City of Berkeley Resource Conservation and Global Warming Abatement Plan

Prepared for:
City of Berkeley

Prepared by:
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January 1998

RESOLUTION NO. 59,322-N.S.

ADOPTING THE CITY OF BERKELEY RESOURCE CONSERVATION AND GLOBAL WARMING ABATEMENT PLAN

WHEREAS, the United Nations Intergovernmental Panel on Climate Change, which includes more than 2,000 leading scientists and technical experts from 130 countries, concluded that humans are changing the global climate; and

WHEREAS, empirical evidence supports this conclusion, including the facts that atmospheric carbon dioxide (a greenhouse gas) is 25% higher than pre-industrial levels; the ten hottest years on record all occurred within the past fifteen years, the 1980's were the warmest decade on record; and 1995 was the hottest year ever recorded; and

WHEREAS, global climate change threatens the life and safety of humankind by stressing food production, water resources, land resources and natural responses to pests and diseases; and

WHEREAS, the Berkeley City Council pledged in a resolution in July of 1995 to join the Cities for Climate Protection Campaign and to prepare and implement a plan to reduce greenhouse gas emissions within the community; and

WHEREAS, the most significant sources of such greenhouse gas emissions in Berkeley are from the use of fossil fuels for transportation and in buildings and industry (including the local use of electricity that is generated from fossil fuels) and from the decomposition of organic wastes in landfills; and

WHEREAS, there are opportunities to reduce emissions from these sources; and

WHEREAS, these opportunities have collateral benefits to the community.

NOW THEREFORE, BE IT RESOLVED that the Council of the City of Berkeley adopts the City of Berkeley Resource Conservation and Global Warming Abatement Plan, attached hereto as Exhibit I, and supports the City's efforts to implement the Plan.

The foregoing Resolution was adopted by the Berkeley City Council on January 27, 1998 by the following vote:

Ayes: Councilmembers Armstrong, Breland, Maio, Olds, Shirek, Spring, Woolley, Worthington and Mayor Dean.

Noes: None.

Absent: None.

ACKNOWLEDGEMENTS

Energy Solutions would like to acknowledge the financial and technical assistance received from a large number of individuals and organizations in the preparation of this report. In particular, we would like to thank City of Berkeley staff Neal De Snoo for championing the project and providing support and feedback and his colleagues Steve Barton, Brian Clark, Debra Kaufman, Jerry Koch, Gary Luchini, Susie Sanderson, and Rochelle Wheeler for their input. Nancy Skinner originally recruited the City into the Cities for Climate Protection campaign, which became the vehicle for this planning effort. We would like to thank the U.S. Environmental Protection Agency, U.S. Department of Energy, and the International Council for Local Environmental Initiatives (ICLEI) for funding the project. Finally, we would like to acknowledge the technical assistance provided by Matt Nichols and Abby Young of ICLEI.

Executive Summary

The City of Berkeley has joined a group of 150 cities around the world that has pledged to reduce the release of greenhouses gases within their communities. Greenhouse gases are produced by consumption and disposal of resources and are an indicator of general environmental impact, as well as the cause of global warming. Global warming is predicted to occur as the concentrations of greenhouse gases, such as carbon dioxide and methane, build up in the atmosphere and trap heat. Scientists predict that global warming will change the climate significantly and may lead to decreases in agricultural output, regional water shortages, rising sea level, and more extreme weather patterns.

The purpose of this project is to develop a City of Berkeley plan to improve the efficiency of natural resource use to the extent that is feasible and can fit with other general City planning goals. This plan is about how to achieve a vision of a prosperous, vital, and environmentally friendly economy for the City of Berkeley. This effort is funded by the U.S. Environmental Protection Agency, U.S. Department of Energy, International Council for Local Environmental Initiatives (ICLEI) Cities for Climate Protection Program, and the City of Berkeley.

This report presents short descriptions of 103 initiatives (including 38 new and 48 expanded initiatives) to reduce natural resource use and global warming. For a subset of these strategies, implementation plans are provided and greenhouse gas emission reductions associated with these efforts are also quantified. In addition, this report documents current City of Berkeley environmental programs related to resource conservation. Different divisions within the City have already developed and implemented a wide range of innovative environmental programs.

The City of Berkeley's goal is to reduce its impact on global warming by 15 percent in the year 2010 using strategies identified in this report. This is twice the projected increase of 7.5% in the baseline forecast. The goal is allocated according to global warming contribution as shown in the table below:

Table ES-1. 2010 Emissions Reduction Targets

	2010 Baseline Emissions (metric tonnes)	*1990 Emissions Share (%)*	*2010 Reduction Target (metric tonnes)*
Transportation	395,000	44%	57,000
Building Energy	329,000	40%	51,000
Organics	133,000	16%	21,000
Total	857,000		129,000

The following pages list the strategies developed to reduce global warming. For each activity, the table indicates whether the activity is currently being done and whether it is feasible to do more. If it is feasible to do more, the table indicates whether this is a short or long term item and which City division would take the lead.

Current Transportation Activities and Additional Strategies						
		Currently Done? (Y/N)	**Feasible to do more? (Y/N)**	**Near Term Implementation**	**Long Term Implementation**	**Lead City Division**
Trip Reduction Strategies	Unlimited BART pass	N	Y	*		To Be Determined
	Mass transit pass/credit instead of employee parking	Y	Y	*		To Be Determined
	Free vanpool parking	N	Y	*		To Be Determined
	Residential parking permits	Y	N			Traffic Engineering
	Mass transit token validation at local stores	N	Y		*	To Be Determined
	Bus station improvements	Y	Y	*		Advance Planning
	Transit subsidies in lieu of building parking spaces	N	Y		*	Current Planning
	Free city bike usage	N	Y		*	To Be Determined
	Subsidize bicycle use for City employees	N	Y		*	To Be Determined
	Development of light weight, low velocity vehicles	N	Y		*	To Be Determined
	Collaboration with rental car companies to promote renting over owning	N	Y		*	To Be Determined
	Day care/private school vanpool	N	Y		*	To Be Determined
	Paratransit and shopping delivery	Y	Y		*	To Be Determined
Land Use Strategies	Mixed use development	Y	Y		*	Advance Planning
	Pedestrian street areas	N	Y		*	Advance Planning
	Transit centers	Y	Y		*	Advance Planning
	Manufacturing retention/expansion	Y	Y			Economic Development
Traffic Efficiency Strategies	Timing traffic lights	Y	Y	*		Traffic Engineering
Fleet Procurement	Vehicle pool system	Y	Y	*		Equipment Maintenance
	Reduce fleet size and new vehicle purchases	Y	Y	*		Equipment Maintenance
	Procurement of energy efficient vehicles	Y	Y	*		Equipment Maintenance
	Procurement of alternative fuel vehicles	Y	Y	*		Equipment Maintenance
	Compressed natural gas modular station	Y	N			Equipment Maintenance
	"Turn Off" labels for City trucks	N	Y	*		Equipment Maintenance
Resource Efficient Transportation	Free electric vehicle parking	N	Y		*	Traffic Engineering
	Electric vehicle charging stations	N	Y		*	Equipment Maintenance
	Collaboration with rental car companies to promote electric vehicles	N	Y		*	To Be Determined
Traffic Calming	Creating slow streets (meanders and speed bumps)	Y	Y	*		Traffic Engineering
	Funneling traffic to major streets	Y	N			Traffic Engineering
	Narrowing wide residential streets	Y	Y		*	Traffic Engineering
Bicycle Strategies	Bicycle boulevards	N	Y	*		Advance Planning
	Bicycles lanes	Y	Y	*		Traffic Engineering
	Bicycle overpass over freeway	N	Y	*		Advance Planning
	Street repaving and sweeping for bicycle safety	Y	Y	*		Traffic Engineering
	Traffic signals that facilitate bicycle access	Y	Y	*		Traffic Engineering
	Shower facilities for bicyclists	N	Y		*	To Be Determined
	Additional bike parking	Y	N			Traffic Engineering
	Bike access on mass transit	Y	Y		*	To Be Determined
Miscellaneous	Staff transportation savings contest	N	Y	*		Energy Office

Current Building Energy Activities and Additional Strategies						
		Currently Done? (Y/N)	Feasible to do more? (Y/N)	Near Term Implementation	Long Term Implementation	Lead City Division
Muncipal/Commercial and Residential Buildings	Non-profit energy consulting company	Y	N			Energy Office
	Publish an Energy Resource Directory	Y	Y	*		Energy Office
	Green power procurement	N	Y		*	Energy Office
	Low-flush toilets	Y	Y	*		Energy Office
	Solar hot water heating	N	Y		*	Energy Office
	Water efficient clothes washers	N	Y	*		Energy Office
	Low-flow showerheads	Y	Y	*		Energy Office
	Water reuse	Y	Y	*		Energy Office
	Purchase electricity from renewable energy sources	N	Y	*		Energy Office
Municipal/Commercial Buildings	Commercial Energy Conservation Ordinance	Y	Y	*		Energy Office
	LED Traffic Lights	Y	Y	*		Energy Office
	Benchmarking	N	Y	*		Energy Office
	Recommissioning/Reauditing city facilities	N	Y	*		Energy Office
	Implement behavioral municipal energy conservation campaign	N	Y	*		Energy Office
	New construction/renovation design review	Y	Y	*		Energy Office
	Procurement of Energy Star office equipment	Y	N			Energy Office
	Enabling Energy Star features in office equipment	Y	Y	*		Energy Office
	Retrofitting lighting at BART stations	N	Y	*		Energy Office
	Procurement of super efficient motors and central AC	N	Y	*		Energy Office
	Replacement of motors instead of rewinding old motors	N	Y	*		Energy Office
	Retrofitting City of Berkeley schools	N	Y	*		Energy Office
	Coordination of ReEnergize with Climate Wise	Y	Y	*		Energy Office
	Coordination of ReEnergize with EPA's Green Business program	Y	Y	*		Energy Office
	Recruitment of additional business from ReEnergize municipal clients	Y	Y	*		Energy Office
	Recruitment of new partner cities as ReEnergize clients	N	Y		*	Energy Office
	Commercial Technical Assistance Program	Y	N			Energy Office
	Energy efficient vending machines	N	Y		*	Energy Office
	Target business sectors for economic and environmental efficiency	Y	Y	*		Office of Economic Development
	Residential Energy Conservation Ordinance	Y	N			Energy Office
Residential Buildings	Ceiling insulation retrofits	Y	Y	*		Energy Office
	Wall insulation retrofits	N	Y	*		Energy Office
	Duct sealing	N	Y		*	Energy Office
	Mass procurement of energy efficient technologies	N	Y		*	Energy Office
	Turn key energy-efficiency services	Y	Y	*		Energy Office
Miscellaneous	Staff energy savings contest	N	Y	*		Energy Office

Current Organics and Recycling Activities and Additional Strategies						
		Currently Done? (Y/N)	**Feasible to do more? (Y/N)**	**Near Term Implementation**	**Long Term Implementation**	**Lead City Division**
Urban Tree Planting	Neighborhood	Y	Y	*		Forestry
	Residential	N	Y	*		Forestry
	City parks and recreational facilities	Y	Y	*		Forestry
	Joint efforts with other organizations	Y	Y	*		Forestry
	Parking lot tree canopies	Y	Y	*		Forestry
Source Reduction	Solid waste audits	Y	N			Recycling
	Residential junk mail	Y	Y	*		Recycling
	Weekly mailings	N	Y	*		Recycling
Reuse	Food reuse	Y	Y	*		Recycling
	Reusable goods drop off	Y	N			Recycling
	Reuse guide	Y	N			Recycling
	Annual reusable goods collection	Y	N			Recycling
Recycling/Closing the Loop	Commercial/industrial recycling	Y	Y	*		Recycling
	Apartment building recycling	Y	Y	*		Recycling
	UC Berkeley recycling	Y	Y	*		Recycling
	BART newspaper recycling	Y	Y	*		Recycling
	Transfer station recycling	Y	Y	*		Recycling
	Appliance recycling	Y	N			Recycling
	Oil recycling	Y	Y	*		Recycling
	Recycling market development zone	Y	Y	*		Office of Economic Development
	Business food waste	Y	Y		*	Recycling
Composting	Residential plant debris	Y	Y	*		Recycling
	School	Y	N			Recycling
	Home	Y	N			Recycling
	Environmental procurement strategies for City	Y	Y		*	Recycling
	Contract requirement to use recycled products	Y	N			Recycling
Procurement	Mandatory construction debris recycling	Y	Y	*		Recycling
	Mandatory recycling areas in new buildings	Y	N			Recycling
Miscellaneous	Solid waste savings contest	N	Y	*		Energy Office

1.0 BACKGROUND

1.1 Purpose

In July 1995, the City of Berkeley joined a group of 90 cities around the world that pledged to reduce the release greenhouses gases within their communities. In less than two years, another 60 cities have joined the program, known as the Cities for Climate Protection Campaign. Participating cities pledge to prepare an inventory of the sources of greenhouse gas emissions within their sphere of influence and a plan for reducing those emissions to a specified target level. Berkeley's plan focuses on reducing carbon dioxide emissions from energy use (transportation, buildings, and industry) and methane emissions from landfilled organic wastes.

1.2 Strategic Objectives

Berkeley's plan recognizes that the efficient use and conservation of natural resources (resource conservation) is a very effective means of reducing greenhouse gas emissions. Furthermore, resource conservation has other substantial environmental, economic, and aesthetic benefits that are advantageous, perhaps even essential, to preserving and improving the quality of life in the community.

The initiatives recommended in this plan are designed to expand the availability of choices to effectively and efficiently meet the needs of the community. Those needs that are particularly resource-intensive include the following: **access** to jobs, goods, services, social activities and civic life; **comfort** in our homes and businesses; and a variety of **practical goods**. In the U.S., the traditional approach to serving the increasing demand for these needs has been to increase the capacity or quantity of supply. This has lead to urban sprawl, costly new power plants, and a proliferation of disposable goods, packaging, and waste.

In each case, there are a variety of alternatives to achieving those needs. For example, **access** can be improved by promoting mixed-use neighborhoods where residents can walk to shops, schools, and work. **Comfort** can be provided with better insulation, lighting, heating, and air conditioning equipment. **Practical goods** can be provided by designing and producing quality products that are long-lasting, reusable, more functional (e.g., more nutritional foods), and have less packaging.

This demand-based approach to meeting community needs ultimately makes good economic sense. Using natural resources more efficiently and effectively correlates to better use of economic resources. Currently, the City and its residents spend over $103 million per year for energy, including gasoline for vehicles and electricity and gas used in buildings. Another $10.3 million is spent on garbage disposal and recycling. Communities and businesses that can meet needs more efficiently and effectively will have satisfied residents and clients and will prosper.

1.3 The Berkeley Tradition

Cities are important players in setting and implementing land use, transportation, and solid waste policies. Choices made by cities can transform urban living toward a more livable and sustainable path, both environmentally and economically. Four decades ago the City of Berkeley began actively shaping its future in ways that were profoundly different from its neighbors. These actions have made Berkeley a very different community and have had significant economic impacts by directing money into more environmentally friendly developments.

Berkeley's efforts to challenge the trends of sprawl, materialism and the culture of the automobile began in the 1950s. The City of Berkeley's 1955 General Plan included plans to fill the bay for three miles out from the current shoreline. Public input into the planning process started the City of Berkeley on a different path and now urban infill strategies are being implemented and the current shoreline is being developed into a regional park. In the 1970s, most cities were widening streets to accommodate increasing traffic. One of the guiding principles in the City of Berkeley's 1977 General Plan was to adopt strategies other than widening streets to deal with increasing automobile traffic. Instead of widening streets, the City has funneled traffic to major streets, limited parking, and promoted mass transportation, walking, and bicycling. In the 1980s, the City adopted aggressive and innovative recycling programs and chose to spend its money trying to reduce, reuse, and recycle, rather than burying ever-increasing mountains of trash. Energy efficiency also became a municipal focus in the 1980s. In 1984, the City founded a non-profit energy service corporation, Community Energy Services Corporation, to implement energy saving projects in municipal facilities, senior and low-income homes, and the community in general.

1.4 The Vision

In the 1950's Berkeley had the vision to see that development strategies employed at that time consumed excessive financial and natural resources and often made existing cities less liveable. The City has since implemented policies to use resources more efficiently. As the community enters the new millennium, it looks forward to a diverse, prosperous, and livable urban environment with energy and resource efficient buildings, greater access, clean transportation, reduced traffic congestion, and parks that include restored creeks, salt marshes, and woodlands.

In this vision of the future, people are at the center. Civic life thrives as people spend more time in their neighborhoods and less time in their cars. Relief in traffic congestion and a shrinking demand for parking spaces allow the City to continue to accommodate its potential for commercial and industrial expansion and employment and to expand recreational areas. Streets not widened to accommodate traffic are lined with trees and gardens enriched with organic compost. Mixed land uses provide increased access to employment for local residents. Local shops prosper as Berkeley grows as a destination for a market interested in quality products. Tens of millions of dollars saved on energy bills stay in the local economy and are reinvested into the health of the community.

This plan is about how to achieve this vision of a prosperous, vital, and environmentally friendly economy for the City of Berkeley. The alternative is to sit back passively and see what develops as congestion increases, businesses suffer from reduced mobility of their customers, people are alienated from the community as they sit trapped in their cars, and money drains out of the community for unnecessarily high energy, water, transportation, and waste disposal costs.

1.5 Project Goal and Emissions Reduction Target

The purpose of this project is to develop a City of Berkeley plan to improve the efficiency of natural resource use to the extent that is feasible and can fit with other general City planning goals. This effort is funded by the U.S. Environmental Protection Agency, U.S. Department of Energy, International Council for Local Environmental Initiatives (ICLEI) Cities for Climate Protection Program, and the City of Berkeley.

This report develops policies and implementation plans for specific steps to reduce natural resource use and global warming and also quantifies the greenhouse gas emission reductions associated with those efforts (see Sections 1.9 and 1.10 for a discussion of global warming and associated impacts). Since resource use generally correlates with contribution to global warming, calculating a percentage change in global warming impact is a good proxy for overall reduction in environmental impact. In addition, this report documents current City of Berkeley environmental programs related to resource conservation. Different divisions within the City have developed a wide range of innovative environmental programs.

The City of Berkeley's goal is to reduce its impact on global warming by 15 percent in the year 2010 using strategies identified in this report. This is twice the projected increase of 7.5% in the baseline forecast. The goal is allocated according to global warming contribution as shown in the table below:

Table 1.1. 2010 Emissions Reduction Targets

	2010 Baseline Emissions (metric tonnes)	*1990 Emissions Share (%)*	*2010 Reduction Target (metric tonnes)*
Transportation	395,000	44%	57,000
Building Energy	329,000	40%	51,000
Organics	133,000	16%	21,000
Total	857,000		129,000

Berkeley is starting from a baseline of 7.8 metric tonnes of CO_2 per person per year.

1.6 City Role in Protecting the Environment

The City of Berkeley can impact the environment both directly and indirectly through many means:

- Within city boundaries, the City can set transportation, land use, and recycling policies that prescribe environmental protection directly and leverage market resources by making environmental decisions more profitable or easier. The City of Berkeley strives to act as a catalyst for creation of an environmental economy that simultaneously builds supply and demand for environmental services.

- Berkeley can serve as an example to businesses and other cities by adopting new environmental technologies and policies.

- The City can extend its influence by working with organizations that operate both inside and outside of Berkeley (e.g., BART and the East Bay Regional Park District).

- The City of Berkeley can work to educate its residents and businesses about environmental issues so that they will make informed environmental choices.

- The City can coordinate volunteer resources from individuals, schools, and organizations, such as the Sierra Club.

1.7 Implementation Effort

Many of the initiatives in this document are already being implemented to varying degrees by different City departments or divisions. In some cases, implementation will require additional resources and in a few cases (i.e., trip reduction initiatives) organizational changes will be needed. Further, the initiatives are intended to be implemented over a period of several years. During that time, it is likely that some initiatives will change as circumstances change and new opportunities present themselves. In many cases, implementation will require the cooperation of other agencies. It is therefore necessary that staff promote the principles of this plan in dealings with other local and regional bodies.

In this context, the report is intended to serve as a guide to help the City pursue work plans with the objectives of conserving resources and abating global warming. The document does not, for the most part, include specific budgetary and organizational recommendations to implement each measure. Rather, the lead City department or division will be responsible for developing the specific budget plans and to balance available resources against competing programs.

In order to maintain a focus on this plan, the Energy Office will convene an implementation team consisting of representatives of the lead City departments or divisions on a regular basis to discuss implementation strategies, monitor progress and update the plan as it evolves. The lead City departments and divisions are as follows:

- the Energy Office for energy;

- the Recycling Division for recycling and materials;
- the Forestry Division for forestry;
- an agency to be determined for trip reduction measures;
- and Advance Planning for all other transportation issues.

The Energy Office will also help acquire resources to assist with implementation. For example, one source may be a consolidated internship program. The City Council could make a request to the University for an in-kind contribution of student interns in its role as a community partner with the City of Berkeley as well as an educational organization. The Energy Officer will take the lead to coordinate the request and interns would be assigned to each agency on an as-needed and as-requested basis. The interns would report to individual agencies that they serve. Grant funding may also be available for implementation of some projects.

Steps toward implementation of the overall plan include:

- The City Manager and Council should identify an agency(ies) within the City to assume responsibility for coordinating or overseeing the Trip Reduction Initiatives in the transportation section. These initiatives will require approximatley 0.5 FTE at the assistant planner or analyst level.

- Resources permitting, each lead agency should continue to implement existing initiatives.

- Each lead agency should pursue new initiatives and expansion of existing initiatives (where appropriate) as they develop their future work programs and budget requests.

- The Energy Office should convene the implementation team, monitor progress and modify the plan as it evolves.

1.8 General Approach

The actions that this report recommends to avoid global warming support current City of Berkeley planning activities and overall goals. Cities in California are required to develop a General Plan to guide local planning and regulations. The City of Berkeley's first general plan was published in 1955, updated in 1977 (City of Berkeley 1977), and the new General Plan is presently under development. Years of planning and consensus building resulted in the present City of Berkeley planning framework. The Conditions Trends and Issues Report (City of Berkeley 1993) contains the majority of the analysis for updating the City's new General Plan.

After reading City of Berkeley planning documents, Energy Solutions staff then interviewed City staff to learn more about the work they did that was connected to natural resource use and hence global warming. Interviews with staff gave us an idea of what types of constraints staff faced. For example, we stayed away from capital intensive projects (due to budget constraints) and rental programs (due to liability concerns). These interviews were intended to make sure that the

options identified would be supported by City staff and would also be feasible for them to implement.

Since global warming is an abstract concept to most individuals, we have recommended options that possess desirable social benefits other than only avoiding global warming. Examples of additional social benefits are reduction of traffic congestion, improvement of local and regional air quality, reduction of energy costs and disposal costs, enhancement of occupant comfort, and increased productivity in office buildings. Finally in recommending options to reduce global warming, we were also looking for actions that could have a significant impact, while still providing significant benefits for the effort and cost involved. Figure 1 summarizes this approach.

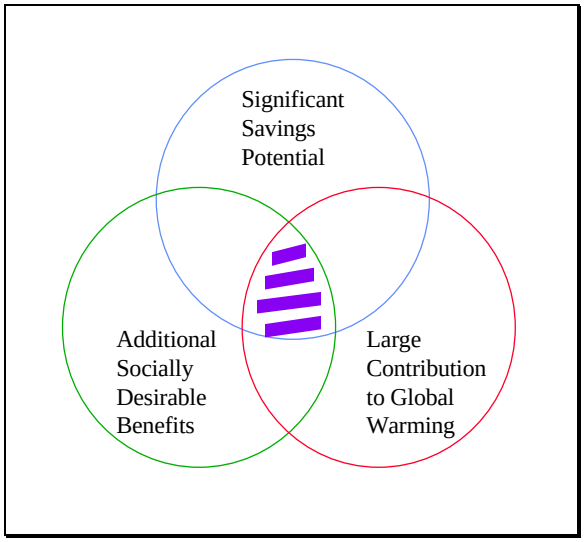


Figure 1.1: Overlapping Benefits

This plan's transportation strategies encourage wider use of public transportation, mixed-use development patterns, increased traffic efficiency, resource-efficient transportation options, and low-tech transportation alternatives. The energy strategies include retrofitting homes, schools, and commercial buildings with energy-efficient technologies. The organics/recycling strategies support increased urban tree planting, source reduction measures, reuse and recycling programs, composting projects, and the further incorporation of green purchasing policies by the City of Berkeley.

1.9 What Is Global Warming?

This report equates reduced consumption of natural resources with reduced greenhouse gas emissions. In order to help the reader understand this connection, the next two sections provide background on global warming and possible impacts.

Having a constant and livable climate is dependent on the heat balance of the planet, something which people generally take for granted. The heat balance is determined by the mix of gases in the atmosphere. There are a number of gases in the atmosphere that allow solar radiation to pass into the atmosphere but block heat radiating from the earth's surface. These "greenhouse" gases determine the temperature of the planet and are emitted into the atmosphere by both natural and human activities. Without these greenhouse gases, the planet would be about 33°C (59°F) cooler (National Academy of Sciences et al. 1992).

Greenhouse gases are released into the atmosphere as a result of human activity. Carbon dioxide (CO_2) is produced any time fossil fuels are burned and accounts for 70-80% of the greenhouse effect. Other common greenhouse gases include methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), and ozone (O_3). Methane results from anaerobic decomposition in landfills, rice paddies, and the digestive tracts of cattle. Chlorofluorocarbons come from refrigeration, insulation, and fire suppression systems. Nitrous oxide and ozone are released from cars and powerplants.

Atmospheric concentrations of greenhouse gases are increasing due to human activities, such as fossil fuel combustion. Carbon dioxide (CO_2) concentrations in the atmosphere are about 25% higher than the pre-industrial period and methane (CH_4) concentrations have doubled (National Academy of Sciences et al. 1992). Most scientists agree that an increase in atmospheric carbon dioxide will lead to global warming. The 1995 United Nations Intergovernmental Panel on Climate Change, which includes 2,000 leading scientists and technical experts from 130 countries, issued a report that concluded humans are changing the global climate (IPPC 1995). A 1990 U.S. EPA Science Advisory Board report identified global climate change as one of the highest environmental risks -- even higher than toxics, pesticides and herbicides (U.S. EPA 1990).

Global warming is not well understood by the public as evidenced by a 1990 Roper Report poll in which the public rated global warming a much lesser risk and rated toxics much higher (Roper 1990). Lack of public understanding is due to the gradual nature of warming and the difficulty of measuring change and predicting impacts. Furthermore, a minority of scientists disagree and claim that feedback effects will nullify the warming effect of the gases. In addition, mainstream journalism does not reflect the near unanimous scientific consensus about global warming. For example, the Wall Street Journal has reported that satellite data on atmospheric temperature show no overall increase in temperature and hence no evidence of the greenhouse effect. The reported data are consistent with global warming theory, which anticipates that the lower atmosphere will warm and the upper will cool, with minimal impact on average. Empirical data indicate that these temperature variations are in fact occurring as predicted. However, that is not the message conveyed in this article.

One of the problems facing policy makers is that by the time global warming is apparent, it will be too late to reverse the effects. The challenge is convincing businesses and individuals of the need to act early. Carbon dioxide has a residence time in the atmosphere of 50-200 years. Therefore, the gases emitted today will continue to impact the environment far into the future. Somewhere between 40-85% of all the CO_2 released into the atmosphere from burning fossil fuels is still in the atmosphere (National Academy of Sciences et al. 1992). In addition, more emissions will be added to the atmosphere because of infrastructure, such as powerplants, that has long lives. For this reason, it is essential to act early. Retiring powerplants or cars early because of their environmental impact is far more expensive than building less environmentally damaging infrastructure in the first place. Recycling or driving more fuel efficient cars now will decrease the need for expensive, draconian measures in the future.

The role of this project is not to debate the issue of global warming, but, given the almost unanimous scientific consensus and severity of the potential consequences, to identify options to reduce greenhouse gas emissions caused by human activity in and around the City of Berkeley. Furthermore, as discussed previously, our approach is to focus on strategies that have additional societal benefits beyond reducing global warming.

1.10 Impacts of Global Warming

A doubling of carbon dioxide is predicted to raise the global temperature approximately 2°C (3.6°F) (IPPC 1995). At the current rate of increase of greenhouse gases, the atmospheric CO_2 level will double in the middle of the next century. Ecosystems adapt to major changes over a period of hundreds if not thousands of years, but global warming will occur over decades. Climate will change more rapidly than at any other period in the earth's history, as carbon dioxide accumulated over millions of years is released in one century.

The last time the earth was 1.0 -1.5°C warmer was 6,000 years ago in the Holocene period, which was the beginning of agricultural societies. The earth has not been 2-2.5°C warmer since the Eem-Sangamon interglacial period some 125,000 years ago. At that time, human society consisted of hunter gather societies and the West Antarctic ice shield had partially disintegrated, raising sea levels by up to 5-7 meters.

The following changes are expected from global warming:

- fresh water shortages will occur in some regions as changes in local climates occur, including semi-arid conditions in the mid-latitude continental regions of North America and Eurasia
- agricultural production will drop as precipitation patterns shift
- sea level will rise up to 0.6 meters (2 feet) in the next 50 years. However, if the West Antarctic ice sheet melts, sea level could rise up to 3.1 meters (10 feet).
- ocean currents will change and shoreline climates and fisheries may change significantly

- extreme weather conditions, including storms and floods in the coastal regions, will occur more often
- forests will die and the species composition will change
- human health will be impacted from increased heat wave mortality, more severe air pollution, and increases in infectious diseases due to the spread of conducive climate conditions

Currently, scientists are unable to model local changes resulting from global warming. Rain and snowpack in California will be affected, but could either increase or decrease. People will undoubtedly migrate away from severely affected areas and thus all communities will see an impact on their resources.

Human civilization is based on a constant climate. Rapid climate changes will affect human societal resources such as food security, forests and biodiversity, land use and human settlements, and freshwater supplies. Agriculture is dependent on constant precipitation patterns and/or extensive irrigation infrastructure. Impacts on agricultural productivity could be particularly severe in developing countries. Important disruptions in natural ecosystems must also be recognized. The possible rate of warming could far outstrip the capacity for forests to migrate. As a result, valuable forest lands may die off while new species do not have enough time to take root. The extinction of forests will also result in loss of biodiversity. A rise in sea level will cause inundation of coastal land. Even a modest sea level rise would threaten coastal settlements. In addition, a rise in sea level would affect the salinity of fertile river delta regions which are areas of prime agricultural land. Finally, temperature increases could reduce stream flow and increase pressure on groundwater supplies in many regions.

Most predictions of global warming assume that the global temperature will increase proportionately to greenhouse gas emissions. However, the results may be nonlinear because of feedback effects. For example, additional warming is likely to occur as methane is released from the warming tundra or if large forests die off because of climate changes and release stored CO_2 when they decay. When possible feedback effects are accounted for, the average temperature increase from a doubling of carbon dioxide concentrations is estimated at 1.5-4.5 °C (Krause et al. 1992, p.28). Scientists are unclear what effect feedback loops will have. These effects make it difficult to model the net impacts of global warming. Therefore, most policy makers have adopted a wait-and-see attitude. The problem with this approach is it will be too late to reverse global warming by the time a temperature increase is apparent.

2.0 BASELINE EMISSIONS INVENTORY

The first step in developing a plan to reduce greenhouse gas emissions is to identify the sources and quantities of emissions that are influenced by the City of Berkeley. This section presents baseline data on greenhouse gas emissions for 1990 and a projection for 2010. Energy and waste disposal costs are included to give an understanding of the expense to the Berkeley economy associated with intensive use of resources.

2.1 Baseline Emissions Inventory

The inventory helps to identify activities that have the greatest impact on climate change. Because of the difficulty in getting accurate data (in particular for the transportation sector), the inventory is not completely accurate. Nevertheless, it does help identify sectors with opportunities for the greatest reductions. A detailed inventory including data sources and methodologies is on file with the Berkeley Energy Office.

The inventory of sources includes:

- electrical power generation serving the City,
- natural gas consumed in the City,
- transportation fuels used by residents, workers and businesses, and
- decomposition of organic municipal wastes.

University of California and Lawrence Berkeley National Laboratory facilities have been excluded from the inventory since the City has limited influence over these institutions. Transportation includes the full length of trips originating or ending in Berkeley but does not include pass-through traffic (e.g., Interstate 80).

In 1990, Berkeley was responsible for the release of 797,000 metric tonnes (1 metric tonne = 1,000 kg) of CO_2 (or CO_2 equivalent methane). The primary sources of these emissions were petroleum burned in the transportation sector, natural gas burned in buildings, methane emissions that will be released as organic materials decompose in landfills, and fossil fuels burned in electrical generating plants serving the community. To put the magnitude of this release in perspective, it is about the same amount of CO_2 absorbed annually by over 100,000 acres of tropical rain forest. Figures 2.1 & 2.2 show the relative shares of emissions by end use and fuel type. The numbers for end use and fuel type breakouts are shown in Tables 2.1 & 2.2 and Figures 2.3 & 2.4.

Transportation accounts for 358,000 metric tonnes of carbon dioxide released into the atmosphere each year, which is 45% of total emissions. The largest contributors (in order of decreasing impact) are:

- resident non-commute travel
- non-resident commutes (working in Berkeley)
- resident commutes (working within and outside Berkeley)
- commercial vehicle travel

Residences account for 30% of total emissions, which is primarily from:
- space and water heating
- landfilled organic wastes, and
- electric appliances such as refrigerators and lights.

Commercial buildings account for 19% of total emissions, which are from:
- space heating,
- ventilation and air conditioning equipment,
- lighting,
- office equipment,
- water heating,
- cooking, and
- organic waste.

Industry accounts for 6% of total emissions, which are from:
- process heat,
- process mechanical (motors),
- space heating,
- lighting, and
- organic waste.

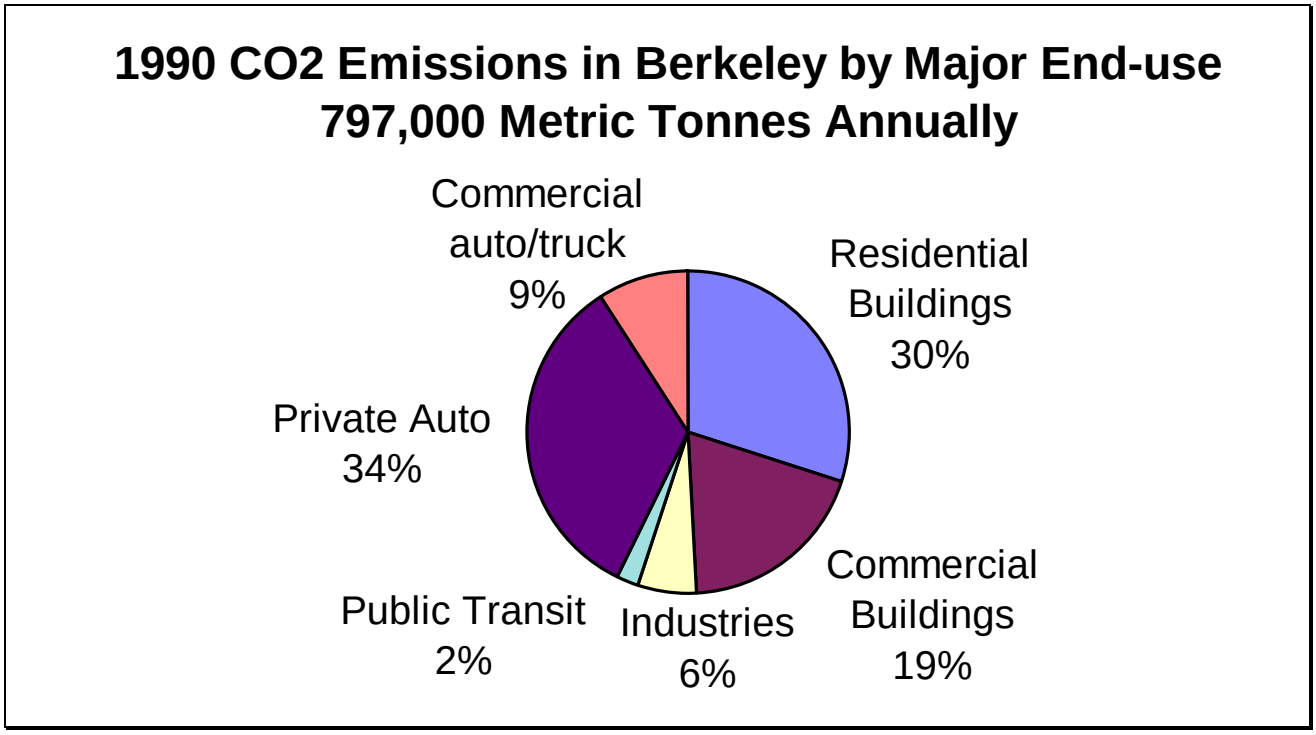


Figure 2.1. 1990 CO_2 Emissions in Berkeley by Major End-use

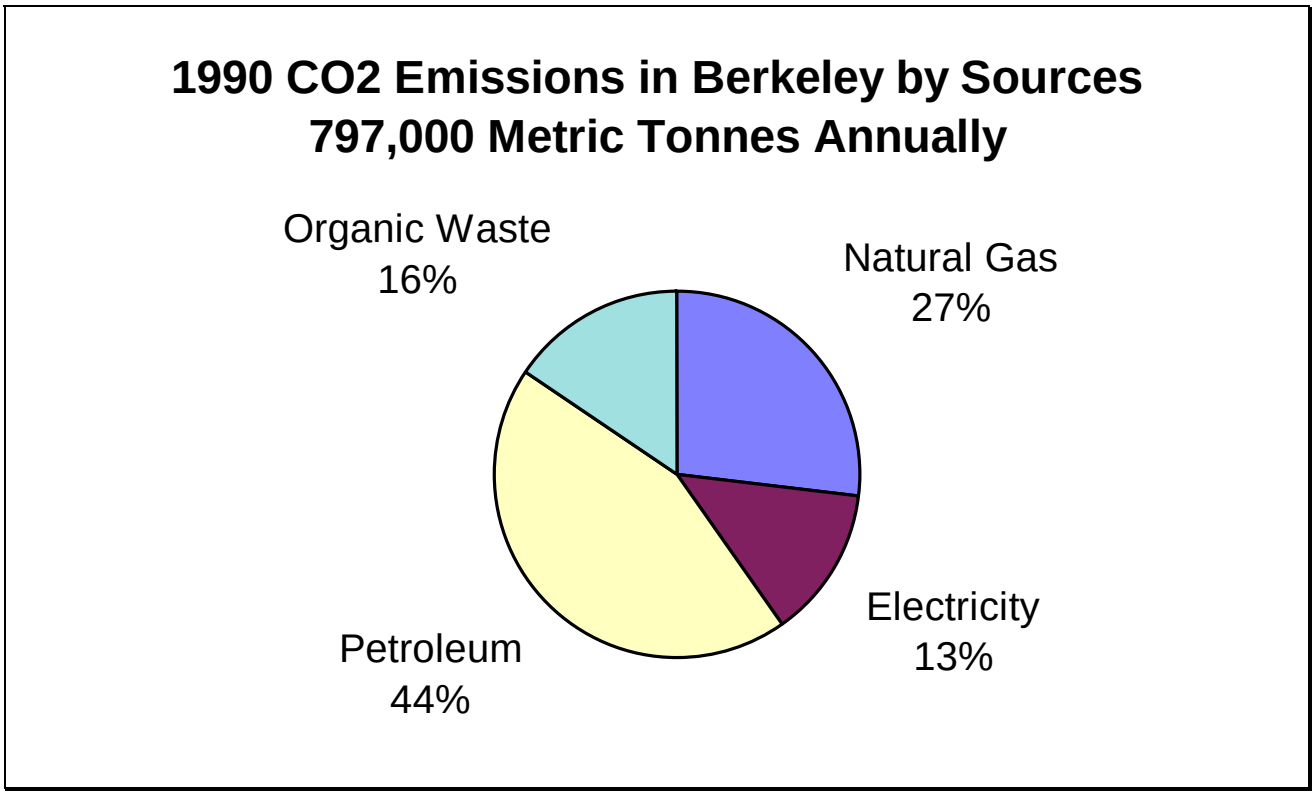


Figure 2.2. 1990 CO_2 Emissions in Berkeley by Sources

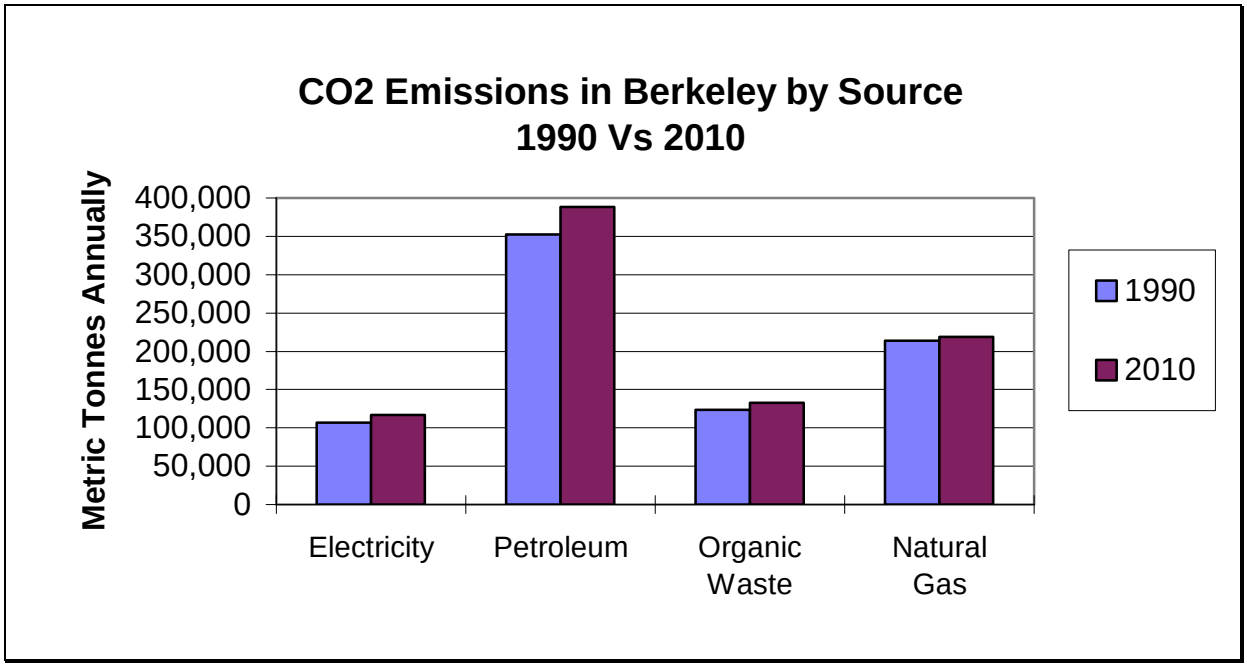


Figure 2.3. CO_2 Emissions in Berkeley by Source - 1990 Versus 2010

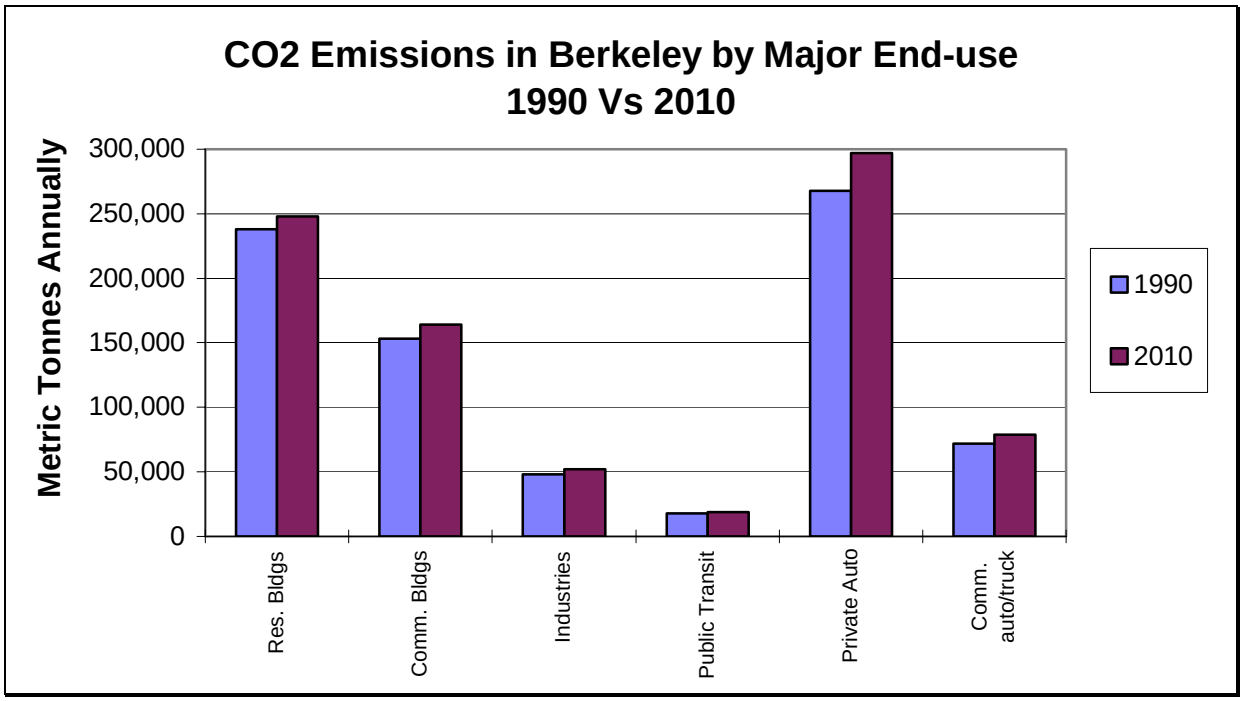


Figure 2.4. CO_2 Emissions in Berkeley by End-use - 1990 Versus 2010

Table 2.1. Year 1990 Metric CO_2 Tonnes Equivalent

	Natural Gas	*Electricity*	*Petrol*	*OrganicWaste*	*TOTAL*	*share*
Residential Bldgs	152,000	36,000		50,000	238,000	30%
Commercial Bldgs	34,000	48,000		71,000	153,000	19%
Industries	28,000	17,000		3,000	48,000	6%
Public Transit		6,000	12,000		18,000	2%
Private Auto			268,000		268,000	33%
Comm. auto/truck			72,000		72,000	9%
TOTAL	214,000	107,000	352,000	124,000	797,000	
share	27%	13%	44%	16%		

Table 2.2. Year 2010 Metric CO_2 Tonnes Equivalent

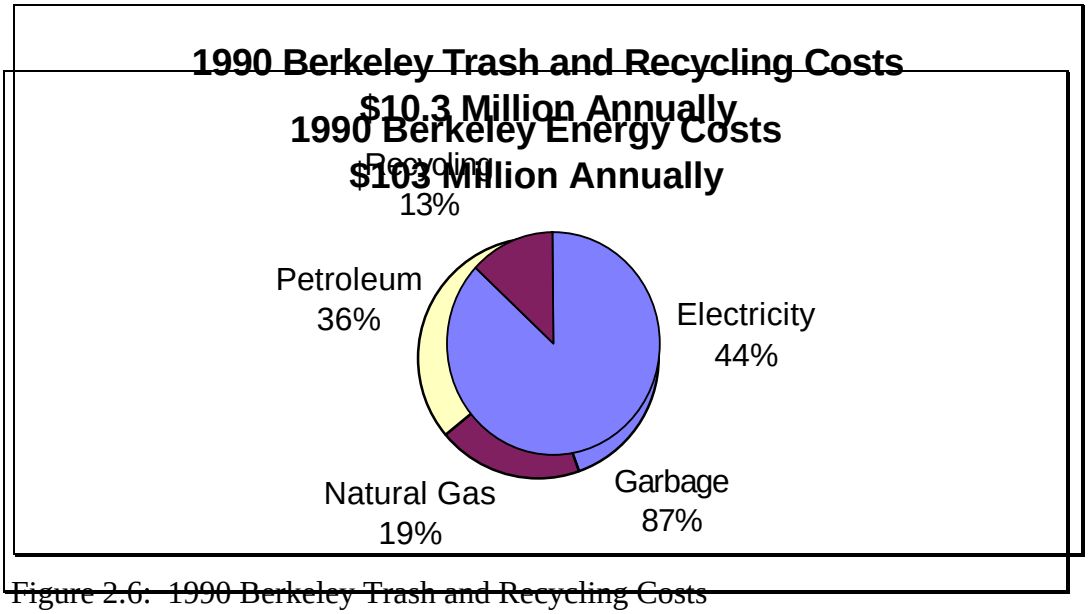
	Natural Gas	*Electricity*	*Petrol*	*OrganicWaste*	*TOTAL*	*share*
Residential Bldgs	154,000	39,000		53,000	246,000	29%
Commercial Bldgs	35,000	52,000		77,000	164,000	19%
Industries	30,000	19,000		3,000	52,000	6%
Public Transit		7,000	12,000		19,000	2%
Private Auto			297,000		297,000	35%
Comm. auto/truck			79,000		79,000	9%
TOTAL	219,000	117,000	388,000	133,000	857,000	
share	26%	14%	45%	16%		

By 2010, CO_2 emissions are projected to increase by 60,000 metric tonnes (7.5%). Transportation numbers are based on countywide projections for growth in vehicle trips, population, and jobs and adjusted for Berkeley's growth rate relative to county population and job numbers. Energy numbers are based on Pacific Gas & Electric's service territory projections for population, jobs, and electric demand, adjusted based on Berkeley's growth rates relative to rest of service territory. Waste figures are based on job and population growth.

The density of the Berkeley community, access to public transportation, mild climate, lack of heavy industry help and community commitment to conserve resources contribute to the fact that Berkeley's CO_2 emissions are well below the national average. Berkeley's 1990 emissions from energy sources (does not include solid waste) were about 6.5 tonnes/capita. As a nation, our emissions are 17.5 tonnes/capita; Germany is 9.6 tonnes/capita; the UK is 8.7 tonnes per capita and Japan is 8.0 tonnes/capita. It is important to note, however, that many of the heavy industries that meet local demand, such as concrete kilns, petroleum refineries, and primary metals are not in the local inventory, nor is the long-haul transportation materials and products. If such "embodied energy" is considered, Berkeley's CO_2 burden, while better than the national average, is probably higher than the developed European countries and Japan.

2.2 Resource Use and Disposal Costs

Natural resource use is a major expense for residences and businesses. The inventory was used to estimate the amount of money the community spends on these source categories. In 1990, the Berkeley community (excluding UCB and LBL) spent $103 million on petroleum, natural gas and electricity. $8.9 million was spent on refuse and $1.3 million on recycling. Any savings achieved by improving efficiency in these areas will also result in economic savings to the community. As a comparison, the City of Berkeley's budgets for schools is $58 million dollars per year. Figures 2.5 & 2.6 show energy and waste disposal costs.



~~Figure 2.6: 1990 Berkeley Trash and Recycling Costs~~
Figure 2.5. 1990 Berkeley Energy Cost

3.0 TRANSPORTATION

This section is organized into four sections:

3.1 Transportation trends
3.2 City of Berkeley Planning Goals
3.3 Difficult to quantify benefits
3.4 Global warming contribution from transportation
3.5 Strategies to reduce greenhouse gas emissions

3.1 Near term trends

The most obvious problems caused by automobile transportation are rising congestion and air pollution. Every year the number of cars on the road rises causing further traffic congestion. This increase in cars is caused by growing population in suburban areas, trends of living far away from the work place, and the convenience and artificially low cost of driving. The governmental response has primarily been to increase the carrying capacity of roads. This increasing

dependence on automobiles contributes to growing air pollution problems. Many cities around the country cannot meet the US Environmental Protection Agency's air quality requirements. If growth in the Bay Area continues, people's attitude toward driving will need to change. Public transportation benefits everyone, whether or not they use it, because of reduced congestion and air pollution. When an electrical failure shut down the transbay BART tube late in 1996, the worst traffic backup ever seen on Highway 24 ensued.

There are state programs and technological improvements which help offset air pollution caused by cars. There have also been technological improvements, such as new blends of cleaner gasoline and increased fuel economy. In terms of increased fuel economy, the corporate average fuel economy (CAFE) has doubled since prior to the oil crisis and is now at 28.5 miles per gallon. However, the increasing popularity of sport utility vehicles with poor gas mileage serves to decrease average fuel economy in the Bay Area. Presently, the most fuel efficient car on the market receives 50 miles per gallon. Within each vehicle class, the fuel economy can differ from five to 10 miles per gallon. There also are prototypes which get 60 to 80 miles per gallon.

In 1996, gasoline stations began carrying new blends of cleaner burning gasoline. Combustion of this gasoline reduces smog by 15% because the gasoline contains fewer smog precursors. To reduce air pollution from cars, the state also implements a smog check program which requires cars to pass a smog test every two years in order to renew registration.

The California Air Resources Board (CARB) developed a plan for a minimum of 2% of new vehicles sold in California by 1998 to be zero emission vehicles (ZEVs) with that number rising to 10% in the year 2000. The CARB plan was subsumed in the Clean Air Act of 1990, but the requirement has since been delayed. With current technologies, the only viable ZEVs would be electric vehicles.

Currently, electric vehicles cost substantially more than gasoline powered vehicles. Passenger vehicles typically cost $40,000 and manufacturers generally lease rather than sell them in order to take the worry out of owning a new type of vehicle. General Motors, Ford, and Toyota are producing electric vehicles that are conversions of gasoline powered designs and are either small trucks or passenger vehicles. General Motors EV1 (sports car) and the Honda EV (sub compact) are purpose built electric vehicles. Corbin is producing a low-cost, one seat town and station car for about $10,000, much less expensive than other EV vehicle prices.

In terms of other fuel type passenger vehicles, the natural gas powered Honda Civic is the cleanest conventional vehicle. It has a 250 mile range and costs approximately $20,000 - 25,000. In terms of municipal vehicles, smaller vehicles, such as parking scooters, can be electrically powered. Larger vehicles, such as garbage trucks and sweepers, can use compressed natural gas.

3.2 City of Berkeley planning goals

The primary transportation goal of the City of Berkeley is to discourage driving without adversely affecting local businesses. Two methods Berkeley has adopted to discourage driving are limiting parking availability and not widening streets. Berkeley also funnels traffic to major

thoroughfares to decrease through-traffic impacts on smaller streets. In the short term, the City will be facing a temporary lack of parking in the Civic Center area with the major reconstruction efforts that are planned.

The City's Resolution *Declaring that the Use of Public Transit be Encouraged* (City of Berkeley 1996a) articulates the social costs of single passenger vehicle use and lays out steps to improve the service and convenience of public transportation.

3.3 Linkages with difficult to quantify benefits

There are many significant benefits from reducing single-passenger automobile use. These include:

- improved air quality, particularly important for people with respiratory ailments
- reduced unproductive driving time
- reduced commuting expense
- promotion of economic growth through improved infrastructure with funds that formerly went to roads
- pedestrian friendly neighborhoods
- supporting local retailers
- increasing mobility and access to employment areas
- more integrated urban development
- establishing a safer community
- instilling a stronger sense of community

3.4 Global warming contribution from transportation

Transportation accounts for 358,000 metric tonnes of carbon dioxide released into the atmosphere each year, which is 45% of total emissions. The largest contributors (in order of decreasing impact) are:

- resident non-commute travel
- non-resident commutes (working in Berkeley)
- resident commutes (working within and outside Berkeley)
- commercial vehicle travel

3.5 Strategies to reduce greenhouse gas emissions

3.5.1 Trip Reduction Strategies

Work with BART to establish an unlimited BART pass

An unlimited monthly BART pass would encourage Bay Area residents to ride BART when the destination is close to a BART station. The pass might need to be priced based on zones traveled to ensure that BART revenues are maintained. Most of the additional ridership would probably be for errands or entertainment and thus would come when trains are mostly empty in the off hours. Employers could buy the passes for their employees as a benefit and claim part of it as a business expense. Such a pass would encourage commuters to use BART for both work and non-work related transit. Additionally, congestion and air pollution would be reduced as more people use BART.

Promote use of mass transit by encouraging employers to offer employees a mass transit pass/credit instead of free employee parking
By providing free employee parking, companies essentially subsidize commute driving and encourage car ownership. In shopping areas with limited parking, such as Telegraph Avenue, any actions that encourage employees to drive to work also limit parking for shoppers. However, as long as the driving option is more time-efficient and cost-effective than mass transit, employees have little incentive to switch to mass transit. The current 'Parking Cash-out' law requires companies with at least 50 employees and who lease off-site parking spaces for employees to give employees the option of receiving cash instead of a free parking space. This law is presently not enforced. Additionally, it could be expanded to smaller businesses.

Some City union employees can participate in a lottery for free parking spaces in the City Garage. Employees could be offered free transit passes instead in order to discourage unnecessary driving. This would also set a good example for the private sector.

In areas with limited parking availability, the City of Berkeley could pass and enforce a new law that requires employers to charge for employee parking spaces and, at the same time, offer employees free mass transit passes/credit. The mass transit pass/credit option would encourage more commuters to use public transportation and would be good for Berkeley businesses because it would leave more parking spaces available for shoppers. The newly available parking spaces could also be leased out and thus be an additional source of revenue.

Offer free vanpool parking
Free van pool parking in convenient locations would encourage vanpools and free up additional parking spaces for shoppers. There is a 50% discount for car/van pools at the City's Center St. Garage. (Car pools are three or more drivers.) No comparable discount exists at Sather Gate. Implementation of a discount at Sather Gate and in selected street parking locations would encourage ride sharing. Any spots not taken by van pools could be open to the general public after 9 AM.

Establish residential parking permit zones
The City of Berkeley uses a residential parking permit system in many areas that sets a two hour maximum for cars without permits. This gives local residents a greater opportunity to find parking, encourages turnover of parking spaces which is good for businesses, and discourages employees from driving to work.

Introduce a token validation system at Berkeley stores

To encourage mass transit use, Berkeley stores could give out mass transit transfers to and from the store when a purchase is made. This option would also result in less traffic congestion in the shopping areas.

Bus Station Improvements
Bus ridership could be improved by adding shelters, maps, and schedules to heavily used stops in the downtown area. This is also the area where commuters link between AC Transit buses and BART.

Allow developers to provide transit subsidies in lieu of building parking spaces
Zoning laws require that developers build parking spaces so that new development does not create a parking crisis. On a case by case basis, the City of Berkeley negotiates with developers and gives them a choice, depending on the area, to provide an equivalent mass transit subsidy, build mass transit infrastructure on site, or maintain a common car instead of building parking. This approach is most applicable to projects in the downtown near mass transit.

Procure city bikes for public use
The traffic congestion in Berkeley could be lessened if the City of Berkeley provided bikes for public use. The cities of Portland (Oregon), Fresno, Boulder, Denver, Missoula, Madison (Wisconsin), Charleston, St Paul, and Tampa all provide bikes for public use. Cities have used non-profit structures for liability reasons and generally used impounded bikes. The City could also have a bike pool for employee business trips. The free bike option has also proven to be successful in closed campus areas, such as research labs and industrial facilities. This idea would require additional controls in Berkeley due to the fact that the bikes would most likely migrate to areas that don't have free bikes. One option would be to dispense bikes from BART stations. Users would sign a liability agreement, have an identification card that is used to track bikes, and pay a deposit that would be forfeited if the bike is not returned within a period of one to three days.

Subsidize bicycle use for City employees
The City could subsidize bicycle use to encourage more employees to commute by bicycle. The City of Palo Alto reimburses employees for bike use at 7 cents per mile. The City of Santa Ana provides cyclists with a commuter bike. The City of Huntington Beach loans out impounded bicycles to employees.

Encourage U.C. Berkeley to develop a light weight, low velocity vehicle for local travel
Much of car travel is spent running errands in a five mile radius from the home. Driving large heavy cars for local travel wastes gas and contributes to air quality problems. A more energy-efficient alternative would be to develop a light weight, low velocity vehicle specifically for local travel. These vehicles could take the shape of a large tricycle which makes the vehicle more stable, have compressed air stored in the frame for motor travel in addition to pedal power. The vehicles would be light and move at lower speeds, and thus use little energy to move, and still have the power to transport up to 300 pounds. Such a vehicle would be ideal for local errands and travel.

U.C. Berkeley's engineering departments have two ongoing design projects to foster student learning. The Civil Engineering Department builds and races a concrete canoe. The Mechanical Engineering Department builds and races a landspeed record bicycle. With the rise in Berkeley's "green" engineering program, the City could challenge the Engineering Department to design and build a lightweight, low velocity vehicle prototype.

Work with local rental car companies to encourage residents and students to rent cars for occasional use instead of owning
Many drivers do not use their cars regularly, but have cars so that they can take trips to the mountains or do major shopping. The City could work with rental car companies to encourage them to offer a frequent user rental car program. Users would have a rental agreement on file and receive additional discounts every time they rented a car so that frequent use lowers average cost, just as with owning a car. There would be no discount for advance booking, though otherwise availability would be first come, first served. This service could also be linked with ski bus services, since this is one of the major reasons for some people to own a reliable car. Note: Avis in downtown Berkeley also rents bicycles.

Day care van pools
Many parents drive primarily to deliver and pick up children from day care or private schools. Private day care/school buses would save parents time and reduce congestion.

Paratransit and Shopping Delivery
Currently, seniors and disabled people in Berkeley are eligible for $75 per quarter for taxis and van service. If recipients share rides, they save on transportation costs and pollution is reduced. However, riders prefer the privacy and convenience of taxis and resist using the van option. AC transit and BART are required to provide pick up and drop off service to all locations within one quarter of a mile of their routes for handicapped transit users.

An alternative is to bring the goods to the shoppers. This reduces the need for prompt service and a private sector provider could deliver goods from participating stores to a particular neighborhood within a two hour window. This service would have the most value for seniors and busy people who value their time enough to pay for delivery costs. In addition to reducing congestion, this service would free up commercial parking spaces for those who don't use the delivery service.

3.5.2 Land Use Strategies

Strengthen existing pattern of urban development to mixed-use development where residents do not need cars
Continue to promote a mixture of commercial and residential usage to encourage Berkeley residents to walk or bike to a neighborhood business center for all their errands and shopping needs. North Shattuck and Elmwood are prime examples of how mixed-use planning has reduced the need for residents to drive. Strategies to create more such neighborhood shopping that can be accessed by local residents could include:

- recruiting anchor businesses desired by the local neighborhood
- increased outlets of existing successful businesses
- recruiting groups of businesses with a theme, such as mixed ethnic cuisine, or an Italian deli, bakery, and restaurant
- highlighting new businesses or providing subsidized advertising for new small businesses
- requiring commercial developments to also include residential space
- reducing developer fees or granting property tax credits for mixed-use developments
- assessing housing "linkage" fees on new commercial development to build nearby housing (Berkeley has a housing "linkage" program.)
- promoting higher density development near stores and transit lines
- developing a web site of small businesses that includes relevant information, such as restaurant reviews, hours, directions, mass transit access, etc.
- maintaining/expanding the manufacturing sector and linking to local hiring as a means of increasing the number of people who both live and work in Berkeley.

The City of Los Angeles is using linkage fees for development of the Central City West area into a mixed commercial/residential area. The City of San Jose is developing the Jackson Taylor Residential Strategy to promote a mix of high density housing, office, retail, and industrial space.

The Urban Land Institute (800-321-5011), the American Planning Association (312-955-9100), and The Local Government Commission (916-448-1198) publish information that covers mixed use development.

Create pedestrian street areas
Another idea to discourage driving is to plan pedestrian shopping areas where cars are prohibited. Only delivery and emergency vehicles and possibly buses would be permitted. The City of Berkeley already holds events (e.g., Jupiter Jam, Farmers Market, Berkeley Jazz Festival, and the annual Crafts Fair on Telegraph) where a street is closed off from traffic. As seen from these festivals, the pedestrian walkway encourages community spirit and local shopping. Permanent pedestrian access only shopping areas can become a retail, dining, and entertainment destination as seen from Pearl Street in Boulder and 3rd Street Promenade in Santa Monica. The City of Berkeley would need to address merchant concerns to ensure their support and would probably want to implement the strategy as a pilot that could be terminated. More permanent changes could be made to the area later once the concept proves itself. The South Campus Circulation Study is evaluating this option for Telegraph Avenue (City of Berkeley 1996).

Transit Center
The idea behind a transit center is to focus transportation resources on an area that is currently poorly served by mass transit and has parking/congestion problems. Coordinating a variety of transit options and providing frequent service can make mass transit the preferred option. West Berkeley along the 6th Street corridor is the most important commercial area in Berkeley that is not effectively served by major mass transit systems. To address this problem, the City of Berkeley is operating the Berkeley Electric Shuttle (BEST), which consists of three, 22-passenger electric shuttle buses that stop at North Berkeley and Ashby BART stations and run through West Berkeley employment areas.

3.5.3 Traffic Efficiency Options

Continue to improve timing of traffic lights on all heavily traveled city streets
Stop-and-go traffic wastes energy since gasoline-powered cars use almost as much energy idling as driving. Timing traffic lights, particularly during commuting hours in the commuting direction, will alleviate congestion and excessive stop-and-go traffic.

The California Energy Commission (CEC 1993) recommends optimizing signals every three to five years. Cities participating in CalTran's Fuel Efficient Traffic Signal Management (FETSIM) program reduced gasoline use up to 19% and travel time was by an average of 7.5% (CEC 1993).

The City is actively working on improving traffic flow and signal control. The largest projects are listed below.

- The City of Berkeley just started a signal coordination project for 30 downtown signals in the area bounded by Hearst/Martin Luther King/Dwight/Shattuck. Implementation of recommendations will take place in August and September, 1997.
- City staff are currently reviewing signal timing on Sacramento Avenue and will complete the review in next 2-3 months.
- The City is designing and installing a new signal interconnect for University Avenue. Implementation should be finished this year.
- The City received a grant from the Metropolitan Transportation Commission to hire a consultant to evaluate traffic control at the Gilman Street/I-80 interchange. Results will be available in the next 3 months and will be used to coordinate with Caltrans regarding traffic control improvements surrounding freeway modifications.
- In addition, City staff are working on miscellaneous timing adjustments at individual intersections.
- The City submitted a grant request to the Metropolitan Transportation Commission to coordinate signals on Ashby between San Pablo and 7th and continuing north on 7th to Heinz. Development in the area is projected to increase traffic above current levels.
- The Metropolitan Transportation Commission is conducting a study on the San Pablo Avenue corridor to evaluate multi-jurisdictional traffic use and signal coordination along San Pablo Avenue.

3.5.4 City of Berkeley's Fleet Procurement Policies

Expand vehicle pool use to limit the number of City vehicles
The City has begun to move from each department owning all its own vehicles to the city, as a whole, owning a pool of vehicles to which the departments have access. The dollar savings from a pooled vehicle system are realized because the City does not need to own and maintain as many vehicles. Reducing the size of the City fleet has environmental benefits because fewer vehicles are used and stored. Many City vehicles owned by individual departments are traveling less than 1,500 miles per year and are dramatically underutilized. The City is switching from Ford Tempos to Ford Escort wagons. The Escort wagon was chosen in part because it is versatile and reduces the need for different types of vehicles.

Currently, there are 13 vehicles in the City pool. Pool vehicles are located at the Corporation Yard on Allston Way, which is about 0.75 miles from Civic Center. The Corporation Yard is not a central location for many City workers and this hinders the use of pool vehicles. In the past, Public Works tried keeping the pool cars in the Center Street Garage, but there were problems with keys not being returned. Setting up a workable arrangement for pool cars in the Center Street Garage would increase pool car use.

Renting from a local car company on an as-needed basis could be used if the pool has occasional shortages. However, the issue that city employees usually need a car on short notice would need to be resolved with the car rental agency.

Reduce Fleet Size and New Vehicle Purchases

Current policies do not encourage departments to remove excess vehicles from the fleet or optimize use and purchase of vehicles. In the fiscal year 98 budget plan, Public Works is considering the following steps to improve fleet efficiency:

- Allow funds from sale of used vehicles to go directly back to the department that owned the vehicle.
- Stop collecting replacement costs once vehicle replacement is fully funded.
- Charge each department for actual maintenance and gas costs. This policy will be implemented in 1998.
- Require written justification for each new vehicle purchase and consideration of alternatives.
- Have departments pay for their own vehicles, rather than the funding coming out of a City vehicle budget.
- Rent occasionally if there is a vehicle shortage.

Continue to purchase energy efficient gasoline powered City vehicles
Within a given vehicle class, there is typically a 5-10% variation in fuel economy. In addition, using the appropriate vehicle class for the job will reduce gasoline consumption. Ford Escort wagons are being purchased by Public Works for general use because of their combination of reasonable price, versatility, and fuel economy.

Continue to purchase alternative fuel City vehicles
Viable alternative fuels include compressed natural gas (CNG), electricity, and human power. The City of Berkeley owns and operates a total of approximately 400 vehicles. Additionally, some City of Berkeley police patrol on mountain bikes. Berkeley owns 14 electric scooters for parking enforcement. The City currently has 21 gas powered scooters. Some gas powered scooters will need to be used in hill areas, but the ratio could be switched from 21/14 for gas versus electric to 14/21 gas versus electric. Electric station cars, electric bicycles, or one passenger electric vehicles like the Corbin Sparrow could be used for trips between the Corporation Yard, Civic Center, and other sites. The smaller vehicles will require fewer parking spaces in the parking constrained Civic Center area.

As an alternative to gasoline, CNG is appropriate for large vehicles that are driven long distances (e.g., trash trucks and sweepers). CNG vehicles are quieter, cleaner, and are more energy-efficient than the traditional counterparts. The tradeoffs are that the CNG vehicles require large fuel tanks which take up a lot of space, take longer to refuel, and are more difficult to fuel due to a lack of CNG fueling infrastructure. Concerning this last issue, Berkeley intends to build a small CNG station to fuel city CNG vehicles (see next strategy). The City currently owns one CNG shop truck, and one CNG bucket truck. The City intends to buy two large CNG pickup trucks. Public Works plans to buy two dedicated CNG passenger vehicles, probably Honda Civics, so that various departments can try the new vehicles through the vehicle pool without having to purchase them directly.

Seventy-five percent of the fuel burned by city vehicles is used by 10 percent of the city's fleet. This is largely because the City of Berkeley collects and trucks the city's solid waste to the Livermore transfer station. Berkeley also owns other large vehicles such as sweepers that operate multiple shifts. Berkeley plans to replace these fuel intensive vehicles with dedicated CNG

vehicles as the existing vehicles reach the end of their economic life. Purchasing CNG trucks and sweepers will lead to the largest reduction in greenhouse gas emissions per vehicle converted.

Berkeley eventually intends to upgrade:

- city cars, which comprise 25 percent of the fleet, into CNG cars
- city pickup trucks into CNG trucks
- parking enforcement vehicles into electric vehicles, except for those used in hill areas

The City is buying dedicated CNG vehicles, as opposed to conversions, because of reliability concerns with converted vehicles.

Build a compressed natural gas (CNG) modular station

The City plans to build a CNG station at the 2nd and Gilman transfer station because they are presently having difficulty refueling city owned CNG vehicles. A few private companies and Pacific Gas and Electric offer fueling, but this is inconvenient and not all stations have the ability to pressurize tanks to 3,600 psi. The high pressure is critical to extending driving range.

This pilot station is intended to prove the concept and allow departments to test CNG vehicles without experiencing fueling constraints. Further stations may be built as more departments switch to CNG vehicles. Additionally, the City may be able to charge other CNG vehicle users to use their fueling facility. Berkeley Unified School District has purchased two CNG buses and plans to buy three more in December 1997. U.C. Berkeley, American Soil Products, and Acme Bread are other potential users of the station.

Encourage vehicle shut off as appropriate when not in use

Vehicles are often left running for several minutes when not in use. The City could have separate “turn off” labels printed for gasoline powered vehicles (which can be shut off immediately) and diesel trucks (which need to be run for at least one minute to let turbochargers cool).

3.5.5 Resource-Efficient Transportation Options

Establish free parking for electric vehicles
When electric vehicle availability improves, unlimited free parking for electric vehicles in metered and short term parking will encourage and promote the adoption of electric vehicles. However, this parking should go on side streets, not in the prime parking spaces in front of businesses. The city would need to erect signs that notify drivers of this added advantage of owning an electric vehicle. If electric cars gain popularity, the city may want to consider supplying emergency-only charging (since electric vehicles should be charged at night using low cost power) at selected parking spaces in garages at a charge to the car owner. As part of the effort to promote electric vehicles, the City could develop a list of sources for residents to use to find the latest information on electric vehicles, including cost, vehicle performance, and locations where electric vehicles can be purchased. The Electric Vehicle Association of the Americas is located in San Francisco (415-249-2690). The Electrical Vehicle Progress Group is in New York City (212-228-0246). Both groups publish newsletters.

Establish electric vehicle charging facilities in the downtown area and at major parking/employment areas
For electric vehicles to become a main stream mode of transportation, charging infrastructure needs to be built. Emergency charging infrastructure in major parking and employment areas are an added convenience that will encourage the adoption of electric vehicles. For example, selected parking spaces in the downtown Great Western garage and Center Street Garage could have charging stations. There currently is no standardization for electric vehicle charging plugs nor a standard charging voltage. The City would need to choose one of the more prevalent types.

Work with local rental car companies to help market rentals of "sporty" electric cars to familiarize public with electric vehicles (EVs)
Renting an electric vehicle is a low risk option for a consumer to try out a new technology. The City could do press releases to help rental electric vehicle marketing or possibly guarantee renting EVs for a specified number of days per year to help subsidize the cost. This approach might also receive funding from the air district.

Some electric vehicles, such as the General Motors EV1, are high profile sporty cars that people would enjoy driving. Also, new EVs are entering the market that are lower in cost. The Corbin "Sparrow" will soon be on the market and will cost about $10,000. The "Sparrow" is a one-seat vehicle, freeway legal and capable of 60 mph and a 60 mile range. Each vehicle carries its own charger that plugs into a 110 volt outlet. The small size also allows parking in spots that are too small for conventional vehicles.

3.5.6 Traffic Calming

Place speed bumps and meanders (chicanes) to slow traffic
Meanders and speed bumps are designed to slow traffic and help make the streets safer for bicyclists and pedestrians. The City of Berkeley is currently reviewing the use of speed bumps for this purpose. The City of Berkeley has found traffic meanders to be less effective and intends to implement different designs in the near future. Many bicyclists feel that curves are hard to see and react to at night and that cars drive in the bicycle lanes to partially avoid speed bumps.

Place barriers to funnel traffic to major streets
Funneling traffic to major thoroughfares maintains quiet and safe local areas. Berkeley funnels traffic to collector and major streets. At the same time, traffic diverted to other streets increases congestion along those streets unless steps are taken to increase capacity along those streets. This approach is a central part of Berkeley's current traffic control strategy. Henry and Sutter (between Eunice and Hopkins) and Milvia Street (between Allston and Channing) have recently been narrowed.

Narrow wide streets that have little traffic
Some streets in the city are extremely wide, but have since been converted to side streets by blocking them off to through traffic. The city can replace the extra width with park median strips or dedicated bike paths to promote non-motorized transport. California Street north of Dwight Way would be a good street for narrowing.

3.5.7 Bicycle Strategies

The Berkeley Bike Plan (City of Berkeley 1994) is a cooperative effort between the City and the bicycling community to "make Berkeley a truly bike friendly city". Since streets were laid out decades ago, almost all bicycle travel in Berkeley is on streets which are also used by automobiles. There are few dedicated bike paths because roads are already in place and go within a few feet of every place in the City. The Berkeley Bike Plan contains a range of strategies to improve bicycle access, safety, and convenience. Key elements are discussed in this section.

Bicycle Boulevards
Bicycle boulevards are streets where the needs of cyclists are met, even if cars are inconvenienced. Most streets throughout the City would remain the way they are (oriented to automobiles), but a few streets would offer bicycles preferential treatment. The City Council has designated five strategically located North-South and East-West streets as bicycle boulevards. When improvements are made, bicycle boulevards will increase bicycle ridership and bicycle traffic will concentrate on those routes, further increasing safety.

Bicycle Lanes
The Bicycle Plan recommends bike lanes be five to eight feet wide in each direction where no parking is allowed. Where parking is allowed, the Plan recommends lanes be 12-14 feet wide (measured from the curb) in order to accommodate parking and car doors. These recommendations are based on safety and effectiveness for bicycles, but implementing these standards will mean removing a lane and creating one way streets or eliminating parking. These options are likely to be opposed by residents and merchants and compromises will need to be worked out in each location.

Bicycle Overpass over Freeway
A bike friendly route over Interstate 80 is particularly important now that the funding for the East Bay Shoreline Park has been approved and there will be bike paths along nine miles of shoreline. This bike path will be used both for pure recreation and shopping and commuting. Funding has been allocated for an overpass near University Avenue. Additional bicycle bridges back to City streets around Ashby and Gilman would provide important links to commercial areas. Additional funding is needed for these multiple crossover points. The bicycle/pedestrian bridge near University Avenue is estimated to cost approximately $3 million.

Street Repaving and Sweeping for Bicycle Safety
Potholes that are a nuisance for cars can cause bicycles to crash. As part of an overall strategy to encourage bicycling, the City will need to improve current street sweeping and pavement policies to ensure that all bikeway surfaces are adequately swept and paved.

Traffic Signals that Facilitate Bicycle Access
In locations where bicycle routes cross major and collector streets, the Berkeley Bike plan recommends special striping, signal timing, installations of bike sensitive loops, and bike/ped activated signals.

Shower Facilities for Bicyclists
Another strategy for promoting bicycling is to offer incentives for employers to provide showers for employees in cases where it is feasible for a significant portion of employees to ride to work. Showers could be an option on a menu of traffic mitigation options for new developments. The City should also do the same in its facilities.

Provide additional safe bicycle parking areas
Bicyclists need to feel that there are safe places to store and park their bikes. The City of Berkeley has recently finished constructing $100,000 worth of bicycle parking throughout the City. Additional racks are being located at some BART stations. New developments are mandated to include secure bike parking.

Work with transportation agencies to allow bikes on more mass transit, particularly during commuting hours
The widespread acceptance of bikes on mass transit would increase the use and convenience of public transportation. Bicycles are not currently allowed on most routes and modes of mass transportation. The Lawrence Berkeley Lab shuttle currently allows bikes. BART allows bikes, except on weekdays in the commute direction before 9 AM and from 3:30 - 6:00 PM. Bicycle

racks and lockers are available at all BART stations except downtown Oakland, San Francisco, and Richmond. The Air District is funding construction of bicycle cage boxes at the three Berkeley and MacArthur BART stations. AC transit allows bikes on certain routes, none of which are in Berkeley. However, AC Transit is currently working with bicycle advocates to choose appropriate bus routes for adding bike racks. The Caltrans Bay Bridge commuter bicycle shuttle fare from MacArthur BART to the Terminal Building in San Francisco is one dollar. In the future, bikes could be allowed on selected bus routes, particularly, on hilly routes and at well spaced stops (e.g., every three quarters of a mile). The occasions that other passengers would have to wait for bike riders would then be less frequent and would pose less of a scheduling issue.

3.5.7 Miscellaneous Transportation Strategies

Sponsor transportation savings contest for City of Berkeley staff to promote involvement in day-to-day operations

Another possibility for savings resources is to award City of Berkeley staff who identifies and is involved with the largest transportation dollar savings. Dow Chemical used this approach in its manufacturing facilities with phenomenal success. The staff most involved in the day-to-day operation have excellent ideas on how to save money and resources, once given the incentive and means to bring forth their ideas. Two transportation awards could be given: one for direct savings to the City and another for community benefit. The contest could be combined with the energy and solid waste contests.

4.0 ENERGY

This section is organized into four sections:

4.1 Energy trends
4.2 City of Berkeley Energy Goals
4.3 Linkages with difficult to quantify benefits
4.4 Strategies to reduce greenhouse gas emissions

4.1 Energy Trends

The most important change facing the electric utility industry is deregulation. Soon after utilities started producing power early in this century, they fell under federal and state jurisdiction and were regulated as monopolies in order to take advantage of economies of scale and avoid duplication of expensive infrastructure. Customers essentially had no choice as to their power provider and power costs fell as new larger and more efficient plants came on line. However, new technologies, such as combined cycle gas turbines, have lower generating costs than the mix of generation owned by most utilities. Additionally, in the 1970s and 1980s many utilities chose to build nuclear powerplants or bought expensive renewable energy contracts at a time when oil prices were predicted to rise far higher than they have. Pressure for lower prices has lead toward utility deregulation.

In April 1994, the California Public Utilities Commission accelerated the pace of deregulation when it issued its Blue Book ruling. The original schedule called for large commercial customers being able to choose their power provider in January 1996. This schedule has now been pushed back to January 1998 when all customers will be able to choose their power provider.

The implications of deregulation are that power will be available from a variety of suppliers at different prices and with different features, similar to long distance telephone service. Reliability will vary, a large number of pricing schemes will be offered, and customers are likely to be able to choose fuel types (e.g., coal, natural gas, hydro, nuclear).

The future of Pacific Gas & Electric's energy efficiency programs under deregulation is highly uncertain. When deregulation goes into effect, electricity costs will be only 1-2 cents per kilowatt hour lower because utilities will still be recovering costs from powerplants they built to serve all the load in their service territory. After four to five years when these costs are recovered, energy will drop another 4-5 cents per kilowatt hour. (For comparison, residential rates are now approximately 12 cents per kilowatt hour and commercial rates are approximately 10 cents per kilowatt hour.) New distributed utility technologies will also replace large, central station utility powerplants.

4.2 City of Berkeley energy planning goals

The City of Berkeley has an energy officer who plays an active role in reducing energy costs for the City and its residents. The primary goals of the energy officer are to:

- promote an aggressive retrofit strategy in buildings owned or occupied by the city in order to cost-effectively reduce energy bills
- serve low-income/senior citizen population with weatherization and home repair
- provide energy efficiency services to small businesses to increase their competitiveness

4.3 Linkages with difficult to quantify benefits

In addition to reducing energy costs, energy efficiency has other important benefits:

- Employee productivity can be improved through well designed energy efficiency projects, such as lighting and air conditioning retrofits.
- Maintenance costs can be reduced because energy efficiency savings are used to pay for new equipment. Additionally, many energy efficiency technologies have much longer service lives than standard equipment. For example, compact fluorescent and LED light sources last more than ten times as long as comparable incandescent lamps.
- The value of existing buildings can be improved through energy efficiency since operating costs are reduced and the savings accrue to the owner. For city-owned and occupied buildings, this is only an issue if buildings are being sold. However, if the City leases buildings and includes energy costs in the rent, energy savings benefit the City directly.
- Comfort in residential buildings can be significantly improved by addition of blown in cellulose wall insulation. Most of the housing stock in Berkeley is old and has no wall insulation. Addition of wall insulation dramatically improves comfort during winter months.

4.4 Global warming contribution from building energy

Natural gas and electricity consumed in residential, commercial, and industrial buildings results in the release of 315,000 metric tonnes of carbon dioxide released into the atmosphere each year. This is 40% of the total CO_2 equivalent emissions in the City of Berkeley.

Natural gas and electricity consumed in residences account for 24% of total emissions, which is primarily from space and water heating and electric appliances, such as refrigerators and lights. Commercial buildings account for 10% of total emissions, which are from space and water heating, cooking, lighting, office equipment, and ventilation and air conditioning equipment. Industry accounts for 6% of total emissions, which are from process heat, process mechanical (motors), space heating, and lighting.

4.5 Strategies to reduce greenhouse gas emissions

There are many ways to reduce greenhouse gas emissions from residential and commercial buildings. Options are grouped based on whether they apply to the commercial/municipal or residential sectors or both.

4.5.1 Commercial/Municipal and Residential Energy Efficiency Strategies

Non-profit energy consulting company
In order to meet its energy efficiency goals, the Berkeley City Council started a non-profit corporation in 1984 called Community Energy Services Corporation (CESC) to carry out energy efficiency retrofit projects in City facilities and weatherization/repair in low-income and senior housing stock. Through a five-year grant from the U.S. Department of Energy Rebuild America program, a group within CESC called ReEnergize is expanding the original mission of energy efficiency in City buildings to transforming the local markets for energy efficiency. ReEnergize is working in the small commercial, large commercial (including municipal), and multifamily sectors.

Publish an Energy Resource Directory
The City publishes and distributes an Energy Resource Directory that also covers solid waste and transportation services and providers. This guide is an excellent summary and should be updated since the last printing was in 1993. The City should also consider a wider distribution effort of this since it reduces market barriers for residents interested in resource conservation by providing a summary of resources. The brochure could be sold for 25 cents at stores, such as Whole Foods, that attract environmentally minded customers.

Buy green power
When deregulation of the electric utility industry occurs, buyers will be able to choose their power supplier. In pilots in other areas of the country, sellers have offered “green” power produced from more environmentally friendly fuels. Individual customers or purchasing blocks can buy “green” power. There is likely to be a cost premium for “green” power of 1-3 cents per kilowatt hour.

Promote low-flush toilets
Building codes apply to major renovations and new construction and require that toilets use a maximum of 1.6 gallons per flush. (Older style toilets use 3.5-7 gallons per flush.) Berkeley’s Residential Energy Conservation Ordinance (RECO) and Commercial Energy Conservation Ordinance (CECO) require low flush toilets be installed at the time of sale or major renovation. EBMUD has a low-flush toilet rebate program that the City can help promote to encourage residential customers to install new low-flush toilets. Community Energy Services Corporation (CESC) is doing EBMUD toilet rebate installations. Additionally, there are several excellent water-saving toilet tank products that are cheaper than new toilets.

Any reduction in water volume sent to the sewer system means less water that has to be treated and pumped to the end user. It also means less sewage to treat. Bubbling and pumping processes

used to treat sewage are energy intensive and thus saving water also saves energy. Targeting high use applications, such as restaurants and office buildings will maximize savings.

Promote solar hot water heating
Promote reactivation of existing non-functioning systems in the City, new installations in facilities without gas service (existing all electric systems), and to property owners who are motivated by
environmental concerns. The City will be installing a solar hot water system at one of the marina restrooms that has no gas service. Solar water heating should always be done in conjunction with measures, such as water efficient clotheswashers and low flow showerheads, that reduce demand for hot water. CESC and ReEnergize can provide technical assistance and contractor referrals for installation and maintenance of solar hot water systems.

Water efficient clothes washers for residential and laundromat use
Horizontal axis clothes washers use less detergent and water and get clothes cleaner. However, they are a new technology and are much more expensive than a conventional washing machine. Currently, horizontal axis clothes washers cost $900 or more, but both PG&E and EBMUD offer rebates. Targeting high use applications, such as laundromats and apartment buildings will maximize savings and help offset the higher capital cost. In addition, since the technology gets clothes cleaner and is environmentally friendly, the City could work with laundromats to demonstrate the technology. If properly promoted, the laundromat could gain a marketing advantage that would motivate them to participate.

Free or nominal cost low flow showerheads
Low flow showerheads are one of the most cost-effective retrofit technologies. They save water, energy to heat water, and sewage treatment costs. Given how cost-effective this technology is, it should be offered to all customers that are visited by City-sponsored auditors. However, if funding is limited, targeting to high users, such as gyms, will save the most energy.

Water reuse
Water reuse saves energy because pumping costs to deliver water, water pretreatment, and wastewater processing are all reduced. Reused water can be used in City irrigation trucks. Pools and fountains may be other sources of reusable water, depending on the chemicals used for water treatment.

Renewable energy supply
With the advent of electric utility restructuring, electric customers will have opportunities to purchase electricity from companies which support renewable energy resources that have less environmental impacts. The City may be able to increase community access to these resources.

4.5.2 Commercial and Municipal Energy Efficiency Strategies

Commercial Energy Conservation Ordinance
The City of Berkeley Commercial Energy Conservation Ordinance (CECO) went into effect April, 1994. At the time of sale or renovation of $50,000 or more to a commercial property,

CECO requires installation of energy and water efficiency measures. The list includes a wide range of measures, such as fluorescent lighting, ceiling insulation, air conditioning system tuneup/recommissioniong, timeclocks, and low flush toilets. If a facility is sold, the CECO requirement can be transferred to the new owner so the space is built to suit the new occupant's needs.

CECO works well for renovation because permits are required and the City is aware of the project. However, title transfers are not always picked up. Customers in need of assistance can be referred to the City of Berkeley's Commercial Technical Assistance (CTAP) project.

Install Light Emitting Diode (LED) traffic lights
Light emitting diode (LED) traffic lights are an alternative to standard incandescent technology. LEDs use less than one quarter of the energy of an incandescent. In addition, LEDs last approximately ten years versus one year for an incandescent and so another big advantage of LEDs is reduced maintenance. LEDs also reduce emergency relampings done at overtime labor rates because they come with independent strings of diodes and if one string fails there are another five to ten still functioning.

Red LEDs are a common retrofit. Other color signals are not commonly retrofitted. Green LEDs have brightness issues that are being worked out and are more expensive than red LEDs. Yellow LEDs are more expensive than red LEDs and don't have enough operating hours to justify themselves on a stand alone basis, though the biggest maintenance savings occur if all the whole signal (all three colors) is converted to LEDs. ReEnergize is currently conducting an LED traffic light retrofit feasibility study and investigating whether it is feasible to replace red, greens, and yellows.

Conduct benchmarking analysis/simple recommissioning on City of Berkeley facilities
City of Berkeley buildings have received extensive lighting and some heating, ventilating, and air conditioning retrofits. Insuring that equipment is operating properly on its own as well as integrating with other systems is critical to achieving energy savings. Benchmarking energy costs on a per square foot can identify buildings with high energy intensities. The next step is to follow up with on-site surveys and diagnose the cause of the high energy intensity. If hourly billing data is available, an easy check of operating procedures and the adequacy of controls is to check nighttime kW use. This will quickly identify whether lighting and office equipment are being left on overnight.

Reaudit City facilities to look for cost-effective second generation energy efficiency opportunities
As noted above, City facilities have had extensive lighting retrofits. However, many of these retrofits involved one-for-one replacements of lamps and included little in the way of redesign or controls. Changing layouts, replacing old lenses, and removing excess lamps will provide savings and better lighting distribution. The goal of an energy efficiency retrofit should be to improve or at least maintain the original lighting quality.

Many older buildings have large lighting zones all controlled by one circuit breaker and with no light switches or other controls. The only way lights can be turned off is to use the circuit breaker which is often in a remote location. Installation of additional switches and occupancy

sensors, particularly in areas where spaces are not uniformly occupied will save energy. Photocells or dimming controls may be appropriate for fixtures located near windows. Most city facilities are of old vintage and should have lighting controls reviewed.

Encourage an energy conservation campaign among City of Berkeley staff
Both behavior and use of efficient equipment are important for saving energy. The city could step up energy conservation awareness among staff and bill it as a team effort to cut operating costs and benefit the environment.

New construction/renovation design review
The City of Berkeley does very little new construction of municipal facilities, but has gut rehab projects, including 2180 Milvia Street, planned. Gut rehabs represent an opportunity to "tunnel through the cost barrier" by optimizing interaction of multiple systems (e.g., lighting, shell, and heating, ventilating, and air conditioning (HVAC)). Many measures that would not be cost-effective by themselves may become cost-effective when packaged together since building shell, lighting, and HVAC systems all interact. For example, improved insulation and window film can avoid the need for space conditioning in some cases or permit a smaller unit with lower capital cost.

Commercial and industrial customers can receive low-cost design review through ReEnergize. New construction and renovation situations offer the best opportunities for cost-effective energy efficiency strategies. New equipment is being purchased already and thus the cost for energy efficient equipment is only the incremental cost of better equipment. Additionally, integrated system design can save even more energy and synergies can reduce first costs. The design review for the City of Berkeley Public Safety building resulted in a configuration that utilized natural cooling supplemented by 8.5 tons of mechanical cooling. Other designs for the same facility specified as much as 300 tons of cooling.

Light colored roofs are a no-cost measure to incorporate in renovations and new designs. Because of reflection of heat, light colored roofs are cooler and last longer. Light colored roofs will improve occupant comfort during hot weather, particularly in buildings that are not air conditioned. Energy savings will be limited since benefits occur mainly over a period of a few weeks each year. Given that there is no cost premium for light colored roofing and that occupant comfort and productivity will improve, this option should be specified for reroofing work. This is also a time to consider whether additional ceiling insulation is warranted.

Purchase Energy Star office equipment
Office equipment is the fastest growing end use in the commercial sector and currently accounts for about 10% of the load in commercial buildings. Office equipment sits idle much of the time. Employees leave their desk area and the computer is not being used or may even be left on over night. Printers, copiers, and faxes are only used a small percentage of the time. The Environmental Protection Agency has worked with equipment manufacturers to incorporate sleep mode features in office equipment so that it powers down when not in use. There is generally no cost premium for these features and all new equipment should be Energy Star certified. (All new City office equipment is Energy Star certified.)

Enable Energy Star features on office equipment
While most new office equipment is available with Energy Star features, often the equipment is shipped without the software enabled and the savings are never realized. This is particularly true for older equipment with Energy Star features. Screen savers are not energy saving features. They just prolong the life of the screen. ReEnergize is currently auditing City owned office equipment to determine what types of equipment are in use and whether Energy Star features are enabled.

Work with BART on retrofitting Berkeley BART station lighting
BART is slowly doing lighting energy efficiency retrofits in its stations. At the time of the retrofit, BART can adjust overlit areas and clean brake dust off of fixture lens to increase light output near train platforms. Fluorescent lighting upgrades to T-8 lamps and electronic ballasts pay back quickly since BART stations operate long hours. Furthermore, BART is still using incandescent lamps in some locations. Compact fluorescents would pay back in a matter of months. Just as importantly, BART stations need improved lighting for appearance and safety. None of the three Berkeley BART stations have been retrofitted yet.

Modify City procurement policy to buy motors and packaged air conditioners that meet Consortium for Energy Efficiency standards
The Consortium for Energy Efficiency (CEE) is a cooperative national effort among major utilities to incent manufacturers to produce the next generation of premium efficient equipment, including motors and air conditioning units. A new generation of “premium efficiency” motors is entering the market. These motors are 1-3 percentage points more efficient than the new National Energy Policy Act standards that go into effect in October 1997. Package unit air conditioners are available with 13 SEER efficiencies, compared to the minimum Title 24 requirement of 10.0 SEER.

Install premium efficiency new motors instead of rewinding
Motors larger than 25 horsepower are generally rewound not replaced. Often these old motors were not efficient in the first place and may have been damaged during routine use, in the failure mode, and during the rewind. Installing premium efficiency new motors in place of rewinding can have a payback of under two years. Utility rebates shorten the payback further.

Retrofit Berkeley schools
The Berkeley Unified School District (BUSD) has a policy targeting 40% higher efficiency than Title 24 building codes for buildings that undergo remodeling or seismic renovation. The City is currently working with BUSD on a retrofit plan for facilities not subject to renovation.

Energy efficiency can be used as a life skills training experience for high school students. The school retrofits can be done with students doing their own audits of the school. Additionally, students can be trained to carry out lighting audits of small businesses. The Rising Sun Energy Center in Santa Cruz trained and supervised high school students to do small commercial lighting audits and found the students got an excellent response from business owners. Many of the owners then carried out the recommendations made by the students. Marketing energy efficiency to the small commercial market sector can be prohibitively expensive, but low cost student labor kept the marketing costs down. Students learned to interact on a professional basis and to prepare reports, which is valuable experience, whatever career they end up following.

Coordinate ReEnergize[1] services with Environmental Protection Agency (EPA) Climate Wise Program for industrial customers
The EPA's Climate Wise program is targeted to industrial customers and combines solid waste, water conservation, and energy efficiency audits into easy one stop shopping for customers. This integrated approach can lead to greater savings and saves time for program participants. Marketing costs are also reduced by coordinating with other agencies.

Coordinate ReEnergize services with Environmental Protection Agency (EPA) Bay Area Green Business Program
The EPA Bay Area Green Business Program is a voluntary program that addresses hazardous waste, solid waste, water conservation, and energy conservation. This program is being piloted with auto repair shops, but EPA plans to expand it to other market sectors. As with the Climate Wise program, the advantage of coordinating with other agencies is that it reduces the marketing costs of finding small businesses that are interested in energy efficiency measures.

Recruitment of additional business from existing ReEnergize municipal clients
In order to help ReEnergize get successfully established, initial clients are extremely important. The cities of Oakland and Berkeley have been active ReEnergize partners. Getting the City of Emeryville to hire ReEnergize to upgrade its facilities and actively recruiting commercial participants would give ReEnergize an extensive portfolio to build its reputation.

Establish additional cities as ReEnergize clients
Recruiting additional cities, such as Richmond and El Cerrito, would give ReEnergize a larger client base, particularly if the cities start by committing their own facilities.

[1] ReEnergize is a non-profit providing energy efficiency services to the commercial and multifamily sectors in Berkeley, Oakland, and Emeryville.

Commercial Technical Assistance Program
ReEnergize is implementing the City of Berkeley's Commercial Technical Assistance Program (CTAP), which is funded by the City of Berkeley and Department of Energy. The target geographic area is downtown Berkeley (Shattuck Ave). ReEnergize is auditing small commercial customers at no charge. ReEnergize then prepares a proposal with a lump sum cost for materials, labor, project management, and followup. Customers with facilities under 3,000 square feet pay half of the equipment installation cost. Larger customers pay the entire cost. Independent contractors carry out the installations. The goal for 1997 is 5-10 copaying customers (under 3,000 square feet) and 5-10 facilities over 3,000 square feet.

Promote energy efficient vending machines
Vending machines are very energy intensive. Jeff Harris at the Department of Energy in Washington D.C. is starting a cooperative effort with manufacturers to produce efficient vending machines and will be looking for initial demonstration sites. The City of Berkeley could get on the list as an initial pilot site.

Target business sectors to increase economic and environmental efficiencies
The City and County are intevening into specific target business sectors to attempt to improive economic and environmental efficiencies. Current sectors being targeted include food processing, printing and publishing, and lodging.

4.5.3 Residential Energy Efficiency Strategies

Residential Energy Conservation Ordinance
The City's Residential Energy Conservation Ordinance (RECO) went into effect in 1981. RECO is triggered when houses are sold or more than $50,000 worth of renovations are done. RECO requires ceiling insulation and low-cost energy saving measures and water savings devices, including low flow toilets.

Promote residential ceiling insulation
Most of the housing stock in Berkeley is old enough so that it was constructed without insulation. Ceiling insulation is simple and cost-effective to retrofit and many houses have been retrofitted. Typical costs are $750-$1,000 per house. Pacific Gas & Electric has offered ceiling insulation rebates in the past and the Residential Energy Conservation Ordinance (RECO) requires ceiling insulation be installed at the time of sale. However, there are still many houses that have no ceiling insulation, inadequate amounts, or poor installations. Houses should have at least R-30 insulation. Promoting insulation for its joint energy and comfort benefits will maximize consumer interest.

Promote residential wall insulation
Most of the residences in Berkeley do not have wall insulation because of their vintage and have not been retrofitted. Wall insulation dramatically improves comfort in uninsulated houses. Infiltration through walls is reduced because air gaps are tightly packed. Convection is reduced because wall cavities are no longer open. Conduction through walls is reduced because of the improved thermal resistance. Finally, rooms feel warmer because the inside wall does not radiate at the cold outside temperature.

Wall insulation has other benefits besides saving energy. Wall insulation provides effective acoustic insulation. Additionally, wall insulation closes the loop on recycling. Cellulose insulation is shredded newspaper and the wall cavities of insulated houses become an effective carbon sink.

Promoting wall insulation for its comfort benefits first and energy savings second is most likely to convince homeowners. Bill savings will be limited because the climate is cold enough that heating bills are too small to offer a rapid payback. Wall insulation should be combined with renovation work so that repainting work is minimized. The City could provide a list of wall insulation contractors and consumer knowledge guidelines to people applying for permit applications.

The cost of wall insulation is approximately $800 per thousand square feet of floorspace. Cellulose insulation is installed by drilling 1.25" holes in plaster or sheetrock and using a powerful blower to pack the cellulose densely into the wall cavity. Wall insulation should only be installed by a knowledgeable professional.

Evaluate duct sealing for inclusion as part of weatherization program
Lawrence Berkeley Laboratory has developed a new duct sealing technology. Energy savings occurs because air leaks in ducts are sealed and a higher percentage of conditioned air is delivered to the working space. This technology should be evaluated for cost-effectiveness and possible inclusion in the City's weatherization efforts.

Mass procurement of energy efficient technologies
Two of the most important market barriers for energy efficiency are first cost and availability. One way to help break down these market barriers is through mass procurement of energy efficient technologies, such as compact fluorescent lamps and super efficient refrigerators. This approach will only work on technologies where needs can be predicted ahead of time. For example, a failed water heater needs to be replaced immediately, but a housing development or dormitory might schedule lighting retrofits or refrigerator replacements well ahead of time. ReEnergize is negotiating a bulk purchase of 380 super efficient apartment sized refrigerators for the Berkeley Housing Authority and the Richmond Housing Authority.

One option would be to work with U.C. Berkeley on joint City/U.C. Berkeley procurement. Berkeley residents would be eligible as well if they paid a deposit on equipment when ordering. All parties would receive a discount based on what could be negotiated with the manufacturer or distributors. U.C. Berkeley could provide student interns to manage the day-to-day efforts of the program.

Turn-key security lighting
The City recently created a program for turnkey installation of energy efficient residential security lighting. The new lighting offers low operating costs and distributed lighting as opposed to bright spots created by the large spacing between street lamps. Contractors have been prequalified and prices set for installation of energy efficient security lighting. This approach reduces the transaction cost and risk for residents.

4.5.4 Miscellaneous Energy Efficiency Strategies

Sponsor energy savings contests for City of Berkeley staff to promote involvement in day-to-day operations
Another possibility for savings resources is to award City of Berkeley staff who identifies and is involved with the largest energy dollar savings. Dow Chemical used this approach in its manufacturing facilities with phenomenal success. The staff most involved in the day-to-day operation have excellent ideas on how to save money and resources, once given the incentive and means to bring forth their ideas. Two energy awards could be given: one for direct savings to the City and another for community benefit. The contest could be combined with the transportation and solid waste contests.

5.0 ORGANICS/RECYCLING

This section is organized into four sections:

5.1 Organics/recycling trends
5.2 City of Berkeley organics/recycling goals
5.3 Difficult to quantify benefits
5.4 Global warming contribution from organics
5.5 Strategies to reduce greenhouse gas emissions

5.1 Near term trends

Food and consumer goods in the U.S. use large amounts of packaging. Disposable products are also popular. These factors, coupled with increased population, strain natural resources and landfill space. The per capita waste generation (which includes commercial and industrial waste) is 1,110 kilograms (2,400 pounds) of waste per year (Cal Recovery figures cited in City of Berkeley 1992). This does not include indirect waste generation from the original manufacturing.

The rise in waste generation in combination with dwindling landfill space has resulted in rising disposal costs. Due to these rising costs, many businesses are moving toward source reduction measures, such as less bulky and lighter packaging materials and recycling. Growing waste management concerns have led policy makers to pass more recycling and source reduction initiatives.

California continues to pass and promote some of the most progressive waste management policies in the U.S. The California Integrated Waste Management Act of 1989 restructured California's waste management system to become a more integrated waste management system. The Act requires Berkeley and other cities and counties in California to divert 25 percent of all solid waste from landfill or transformation facilities by 1995 and 50 percent by 2000 through source reduction, recycling, and composting activities. Each city is required to prepare and implement a source reduction and recycling program for management of solid waste generated within the city.

Many Californian city planners have also recognized the importance of urban tree planting. In the City of Berkeley's Tree Master Plan, the 1990 Tree Policy recommends that the Forestry Element "require consideration of, and planning for, existing and new trees in every development decision."

5.2 City of Berkeley organics/recycling planning goals

The City of Berkeley is implementing an aggressive source reduction and recycling program. At the same time, the city wants to maintain a reasonable residential waste management bill. In the Source Reduction and Recycling Element of 1992, Berkeley planned to divert 55,334 tons per year or 43 percent of the waste stream by January 1, 1995 and 79,318 tons per year or 62 percent of the waste stream by January 1, 2000. Approximately two-thirds of this diversion will take place through recycling, with the remainder divided equally between source reduction and composting.

5.3 Linkages with difficult to quantify benefits

There are many significant benefits from reducing material sent to landfills:

- conserving energy through reprocessing recyclable materials instead of manufacturing from raw materials
- reducing air, water, and land pollution
- reducing global warming
- decreasing reliance on landfills
- promoting environmental awareness among community members
- enhancing city aesthetics and community spirit
- improving soils and reducing fertilizer use through composting

5.4 Global warming contribution from organics

Landfill decomposition of waste from residential, commercial, and industrial buildings results in the release of methane equivalent to 124,000 metric tonnes of carbon dioxide each year. This is 16% of the total CO_2 equivalent emissions in the City of Berkeley. Residential organic waste accounts for 6% of total emissions. Commercial organic waste accounts for 9% of total emissions and industry contributes an additional 0.4%.

5.5 Strategies to reduce greenhouse gas emissions

5.5.1 Urban tree planting

Trees contribute to a city in many ways. They can define a streetscape, provide shade, and generally lead to increased property values. Sacramento Municipal Utility District has run a shade tree program, partly as an effort to reduce summer air conditioning loads. Trees reduce air conditioning loads by providing shade and by evapotranspiration of water from the leaves. With the planting of a high density of trees, a heat island effect can be achieved where the local temperature is decreased on hot days.

Some cities, such as neighboring Oakland, have passed landscaping parcel assessment taxes to fund tree planting. Tree planting efforts can also get donations from non-profit, state, and private organizations and individuals. In addition, organizations, such as Tree People (Los Angeles) and the American Forest Council provide advice on tree planting programs.

In Berkeley, many of the trees are in need of replacement. There are a lot of problems with inappropriate species, inadequate space, pruning, and old age. The City is trying to gradually replace mature trees so that streets do not loose all the mature trees at once.

Tree planting programs are an excellent opportunity for members of the community to get involved by providing much of the labor and thereby leveraging tree planting budgets. Different tree planting programs are discussed below.

Continue street tree plantings
In an effort to improve its response time for tree requests, the City changed its tree planting program in Fall 1996. Under the new program, the City helps residents select tree types, checks the location of utilities, and purchases and delivers the trees. The City has developed an informational packet to help residents understand the constraints of their space and make an appropriate choice from the list of 50 canopy species. The resident is responsible for any necessary sidewalk cuts, planting the tree and watering it. Under this program, the City estimates that 300-400 trees will be planted per year. The City's goal is to deliver the trees within two weeks of the initial request.

If resources were available, the program could be further expanded to promote a more intensive tree planting program on neighborhood streets. Currently, the program is mainly promoted through word of mouth and there are many street areas with no trees. An intern could help process more requests, develop a brochure on site selection, coordinate transformation of the current informational packet into a tree planting guide, as well as investigate sources of additional funding or ways to leverage resources of environmental and community groups. Residents could also be given the option of making a voluntary contribution for the trees so that the additional money goes to planting more trees in the City.

Promote residential tree planting
With information on proper tree siting, property owners can plant trees on their own property to optimize cooling, buffer wind, and grow food for consumption. The City materials on street trees could be expanded to include different backyard fruit trees and the varieties of each species that grow best in this climate.

Plant trees in City of Berkeley parks and recreation facilities
There are 51 parks and recreation facilities in Berkeley on 235 acres of land. The City could plant more trees in many parks and recreation facilities. Landscape crews have considerable discretion over the parks they manage. In addition, neighborhood groups can lobby the City or apply for a tree planting grant from the City. Residents can also arrange to plant memorial trees in parks.

Joint tree planting efforts with other organizations
The City of Berkeley could team with other local organizations, such as the Berkeley Unified School District, East Bay Municipal Utility District (EBMUD), and East Bay Regional Parks District (EBRPD) to increase tree planting efforts. Coordination with other agencies would be an excellent use for an intern from U.C. Berkeley.

Many Berkeley Unified School District properties have huge open areas and there are significant opportunities for more trees. Additionally, little or no educational activities regarding tree planting are occurring at schools. Necessary open areas could still be left for safety concerns. School sites are one of the best opportunities for increased tree plantings. A champion from within each school would help overcome bureaucratic issues. Janitors are likely to be concerned with maintenance issues.

EBMUD owns land around the Briones, San Pablo, San Leandro, and Lafayette reservoirs. Berkeley can collaborate with EBMUD to plant native trees on these lands.

EBRPD is currently removing eucalyptus on its lands due to fire concerns. Berkeley could coordinate efforts to grow native species in replace of eucalyptus in regional parks such as Tilden. Other parks could then use Tilden Regional Park as a model to follow. The creation of the East Bay Shoreline Park is another opportunity for the City to promote planting of appropriate trees.

Enforce and extend tree canopy coverage of parking lots
The City's 1990 tree policy requires all new developments to provide 50% tree canopy coverage of parking lots at maturity. This policy could be strictly enforced and possibly extended to existing parking lots.

5.5.2 Source Reduction Strategies

Continue to provide assistance to local businesses for source reduction/recycling/buying recycled
Free audits involving source reduction/recycling/buying recycled are available to all businesses and are often combined with water and energy audits. The City is developing a business waste management guide.

Continue to assist residents in reducing addressed junk mail
Junk mail reduction cards are distributed at events and speaking engagements. The cards are addressed to marketing preference organizations that maintain mailing lists.

Consider assisting residents in reducing unaddressed weekly booklets from big chain businesses
Every household receives weekly publications from chain stores like Longs, Kmart, Safeway, and Lucky. The City may be able to assist households that do not want to receive the advertisements.

5.5.3 Reuse Strategies

Continue to promote redistribution of food from private companies
The City recently sent out a brochure on how to donate food to all food-generating businesses.

Continue to promote reusable goods drop-off
There are over 200 specialized reuse/rental/repair retail stores in Berkeley. The Berkeley/Albany Guide to Reuse/Repair/Rental Shops lists all of these businesses. Urban Ore is the largest and most diverse. Their construction yard and store at 6th and Gilman accepts, buys, sells, and trades 2,500 tons per year of construction, office, computer, art and household items that otherwise would have been discarded.

Continue to promote the Berkeley Energy Resource Directory, Alameda Reuse Guide, and the Berkeley/Albany Guide to Reuse/Repair/Rental Shops
These guides include extensive lists of local organization and companies that are involved in energy efficiency, recycling, reuse, and efficient transportation. Consider selling them at checkout counters of environmentally minded businesses for 25 cents.

Continue to promote annual reusable goods free collection
For the past two years as part of the City’s annual bulky goods collection program, the City has sponsored "reusables Friday", where residents can place their reusables out for collection and reuse by Urban Ore.

5.5.4 Recycling Strategies

Continue to expand the commercial/industrial recycling program
The City's Commercial collection program began in 1989. Bottles, cans, newspaper, mixed paper, white office paper, cardboard, and (pilot) plastic bottles are collected from businesses and apartment buildings over 9 units. The program services over 1,800 businesses and large apartment buildings, including businesses that have limited space and who recycle using City carts which take up less space than the front loader bins offered by the private sector. The City also services businesses that need special attention or more complicated accounts such as schools or multi-tenant office buildings. Approximately 2,200 tons per year of commercial waste are collected for recycling from this program. The City is using an in-field marketer and mailings to do intensive outreach to increase participation.

Continue to expand apartment building recycling
Apartment buildings have considerably lower recycling rates than single family. The City is presently doing outreach to building managers and owners to increase recycling participation. Apartment buildings currently possess central containers for their tenants.

Coordinate with Associated Students of University of California Recycling Project (ASUC Recycling) to improve the University of California at Berkeley recycling program
Through the combination of the ASUC and Cogido programs at the University, an estimated 890 tons per year are recovered and recycled. This percentage would increase if ASUC Recycling placed additional recycling bins around the campus and expanded education efforts.

Coordinate with BART on improved newspaper recycling
BART newspaper recycling rates could be dramatically improved by placing recycling bins on station platforms, putting signs on trash cans indicating "Trash only. Please use recycling bins", using commuter video screens to run recycling announcements, and placing further announcements in the BART cars. These efforts would also lead to reduced trash contamination in recycling bins. Newspaper is a valuable commodity and accounts for much of the trash at stations. BART should be able to lower its garbage costs with better newspaper recycling. This effort would be coordinated with other BART issues, such as energy efficient lighting and security.

Continue transfer station recycling
Despite the convenience of recycling in Berkeley, large quantities of recyclable/reusable materials end up in the garbage. Refuse workers salvage over 500 tons/year of scrap metal from the transfer station floor for recycling. Urban Ore has two full time salvagers who retrieve 300 tons per year of usable construction and household items for sale at their retail store. The scalehouse directs clean loads of compost and woodwaste to the compost pile. Future plans call for recovery of wood, soil, rock and concrete from individual haulers.

Continue appliance recycling
The City has a contract with Freon Free to recycle appliances brought to the transfer station, and to collect appliances from the public. ARCA removes hazardous components and CFCs, and recycles or refurbishes the appliance.

Continue oil recycling
The oil recycling program educates citizens to recycle rather than dump their motor oil and provides convenient drop off locations. The City accepts used motor oil from the public at the transfer station. The oil recycling campaign began in November 1996. The program is funded through annual block grants from the California Integrated Waste Management Board.

Continue to promote the Berkeley-Oakland Recycling Market Development Zone
The City participates in the Berkeley-Oakland Recycling Market Development Zone (RMDZ). This project assists Berkeley businesses to use recycled material, and solicits such businesses to locate in Berkeley. Tax breaks are offered as part of the RMDZ. The City contributes 10% of the zone's cost, or approximately $24,000 per year, in addition to staff time.

5.5.5 Composting Strategies

Increase composting of food waste from local food businesses
The City of Berkeley has started a food waste pilot program for restaurants, grocery, and produce stores. The program accepts approximately 10 tons of food per week (everything except meat). Currently, the City collects a limited amount because the program uses either a spare truck or co-mingles the scraps with plant material. The City needs a dedicated route, an additional truck, and two more staff in order to expand collection. With these resources collection could be expanded by approximately a factor of five. The alternative of feeding food waste to livestock is not feasible because there are not enough farms in the vicinity to receive the food waste.

Increase frequency of residential plant debris collection
Residential plant debris collection began in 1989, using retired compactor trucks and 32 gallon brown paper bags. City crews now collect plant trimmings once per month from each single family residence. In October of 1996, 64 and 96 gallon carts were distributed to 15,000 households that requested them. Since 1994 the tonnage collected has more than doubled to 350 tons per month and requires two collection routes per day. In addition, 300 tons per month of plant trimmings and wood are brought to the transfer station by individuals. A contractor hauls the compostable material to Modesto, where it is made into compost and mulch. The City receives back ten percent of the finished compost each month, which is used by community gardens, schools, and City projects. This creates a closed loop recycling system.

The tonnage of residential plant debris diverted is reduced due to infrequent collection. Residents often put plant waste in with their trash because plant debris pickup is done on a monthly basis. The city would need to implement a bi-monthly collection system in order to capture the majority of the yard waste. Such a program would cost an additional $400,000 or $16 per household every year. Another option would be to increase collection during the high production months of April through October if seasonal labor and additional trucks are available. With more frequent collection, it might be possible to include food waste in the residential plant debris collection. Large quantities of plant and clean wood debris can be dropped off at the transfer station at 2nd and Gilman Streets and are accepted at a discounted rate compared to trash disposal.

Continue to promote school composting programs and education
A worm-composting project (funded by a grant from the Alameda County Waste Management Authority) in City schools helps the schools to compost their food waste and teaches children to use this technique at home. The City sends compost to Willard Junior High and six other school pilot programs for use in school gardens.

Continue to educate homeowners how to compost in their backyard and, educate apartment residents how to use worm boxes indoors
Low-cost home composting bins are available from the Alameda County Waste Management Authority. Approximately 5,000 Berkeley households have requested them, giving Berkeley the highest home composting rate in the County. Another possibility is to offer higher end composters, such as tumbling bins, that cost more, but are easier to use and generally produce superior compost with less effort.

5.5.6 Purchasing Policy/Local Government Strategies

Adopt additional waste reduction/recycling policies in local government facilities and further enhance City of Berkeley purchasing policies that reflect environmentally conscious product choices
The city sets an example to the rest of the community with its purchasing policy. Existing policies include purchasing products packaged in recyclable materials, and buying paper products which contain a post-consumer recycled content of at least 25%. Other possibilities include purchasing plastic lumber to replace traditional organic lumber and banning one-use items. The Department of Public Works already provides a variety of recycling programs at City Hall and other city facilities. The next step is to expand source reduction policies such as requiring double-sided copy machines and optimizing the 'paperless office' concept.

Continue to require private companies which win a City of Berkeley contract or grant to use recycled products
The City requires companies that work for Berkeley to do business in an environmentally responsible manner. This requirement conserves resources and shows private companies that being environmentally conscious is a profitable alternative.

Continue to require new construction projects to plan for construction debris recycling
The City requires new construction projects to recycle debris. This approach saves construction companies the cost of disposal, but results in slightly higher labor costs because of material sorting.

Continue to require architects and designers to incorporate recycling areas into the design of buildings
The City requires architects to incorporate space for recycling bins in building designs and design the exterior of the building to allow for recycling aggregation and easy pickup.

5.5.7 Miscellaneous Organics & Recycling Strategies

Sponsor contests for City of Berkeley staff to promote involvement in day-to-day operations
Another possibility for savings resources is to award City of Berkeley staff who identifies and is involved with the largest solid waste dollar savings. Dow Chemical used this approach in its manufacturing facilities with phenomenal success. The staff most involved in the day-to-day operation have excellent ideas on how to save money and resources, once given the incentive and means to bring forth their ideas. The contest could be combined with the transportation and energy waste contests.

6.0 Transportation Implementation Plans

Implementation plans are provided for the following transportation actions:

- Unlimited BART pass
- Offer free vanpool parking
- Bicycle boulevards
- Additional bicycle freeway overpass

6.1 Unlimited BART pass

Description: An unlimited monthly Bay Area Rapid Transit (BART) pass would encourage Bay Area residents to ride BART when the destination is close to a BART station. The pass might need to be priced based on zones traveled to ensure that BART revenues are maintained. Most of the additional ridership would probably be for errands or entertainment and thus would come when trains are mostly empty in the off hours. Employers could buy the passes for their employees as a benefit and claim part of it as a business expense. Such a pass would encourage commuters to use BART for both work and non-work related transit. Additionally, congestion and air pollution would be reduced as more people use BART.

Lead Agency: To be determined

Timeframe: Two years

Implementation: A lead agency would work with BART and other local groups involved in transportation to set up an unlimited, monthly BART pass to encourage use of BART for errands and commuting.

Reduction in Resource Use: BART currently carries 250,000 riders per day. Assuming an extra 10,000 riders per day (4% increase) and 10 miles per trip, vehicle miles traveled (VMTs) would be reduced by 36,500,000 annually. Assuming 0.38 kg CO_2/VMT (solo travel @23 mpg), carbon dioxide is reduced by 14,000 metric tonnes annually.

First Cost: $5,000 (based on 0.1 FTE for one year).

Annual Cost: See first cost.

Funding Source: To be determined.

Annual Dollar Savings: Assuming VMTs are reduced by 36,500,000 annually and using the Internal Revenue Service expense figure of $0.30/mile, savings to drivers are $11 million per year.

6.2 Free Vanpool Parking

Description: Free van pool parking in convenient locations would encourage vanpools and free up additional parking spaces for shoppers. There is currently a 50% discount for car/van pools at the City's Center St. Garage. (Car pools are three or more drivers.) No comparable discount exists at Sather Gate. Implementation of a discount at Sather Gate and in selected street parking locations would encourage ride sharing. Any spots not taken by van pools could be open to the general public after 9 AM.

Lead Agency: To be determined

Timeframe: One year

Implementation: Staff would determine appropriate locations for free vanpool parking and coordinate marketing efforts for use of the spots.

Reduction in Resource Use: Assuming an additional 12 vanpools per day, 8 people per van, 70 miles per person in avoided driving, and 200 business days per year, annual vehicle miles traveled (VMTs) would be reduced by 1,350,000. Assuming 0.38 kg CO_2/VMT (solo travel @23 mpg), carbon dioxide is reduced by 500 metric tonnes annually.

First Cost: Cost is staff time from division that takes the lead on this initiative.

Annual Cost: See first cost. Some lost revenues may result from reduced fees, though there may more turnover (and hence revenue) if single commuter spaces are turning over during the day.

Funding Source: Funding from division that takes the lead on this initiative.

Annual Dollar Savings: Assuming VMTs are reduced by 1,350,000 annually and using the Internal Revenue Service expense figure of $0.30/mile, savings to drivers who use the vanpool service are $400,000 per year minus the vanpool cost.

6.3 Bicycle Boulevards

Description: Bicycle boulevards are streets where the needs of cyclists are preferentially met, even if cars are inconvenienced. Most streets throughout the City would remain the way they are (oriented to automobiles), but a few streets would offer bicycles preferential treatment. The City Council has designated five strategically located North-South and East-West streets as bicycle boulevards. When improvements are made, bicycle boulevards will increase bicycle ridership and bicycle traffic will concentrate on those routes, further increasing safety.

Lead Agency: Advance Planning

Timeframe: Two years

Implementation: Advance Planning would work with the various interests in the community to gather input and design bicycle boulevards. Improvements would then be made to facilitate bike use on these streets.

Reduction in Resource Use: Assuming 1,000 more bicycle trips per day, 5 miles per trip, vehicle miles traveled (VMTs) would be reduced by 1,825,000 annually. Assuming 0.38 kg CO_2/VMT (solo travel @23 mpg), carbon dioxide is reduced by 1,000 metric tonnes annually.

First Cost: The consultant plan for design will cost approximately $40,000. Depending on the recommended design, implementation costs will vary, but improvements are anticipated to cost up to $750,000 to implement.

Annual Cost: An additional $30,000 per year for maintenance of improvements.

Funding Source: City funds and grants.

Annual Dollar Savings: Assuming VMTs are reduced by 1,825,000 annually and using the Internal Revenue Service expense figure of $0.30/mile, savings to drivers are $550,000 per year.

6.4 Additional Freeway Overpass for Bicycles

Description: A bike friendly route over Interstate 80 is particularly important now that the funding for the East Bay Shoreline Park has been approved and there will be bike paths along nine miles of shoreline. This bike path will be used both for pure recreation and shopping and commuting. Funding has been allocated for an overpass near University Avenue. Additional bicycle bridges back to City streets around Ashby and Gilman would provide important links between the shoreline bike path and other commercial centers. Additional funding is needed for these multiple crossover points. The bicycle/pedestrian bridges cost approximately $3 million.

Lead Agency: Advance Planning

Timeframe: Five to ten years

Implementation: Advance Planning would work with the bicycling community to determine the best location for additional overpasses.

Reduction in Resource Use: Assuming 150 more bicycle trips per day, 5 miles per trip, vehicle miles traveled (VMTs) would be reduced by 275,000 annually. Assuming 0.38 kg CO_2/VMT (solo travel @23 mpg), carbon dioxide is reduced by 100 metric tonnes annually.

First Cost: The bicycle/pedestrian bridges cost approximately $3 million each.

Annual Cost: See first cost.

Funding Source: Grants

Annual Dollar Savings: Assuming VMTs are reduced by 275,000 annually and using the Internal Revenue Service expense figure of $0.30/mile, savings to drivers are $80,000 per year.

7.0 Building/Municipal Energy Implementation Plans

Implementation plans are provided for the following building/municipal energy actions:

- Retrofit of Light Emitting Diode (LED) traffic lights
- Retrofit of Berkeley Unified School District properties
- Commercial Technical Assistance Program
- New construction/renovation design review for municipal buildings

7.1 Retrofit of red incandescent traffic light and pedestrian walk signals with light emitting diode (LED) technologies

Description: Light emitting diode (LED) traffic lights are an alternative to standard incandescent technology. LEDs use less than one quarter of the energy of an incandescent. In addition, LEDs last approximately ten years versus one year for an incandescent and so another big advantage of LEDs is reduced maintenance. LEDs also reduce emergency relampings done at overtime labor rates because they come with independent strings of diodes and if one string fails there are another five to ten still functioning.

Red LEDs are a common retrofit. Other color signals are not commonly retrofitted. Green LEDs have brightness issues that are being worked out and are more expensive than red LEDs. Yellow LEDs are more expensive than red LEDs and don't have enough operating hours to justify themselves on a stand alone basis, though the biggest maintenance savings occur if all the whole signal (all three colors) is converted to LEDs. ReEnergize is currently conducting an LED traffic light retrofit feasibility study and investigating whether it is feasible to replace red, greens, and yellows.

Many cities have implemented this technology. Local cities that have installed red LEDs include Antioch, Davis, and San Jose. PG&E has just started offering rebates for red LEDs and orange pedestrian crossing signals under its Retrofit Efficiency Options program. Financial incentives are also available through PG&E's Power Savings Partners program, which involves contracting with ESCOs.

Lead Agency: Energy Office in conjunction with Public Works

Timeframe: Pilot in first year, followed by full implementation in five years.

Implementation: Public Works would install LED retrofits.

Reduction in Resource Use:
The City of Berkeley has approximately 1,100 red signal lights, including 800 eight-inch and 300 twelve-inch diameter lens. There are approximately 800 ped heads incorporating both orange and white colors.

Based on current traffic control use of 880,000 kWh per year and 64% savings from retrofitting red traffic control lights and pedestrian walk signals, annual savings are 563,000 kWh or approximately $56,000 per year at current energy prices.

Wattages for the common types of traffic signals are shown below.

Signal Type	Incande-scent Wattage	LED Wattage	Duty Cycle	Peak Load kW Savings	Annual Base kWh	Annual LED kWh	Percent Savings	Annual kWh Savings
12” Red Ball	150	22	60%	0.077	788	116	85%	673
8” Red Ball	69	12	60%	0.034	363	63	83%	300
12” Red Arrow	150	10	75%	0.105	986	66	93%	920
Orange Walk	69	10	90%	0.053	544	79	86%	465

Savings of approximately 563,000 kWh per year translate into 323 metric tonnes of carbon dioxide.

First Cost: Assuming a retrofit cost (material and labor) of $170/ traffic light for 800 eight-inch red lights, $240 each for 300 twelve-inch red lights, and $160/pedestrian control light for 800 lights, the project would cost $336,000. These costs do not include maintenance savings from using longer lived lamps or avoided incandescent lamp costs. Lease purchase financing can be arranged at tax exempt rates. Costs are dropping rapidly for this technology and are likely to be lower than those stated above by the time project implementation occurs.

Annual Cost: Lease payments on $336,000. With a seven year lease at 6.25%, lease payments would be $60,000 per year. Lamp life is likely to be more than seven years and the lease payment costs do not include the other benefits discussed above.

Funding Source: Lease purchase financing.

Annual Dollar Savings: Approximately $56,000 at current energy prices.

7.2 Retrofit of Existing Berkeley Unified School District (BUSD) Properties

Description: For buildings undergoing seismic rehabilitation, BUSD has set a goal to exceed the efficiency of Title 24 building standards by 40%. BUSD is not actively retrofitting the other 300,000-400,000 square feet that are not being rehabbed or its administrative facilities. The goal is implement retrofits in these facilities as well, in order to realize all cost-effective energy saving projects in BUSD. The cornerstone of each project will be a lighting retrofit.

Lead Agency: Energy Office in conjunction with Berkeley Unified School District and ReEnergize

Timeframe: Three years

Implementation: ReEnergize will work with Berkeley Unified School District staff. ReEnergize will audit the facilities and put together bid packages for the district.

Reduction in Resource Use: Assuming 350,000 square feet of eligible floorspace, energy bills of approximately $1.00/ft^2, and 15% savings, BUSD's energy bill would be reduced by approximately 525,000 kWh per year, which translates into 150 metric tonnes of carbon dioxide.

First Cost: Assuming a lighting retrofit cost of 1.00/ ft^2, the projects would cost $350,000. However, this can be arranged as lease purchase financing at tax exempt rates.

Annual Cost: Lease payments on $350,000. With a seven year lease at 6.25%, lease payments would be $62,000 per year. With a ten year lease at 6.25%, lease payments would be $47,000 per year.

Funding Source: Lease purchase financing.

Annual Dollar Savings: Approximately $52,500 at current energy prices.

7.3 Commercial Technical Assistance Program

Description: The goal of the City of Berkeley's Commercial Technical Assistance Program (CTAP) is to increase the market penetration of energy efficiency in the small commercial sector. Traditionally, small businesses have not implemented energy efficiency projects. Under the CTAP program, all services other than installation are carried out by ReEnergize. The goal for 1997 is 5-10 copaying customers (under 3,000 square feet) and 5-10 facilities over 3,000 square feet.

Lead Agency: Energy Office and ReEnergize

Timeframe: In progress

Implementation: ReEnergize is implementing the City of Berkeley's Commercial Technical Assistance Program (CTAP), which is funded by the City of Berkeley and Department of Energy. The initial target geographic area is downtown Berkeley (Shattuck Ave). ReEnergize is auditing small commercial customers at no charge. ReEnergize then prepares a proposal with a lump sum cost for materials, labor, project management, and followup. Customers with facilities under 3,000 square feet pay half of the equipment installation cost. Larger customers pay the entire cost. Independent contractors carry out the installations.

Reduction in Resource Use: Assuming 25 new participants per year, average facility size of 15,000 square feet, energy intensity of 20 kWh/ft^2-yr, and 15% savings, new CTAP participants will save 1,125,000 kWh year. Savings will be lower in the first year, but should ramp up to and possibly exceed this level. By the year 2010 (year 14), assuming that 30% savings degradation occurs (primarily due to store turnover), cumulative savings will be 11,000,000 kWh per year, which translates into approximately 3,150 metric tonnes of CO_2.

First Cost: The cost to the City is anticipated to be $15,000 per year. The rest of the cost is paid by customers and for the pilot period by the Department of Energy.

Annual Cost: See First Cost.

Funding Source: Retrofits and upfront engineering work will be predominantly customer funded.

Annual Dollar Savings: Ramping up to approximately $84,000 (at current energy prices) in year 2010.

7.4 New Construction/Renovation Design Review for Municipal Buildings

Description: The City of Berkeley does very little new construction, but has gut rehab projects planned, including 2180 Milvia Street. Gut rehabs represent an opportunity to "tunnel through the cost barrier" by optimizing interaction of multiple systems (e.g., lighting, shell, and heating, ventilating, and air conditioning (HVAC)). Many measures that would not be cost-effective by themselves may become cost-effective when packaged together. Building shell, lighting, and HVAC systems all interact. Improved insulation and window film can avoid the need for space conditioning in some cases or permit a smaller unit with lower capital cost.

Lead Agency: Energy Office in conjunction with ReEnergize and PG&E

Timeframe: Immediate

Implementation: The Energy Office would coordinate design review by ReEnergize and/or PG&E.

Reduction in Resource Use: Assuming 300,000 ft^2 reviewed by the year 2010, 15 kWh/ft^2-yr base consumption, and 15% savings, annual savings are 675,000 kWh/year by the year 2010 or 385 metric tonnes of carbon dioxide.

First Cost: See Annual Cost

Annual Cost: $7,500 of staff time for Energy Officer

Funding Source: Energy Office and customer funding

Annual Dollar Savings: Assuming current electricity prices of approximately $0.10/kWh, annual dollar savings ramp up to $67,500 in the year 2010.

8.0 Organics and Recycling Implementation Plans

Implementation plans are provided for the following organics and recycling actions:

- Increasing frequency of residential plant debris collection
- Expanding business food composting program
- Increasing participation in Commercial Paper Recycling Program
- Increasing demolition and construction on-site recycling
- Recycling additional wood from transfer station floor
- Tree planting in City Parks
- Tree planting on Berkeley Unified School District (BUSD) school grounds

8.1 Increased frequency of residential plant debris collection

Description: City crews now collect plant trimmings once per month from each single family residence. The tonnage of residential plant debris diverted is reduced due to infrequent collection. Residents often put plant waste in with their trash because plant debris pickup is done on a monthly basis. The city would need to implement a bi-monthly collection system in order to capture the majority of the yard waste. With more frequent collection, it might be possible to include food waste in the residential plant debris collection.

Lead Agency: Recycling

Timeframe: 2 years

Implementation: The City would need to add additional trucks and staff to move from monthly to bi-weekly residential plant debris collection.

Reduction in Resource Use: More frequent collection would increase the tonnage of residential plant debris collected for composting by 2,200 metric tonnes (2,400 tons) per year. Assuming savings of 1.95 metric tonnes CO_2 per metric tonne of organic material, this program would reduce methane equivalent to 4,300 metric tonnes of CO_2 per year.

First Cost: $400,000 or $16 per household per year.

Annual Cost: See First Cost

Funding Source: Garbage bill

Annual Dollar Savings: Disposing of green waste is $15/ton cheaper than landfilling. Therefore, annual savings are $36,000.

8.2 Expansion of business food composting program

Description: The City of Berkeley started a food waste pilot program for restaurants, and grocery and produce stores. The program accepts approximately 10 tons of food per week (everything except meat). Collection is limited because of equipment and staff resources.

Lead Agency: Recycling

Timeframe: 3 years

Implementation: The City needs a dedicated route, an additional truck, and two more staff in order to expand collection. With these resources collection could be expanded by approximately a factor of five.

Reduction in Resource Use: More frequent collection would increase the tonnage of food waste collected for composting by 2,300 metric tonnes (2,500 tons) per year. Assuming savings of 1.95 metric tonnes CO_2 per metric tonne of organic material, this program would reduce methane equivalent to approximately 4,500 metric tonnes of CO_2 per year.

First Cost: $134,000. The Alameda County Waste Management Authority has provided a $75,000 grant for a dedicated truck. Therefore, first year costs are equal to annual operating costs. Annual operating costs include two staff ($104,000 for salary and benefits) and $30,000 per year for fuel and maintenance.

Annual Cost: $134,000.

Funding Source: Garbage bill

Annual Dollar Savings: Disposing of food waste is $15/ton cheaper than landfilling. Therefore, annual savings are $37,500.

8.3 Increasing Participation in Commercial Paper Recycling Program

Description: The City's Commercial collection program services over 1,800 businesses. Approximately 2,200 tons per year of commercial waste are collected for recycling from this program. The City is using an in-field marketer and mailings to do intensive outreach to increase participation, but needs more funding to expand its routes and increase outreach for mixed paper and cardboard.

Lead Agency: Recycling

Timeframe: 2 years

Implementation: The City would use an in-field marketer and mailings to do intensive outreach to increase participation. Additionally, the City would create a new mixed paper recycling route to handle the increased volume of material.

Reduction in Resource Use: Additional outreach efforts using 1/3 FTE would increase the tonnage of paper by approximately 680 metric tonnes (750 tons) per year. Assuming savings of 1.95 metric tonnes CO_2 per metric tonne of organic material, this program would reduce CO_2 by approximately 1,330 metric tonnes per year.

First Cost: $15,000 per year for outreach. This would cover slightly more than 1/3 FTE for outreach efforts. $110,000 for an additional refuse crew to collect materials.

Annual Cost: $125,000.

Funding Source: Garbage bill

Annual Dollar Savings: Savings are $20/ton over landfilling. Therefore, annual savings are $15,000.

8.4 Increasing Construction and Demolition On-Site Recycling

Description: The City requires new construction and renovation projects to recycle debris. This approach saves construction companies the cost of disposal, but results in slightly higher labor costs because of material sorting. Additional effort by City staff is required to work with contractors on how to properly sort materials to facilitate recycling.

Lead Agency: Recycling

Timeframe: 2 years

Implementation: The City needs additional outreach staff to work on-site with contractors.

Reduction in Resource Use: Additional outreach efforts using 1/3 FTE would increase the tonnage of construction debris that is recycled by approximately 450 metric tonnes (500 tons) per year. Assuming savings of 1.95 metric tonnes CO_2 per metric tonne of organic material, this program would reduce methane equivalent to approximately 890 metric tonnes of CO_2 tons per year.

First Cost: $20,000. This would cover slightly more than 1/3 FTE for outreach efforts.

Annual Cost: $20,000.

Funding Source: Garbage bill

Annual Dollar Savings: Disposing of construction waste is approximately $15/ton cheaper than landfilling. Therefore, annual savings to contractors are $7,500. There are no direct cost savings to the City.

8.5 Recycling Additional Wood from Transfer Station Floor

Description: Large quantities of materials are pulled from the transfer station floor. Refuse workers salvage over 500 tons/year of scrap metals from the transfer station floor for recycling. Urban Ore has two full time salvagers who retrieve 300 tons per year of usable construction and household items for sale at their retail store. The scalehouse directs clean loads of compost and woodwaste to the compost pile. With additional resources, substantial quantities of wood that are mixed in with other debris could be pulled from the transfer station floor.

Lead Agency: Recycling

Timeframe: 2 years

Implementation: A dedicated half time FTE would be needed to pull wood from the transfer station floor in loads where green waste is mixed in with other materials.

Reduction in Resource Use: Approximately 910 metric tonnes (1,000 tons) of wood waste could be recovered each year with this level of effort. Assuming savings of 1.95 metric tonnes CO_2 per metric tonne of organic material, this program would reduce methane equivalent to approximately 1,770metric tonnes of CO_2 tons per year.

First Cost: $80,000 for equipment to efficiently move wood into recycling area.

Annual Cost: $42,000 per year. $27,000 for 0.5 FTE ($16,000 for salary and $11,000 for indirect costs) plus $15,000 for equipment maintenance.

Funding Source: Garbage bill

Annual Dollar Savings: Disposing of wood waste is $15/ton cheaper than landfilling. Therefore, annual savings are $15,000.

8.6 *Tree Planting in City Parks*

Description: Many City parks could use more trees. This project would identify appropriate locations and get the trees planted.

Lead Agency: Forestry

Timeframe: 5 years

Implementation: Each park has a crew assigned to maintain that property. The Forestry Department would solicit tree planting proposals for each park from the maintenance crews. Workloads would then be adjusted or additional assistance sought from neighborhood groups so that the additional trees could be planted and maintained.

Reduction in Resource Use: The average amount of carbon dioxide sequestered annually by each tree is approximately 14.7 kilograms. Assuming an additional 500 trees are planted, this would reduce atmospheric CO_2 by 3.7 metric tonnes per year.

First Cost: Assuming a tree planting cost of $120 (tree plus site inspection, tree delivery, checking for utilities, and labor for planting), the first cost is $60,000. Maintenance of these trees would come out of existing budgets.

Annual Cost: See First Cost

Funding Source: Forestry Department

Annual Dollar Savings: Not applicable

8.7 Tree Planting on Berkeley Unified School District (BUSD) School Grounds

Description: Many school grounds have few or no trees. This project would identify appropriate locations on school sites and get the trees planted.

Lead Agency: Forestry in conjunction with Berkeley Unified School District (BUSD) staff

Timeframe: 5 years

Implementation: The Forestry staff would work with BUSD maintenance staff to identify tree planting opportunities on school grounds. Trees would be planted by students and teachers or community volunteers so as not to increase workloads of BUSD staff. Compost for tree planting would be provided by City Recycling staff.

Reduction in Resource Use: The average amount of carbon dioxide sequestered annually by each tree is approximately 14.7 kilograms. Assuming an additional 250 trees are planted, this would reduce atmospheric CO_2 by 1.8 metric tonnes per year.

First Cost: Assuming a tree planting cost of $100 (tree plus site inspection, tree delivery, and checking for utilities), the first cost is $25,000. Maintenance of these trees would come out of existing budgets.

Annual Cost: See First Cost

Funding Source: Forestry Department/BUSD

Annual Dollar Savings: Not applicable

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