (MTons)	Kwh from existing non-residential that would improve energy efficiency	Kwh Reductions with 15% improvement	GHG Reductions (MTons)
Non-Residential	200,316,251	6,848,725	232,857	31	12,841,359	436,606	59

		2020			2035		
Natural Gas	Title 24 Therms from Existing (pRE-1005 Title 24)	Therms from existing non-residential that would improve energy efficiency	Therms Reductions with 15% improvement	GHG Reductions (MTons)	Therms from existing non-residential that would improve energy efficiency	Therms Reductions with 15% improvement	GHG Reductions (MTons)
Non-Residential	7,832,991	267,807	28,521	190	502,137	53,478	357
				222			415

New Residential - Energy Star Appliances

EC-1 Mandate the use of energy-efficient appliances in new development that meet Energy Star standards and the use of energy-efficient lighting technologies that meet or exceed Title 24 standards. Reduces GHGs by: 8

Assumes developers would provide energy-efficient appliances or residents would purchase new appliances, which meet the Title 25 Energy Code.

Percent of Total Electricity	Residential
Refrigerators	18%
Clothes washer	1%
Dishwasher	3%

Sources: Brown, Richard E. and Koomey, Jonathan G., 2002, May. Electricity Use in California: Past Trends and Present Usage Patterns. University of California, Berkeley (UCB), Energy analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National

Energy Star appliances Increased Efficiency - CLIMATE ZONE 5

	Single Family	Multi-Family	Townhome	Residential (average)
Refrigerators	1.99%	3.07%	2.78%	2.61%
Clothes washer	0.58%	0.03%	0.35%	0.32%
Dishwasher	0.14%	0.12%	0.14%	0.13%

Source: California Air Pollution Control Officers Association (CAPCOA). 2010, August. Quantifying GHG Mitigation Measures. Average based on percentage multi-family and single-family units anticipated in Climate Zone 5.

Lighting (hard-wired interior [6%] and exterior [33%]) is 39% of total commercial energy use (CEC). Hard-wired lighting is regulated under Title 24 and therefore not included in reductions.

ENERGY STAR Appliances:	2020		2035	
	kwh	MTon	kwh	MTon
Energy Saving from New Residential Units:	58,551	8	73,189	10

Existing Residential - Turnover to Energy Efficient Appliances

	Partner with Pacific Gas & Electric and other appropriate energy providers to promote energy conservation, including the following: - Conduct outreach to educate the public about available rebates and other incentives from energy providers. - Promote the purchase of ENERGY STAR appliances. - Inform the public about where to find low-cost compact fluorescent light (CFL) bulbs and/or fixtures. - Offer a halogen torchiere lamp exchange to community members. - Promote energy efficiency audits of existing buildings to check, repair, and readjust heating, ventilation, air conditioning, lighting, water heating equipment, insulation and weatherization. - Encourage energy audits to be performed when residential and commercial buildings are sold. Energy audits would include information regarding the opportunities for energy efficiency improvements, and would be presented to the buyer. Commercial buildings are encouraged to be "benchmarked" using EPA's ENERGY STAR Portfolio Manager Tool. Consider requiring energy audits if future evaluations of ECAS performance demonstrate that City is not meeting its target. - Promote individualized energy management planning and related services for large energy users.	
EC-2	- Fund and schedule energy efficiency retrofits or "tune-ups" of existing buildings.	Reduces GHGs by 71
Support Measures		

ENERGY STAR APPLIANCES - EXISTING

Assume a portion of the existing residential uses would purchase new energy-efficient appliances which meet the Title 25 Energy Code.

Percent of Total Electricity	Residential
Refrigerators	18%
Clothes washer	1%
Dishwasher	3%

Sources: Brown, Richard E. and Koomey, Jonathan G., 2002, May. Electricity Use in California: Past Trends and Present Usage Patterns. University of California, Berkeley (UCB), Energy analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory. lBL-47992. http://enduse.lbl.gov/Projects/CAdata.html.

Energy star appliances Increased Efficiency

	Residential Increase in Efficiency (average multi & single family)	Average Appliance Life Expectancy	Residential Turnover in the next 10 years	Residential Turnover in the next 27 years
Refrigerators	1.99%	14 years	70%	100%
Clothes washer	0.58%	12 years	60%	100%
Dishwasher	0.14%	12 years	60%	100%

Source: California Air Pollution Control Officers Association (CAPCOA). 2010, August. Quantifying GHG Mitigation Measures. Based on single-family units anticipated in Climate Zone 5 for existing single-family residential in the City.

Source: Appliance Life Expectancy. http://www.mrappliance.com/expert/life-guide/ Based on the life expectancy of appliances as reported in the 23rd annual portrait of the U.S. appliance industry.

ENERGY STAR Appliances:

	2020		2035	
	kwh	MTons	kwh	MTons
Energy Saving from Existing Residential Units:	526,176	71	754,326	102

Existing Lighting

EC-4 Continue to replace City street lights with LED, induction, or other energy-efficient lighting, and require similar energy-efficient street lights in new development..

Reduces GHGs by: 252

Non-Residential Exterior Lighting: 6% of Total Energy Use

of California, Berkeley (UCB), Energy analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National

Energy-Efficient exterior lighting is assumed to be LED technology

Efficiency of LED vs. High Pressure Sodium Lighting

	Average Power (Watts)	Power Saving (Watts)	Annual Energy Saving (KWh) Per Luminaire	Lifespan (hours)	Annual Hours
High Pressure Sodium Luminaire	121			30,000	4,100
LED Luminaire	77.7	43	178		
	Percent Reduction	36%	Turnover (years)	7.3	100% in 10 years

Source: U.S. Department of Energy (DOE). 2008, January. Final Report Prepared in Support of the U.S. DOE Solid-State Lighting Technology Demonstration Gateway Program and PG&E Emerging Technologies Program. Prepared by Energy Solutions.

NON-RESIDENTIAL EXTERIOR LIGHT REPLACEMENT

	2020		2035	
	kwh	MTon	kwh	MTon
Energy Saving from Non-Residential Lighting (Existing):	1,870,720	252	1,870,720	252

Local Waste Reduction Measures

Waste	Existing (Average 2006-2008)			
	Tons/Day	GHG MTons	Diverted Tons/Day	Total
Solid Waste	105,168	NA	NA	
ADC	5,864	NA	NA	
Total	111,032	19,033	95,860	206,892

Waste	2020			
	Tons/Day	GHG MTons	Diverted Tons/Day	Total
Solid Waste	118,092	NA	NA	
ADC	6,584	NA	NA	
Total	124,676	21,372	107,640	232,316
Increase	0	2,339		

0

Waste	2030			
	Tons/Day	GHG MTons	Diverted Tons/Day	Total
Solid Waste	134,246	NA	NA	
ADC	7,485	NA	NA	
Total	141,731	24,295	122,364	264,095
Increase	17,055	2,924		

Average Diversion Rate

CalRecycle average diversion rate for Vacaville (2004 to 2006; not reported after 2007) 54%

2004	53%
2005	56%
2006	52%

Source: CalRecycle. Countywide, Regionwide, and Statewide Jurisdiction Diversion/Disposal Progress Report
http://www.calrecycle.ca.gov/LGCentral/Reports/jurisdiction/diversiondisposal.aspx

Local Measures that Support Waste Reduction and the Statewide Goal of 75% Waste Diversion

Assembly Bill 939 (AB 939), the California Integrated Waste Management Act of 1989, requires jurisdictions to divert 50 percent of waste from landfills. In 2011, the Governor signed Assembly Bill 341 (AB 341) expanding the waste reduction goals by ensuring the state is diverting 75 percent of municipal solid waste. AB 341 identifies a goal of the state that not less than 75 percent of solid waste generated be source reduced, recycled, or composted by the year 2020.

SW-1	Support waste reduction through the following sub-measures. Solid waste sub-measures SW-1A through SW-1H support measure SW-1 and when com-bined reduce GHG emissions in Vacaville by 7,770 MTC02e or 9 percent of the total GHG emission reductions. The modeling conservatively assumes a 66 percent waste diversion rate (approximately 12 percent increase) based on historic trends in waste disposal in the City for 2020 and 75 percent goal for 2035. Therefore, the matrix does not show a quantified percent of total GHG reductions for each sub-measure, and it does not list any assumptions.
SW-1A	Continue to require at least 50 percent diversion (i.e. reuse or recycling) of non-hazardous construction waste from disposal, consistent with CALGreen - the Statewide Green Building code.
SW-1B	Require all new and existing multi-family developments that are redeveloping or re-modeling to provide recycling areas for their residents. Allow a reduction in the parking requirement if necessary to allow adequate space for the recycling area.
SW-1C	Continue to promote recycling and waste diversion in Vacaville through marketing efforts to increase participation by residents and businesses. As part of this program, continue to conduct through the City's Recycling Coordinator public education and outreach about reuse and recycling, including existing programs for appliance disposal, yard debris and kitchen waste collection and composting, waste to energy, and zero waste programs. Where applicable, coordinate recycling outreach efforts with the City's contracted solid waste hauler Recology Vacaville Solano (RVS).
SW-1D	Encourage the use of salvaged and recycled-content materials and other materials that have low production energy costs for building materials, hard surfaces, and non-plant landscaping. Require sourcing of construction materials locally, as feasible.
SW-1E	Investigate the provision of recycling containers Downtown and in City-owned parks.

Based on historical trends in waste disposal reduction, as reported by CalRecycle, for the City of Vacaville. Not corrected for SOI or Planning Area population and employment. Although population and employment increased, generally waste disposal has decreased.

Disposal Year	Solid Waste Disposal Tons	Alternative Daily Cover Tons	Total Tons
2005	103,319	3,913	107,232
2006	113,418	3,348	116,766
2007	105,120	9,532	114,652
2008	96,967	4,710	101,677
2009	85,502	2,854	88,356
2010	83,129	3,260	86,389

Source: California Department of Resources Recycling and Recovery (CalRecycle). Disposal Reporting System. Jurisdiction Disposal by Facility, Vacaville, 2005-2010. http://www.calrecycle.ca.gov/lgcentral/Reports/DRS/Default.aspx

1 Includes materials used for Alternative Intermediate Cover (AIC) in ADC. However, AIC materials are stipulated under the Public Resources Code Section 41781.3 as recycling and not disposal and are calculated separately in disposal years 2006 and after.

	Percent Reduction MSW	Percent Reduction ADC
2005-2006	9.8%	-14.4%
2006-2008	-14.5%	40.7%
2008-2009	-11.8%	-39.4%
Average % Reduction Per Year	-5.5%	-4.4%

Exponential Equation

Reduction = Beginning Amount (1 + r)^t

r = rate

t = time (8 years from 2012 to 2020)

Note: Outlier data for 2007 was omitted.

The modeling conservatively assumes a 66% waste diversion rate (approximately 12 percent increase) based on historic trends in waste disposal in the City for 2020 and 75% goal for 2035.

Waste	2020 MSW Adjusted Tons/Day	2020 ADC Adjusted Tons/Day	GHG MTons	Diversion Rate
Total	74,992	4,598	13,597	66%
Reduction	43,100	1,986	7,775	

Waste	2035 MSW Adjusted Tons/Day	2035 ADC Adjusted Tons/Day	GHG MTons	Diversion Rate
Total	45,660	3,191	8,303	75%
Reduction	88,586	4,294	15,993	

VACAVILLE ECAS

2020 VMT Summary

Measure		Daily VMT		VMT Reduction from BUA		VMT Reduction (Normalized)		Percent VMT Reduction	
		Vacaville Roads Only	All Roads	Vacaville Roads Only	All Roads	Vacaville Roads Only	All Roads	Vacaville Roads Only	All Roads
None	Business as Usual	1,137,892	3,913,894						
LU-1	Emphasis on Pedestrian Entrances	1,137,865	3,913,863	(27)	(31)	(28)	(31)	0.00%	0.00%
LU-2	Pedestrian or Bicycle Connections	1,136,890	3,912,895	(1,002)	(999)	(1,037)	(1,011)	-0.09%	-0.03%
LU-3	Traditional Development Patterns	1,137,853	3,913,870	(39)	(24)	(40)	(24)	0.00%	0.00%
LU-4	Pedestrian Access	1,137,869	3,913,874	(23)	(19)	(24)	(20)	0.00%	0.00%
TR-1	Bikeway Plan	1,137,827	3,913,821	(65)	(72)	(68)	(73)	-0.01%	0.00%
TR-2	Bike Parking in Comm. Dev. and PNR	1,136,243	3,912,111	(1,649)	(1,783)	(1,707)	(1,804)	-0.15%	-0.05%
TR-3	Shared Parking and Infill Reductions	1,117,602	3,838,526	(20,290)	(75,367)	(21,000)	(76,279)	-1.88%	-1.99%
TR-4	Voluntary Trip Reduction Program	1,115,491	3,805,881	(22,401)	(108,012)	(23,184)	(109,319)	-2.08%	-2.87%
TR-5	Commute Reduction Strategies	1,125,442	3,855,576	(12,450)	(58,318)	(12,886)	(59,023)	-1.14%	-1.53%
TR-6	School Trip Reduction	1,124,710	3,863,119	(13,182)	(50,774)	(13,643)	(51,389)	-1.21%	-1.33%
TR-7	Shuttle Service for Major Emp. Centers	1,137,489	3,912,182	(403)	(1,712)	(417)	(1,733)	-0.04%	-0.04%
TR-8	Parking Cash-out	1,136,761	3,910,220	(1,131)	(3,674)	(1,171)	(3,718)	-0.10%	-0.10%
TR-9	Transit Network Expansions	1,133,004	3,890,146	(4,888)	(23,748)	(5,059)	(24,035)	-0.45%	-0.62%
	TOTAL INDIVIDUAL MEASURES			(77,552)	(324,534)	(80,264)	(328,460)		
Maximum ECAS Measures		1,057,628	3,585,434	(80,264)	(328,460)	(80,264)	(328,460)	-7.59%	-9.16%
	Percent Difference			-3.4%	-1.2%	0.0%	0.0%		

Source: LSA 2012. Based on EMFAC2011	Daily VMT	Tons/Day CO2	MTons/Day CO2	MTons/Year CO2 BAU	Tons/Day CO2 (Pavley+LCFS)	MTons/Day CO2 (Pavley+LCFS)	MTons/Year CO2 (Pavley+LCFS)
2008	3,075,131	1,899.8	1,723.5	598,044	1,899.8	1,723.5	598,044
2020	3,913,894	2,567.2	2,328.9	808,137	2,032.4	1,843.8	639,785
2020 w/ECAS	3,585,434	2,351.8	2,133.5	740,327	1,861.9	1,689.1	586,104

*** Daily vehicles miles traveled (VMT) multiplied by 347 days/year to account for reduced traffic on weekends and holidays. This assumption is consistent with the California Air Resources Board's (CARB) methodology within the Climate Change Scoping Plan Measure Documentation Supplement.

Local Water/Wastewater Measures

Local Measures that are Required Pursuant to the model Water Efficient Landscape Ordinance (WELO) or California Building Code
Local Measures that Support EBMUD's Urban Water Management Plan to Achieve 20% Per Capita Water reductions.

The California Department of Water Resources adopted a plan to reduce per capita water use by 20 percent by 2020 in accordance with the Final 20X2020 Water Conservation Plan. New development is required to comply with the new Title 24 California Green Building Code (CALGreen) water efficiency provisions that mandate an improvement over existing plumbing and irrigation water efficiency. This efficiency corresponds with the 20X2020 goal to reduce per-capita water use by 20 percent.
Reductions from these measures are capped at the 20 percent per capita goal.

Measures WW-1A through WW-1G all support the following reduction: 1,452

WW-1	Support the conservation measures outlined in the City's Urban Water Management Plan and implement the City's Water Efficient Landscape requirements through the following sub-measures. Water and wastewater sub-measures WW-1A through WW 1L support measure WW-1 and when combined reduce GHG emissions in Vacaville by 2,850 MTCO2e or 3 percent of the total GHG emission reductions. Therefore, the matrix does not show a quantified percent of total GHG reductions for each sub-measures, and it does not list any as-sumptions.
WW-1A	For all new development, require all water use and efficiency measures to comply with City Codes.
WW-1B	At least every five years, review and update the City's Water Efficient Landscape require-ments with improved conservation programs and incentives for non-residential customers.
WW-1C	Continue to offer conservation programs and incentives to large landscape customers per the Urban Water Management Plar
WW-1D	Implement water efficient residential programs identified in the current Urban Water Man-agement Plan. Continue to coordinate with local water purveyors to achieve consistent standards
WW-1E	Expand the public information and school education program to promote water conservation and its benefits in coordination with efforts of local water purveyors. Con-duct public education and outreach to reduce watering of non-vegetated surfaces and promote the use of pervious paving materials
WW-1F	Encourage the use of non-potable water for irrigation purposes
WW-1G	Continue to meter all new connections and retrofits of existing connections with commodity rates. Continue to provide information to customers about their water use

	2020 w/20% Reduction	2035 w/20% Reduction	2020 w/20% Reduction	2035 w/20% Reduction
	Cubic Feet Per year		Million Gallons Per Year	
Water	778,458,030	884,947,871	5,186	5,823
Wastewater	350,646,547	398,613,545	2,336	2,623

	2020 w/20% Reduction	2035 w/20% Reduction	2020 w/20% Reduction	2035 w/20% Reduction
	Acre-Feet/Year		Liters Per/Year	
Water	17,871	20,316	19,628,974,659	22,041,077,270
Wastewater	8,050	9,151	8,841,622,696	9,928,123,726

Energy

Energy Associated with Water Use	2020	2035
	MwH/Year	
Water	18,151	20,381
Wastewater	4,464	5,013
Total Water/Wastewater	22,615	25,394

Indirect GHG Emissions from Energy Associated with Water Use	2020	2035	Reduction from Adjusted 2020	Reduction 2035
	MTons/Year		MTons/Year	
Water	2,447	2,748	-988	-1,157
Wastewater	602	676	-243	-285
Total Water/Wastewater	3,049	3,424	-1,231	-1,441

Energy

LGOP Version 1.1. Equation 10.9.

N2O = Wastewater x 10^-6 x Nload x EF effluent x 10^3

	2020	2035	Reduction 2020	Reduction 2035
	MTons/Year		MTons/Year	
N2O	1.768	1.986	-0.714	-0.836
CO2e =	548	616	-221	-259

Source: California Air Resources Board (CARB). 2010, May. Local Government Operations Protocol (LGOP), Version 1.1. The LGOP protocol provides default values for all the terms except the Nitrogen Load, which is assumed to be 40 mg of N per Liter of wastewater effluent based on USEPA methodology outlined in the CalEEMod program manual. South Coast Air Quality Management District (SCAQMD). 2011. California Emissions Estimator Model (CalEEMod), Version 2011.1.1. User's Manual. USEPA. 2008. Page 8-12. USEPA cites Metcalf & Eddy, Inc., 1991, "Wastewater Engineering: Treatment Disposal, and Reuse," 3rd Ed. McGraw Hill Publishing.

Total

	2020	2035	Reduction from Adjusted 2020	Reduction 2035
	MTons/Year		MTons/Year	
Total Water/Wastewater	3,597	4,039	-1,452	-1,701