City of Irvine Energy Plan

FINAL

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Executive Summary

The City of Irvine has a long tradition of environmental stewardship and planning for the future. It has taken many bold steps in its 36-year history to preserve the quality of life through setting aside open space, protecting the environment, and developing or participating in programs to conserve energy. It has also consistently planned for the future through installing reclaimed water systems to conserve potable water and enforcing development standards for fire protection such as fire resistant landscaping and building features that help prevent the spread of fire. Sustainability, smart growth, green building, conservation, and recycling have all become increasingly important issues for local governments. Irvine stands at the forefront of many of the environmental programs and policies being developed to address these issues, including the creation of this Energy Plan for the City.

The Energy Plan began with the Planning Commission's request to City Council to implement the policies of the Energy Element of the General Plan. In September 2005, City Council directed two Planning Commissioners to work with staff to develop energy standards and policies to guide the City in achieving its long-term objectives to be a leader in energy efficiency, the use of renewable energy, and reducing carbon emissions. The Energy Plan serves as the first step in tackling these objectives by presenting the current energy situation, defining goals, listing the next steps to be taken, and presenting strategies and policies to meet the goals.

The Energy Plan consists of eight sections. The first section presents an introduction to the Energy Plan's development as well as provides an overview of global climate change, including the need for adaptability and carbon emission reductions, and the significant role that energy plays when discussing dealing with global climate change and its affects.

Sections 2 and 3 assess municipal and citywide energy use, respectively. When comparing the two, it becomes apparent that the municipal facilities and fleet represent very little of the overall energy consumed in Irvine. In fact, the City of Irvine municipal buildings consume less than 1/10 of one percent of the total energy consumed by buildings within City of Irvine boundaries. A breakdown of the total energy consumed within Irvine is approximately 40 percent electricity, 34 percent natural gas, and 26 percent gasoline. Of the electricity consumed, 72 percent is consumed by small-to-medium-sized businesses (i.e., small to medium manufacturing and processing firms, retail businesses, churches, service stations, schools, and restaurants), 16 percent is consumed by residential and 10 percent by large commercial and industrial.

Section 4 describes energy plans at the federal, state and local level, and describes which goals are being set by other California government agencies, the state of California, and the US Conference of Mayors. This helps set the

stage for the Energy Plan goals for the City of Irvine. The rapidly growing concerns about reducing climate changing emissions, the majority of which are associated with the generation and use of energy in buildings and in transportation, are a major influence on the development of both California's and the Conference of Mayors' energy goals.

The driving force for the State of California is Assembly Bill 32 (AB 32) which was signed by the Governor in 2006. AB 32, known as *The Global Warming Solutions Act*, sets a goal for carbon emissions to be reduced to 1990 levels by year 2020. The implementation actions for AB 32 have not yet occurred, but the state agencies that can affect AB 32 goals best--the California Energy Commission, the Attorney General's Office, and the California Air Resources Board--are currently conducting public meetings to help determine what those actions will be.

Section 5 sets out four goals for the City of Irvine. In keeping with Irvine's history of leadership, the intent of the goals is to match or exceed the State's energy and emissions reduction goals for California. The year 2020 timeframe for the goals was designed to align with that of the State of California.

- The first goal of the Plan is to involve 100 percent of Irvine residents and businesses in reducing energy consumption and thus, reduce carbon emissions. Ensuring widespread participation will require that all sectors of the community are well-informed about energy issues and enabled to take action to change their day-to-day energy use practices.

- The second goal is to increase the energy efficiency in buildings to reduce building energy use to 30 percent by the year 2015. Existing buildings present a major challenge and cannot be ignored since they already represent a very high percentage of the building stock in Irvine, and will continue to consume energy for years to come.

- The third goal is to transition new buildings Citywide to renewable energy. This can be done directly with solar panels, solar water heating and small wind turbines. It will also be occurring, indirectly, as Southern California Edison moves to produce more of its electricity using renewable resources per California Public Utility Commission mandates. Together, the goal for renewable energy use by new buildings is achievable.

- The fourth goal is to reduce greenhouse gas emissions Citywide to 1990 levels by 2020, in accordance with AB 32. Achievements in the previous three goals will contribute greatly to this goal. There will also likely be measures mandated statewide. Achieving this goal will demonstrate the City of Irvine's leadership by reducing emissions within its own boundaries to meet the state's goal.

Successful implementation of all these goals will require that they be fully

supported politically and by community and business leaders. The goals will need to become fully integrated into the day-to-day activities within city governments, businesses, and homes.

Section 6 discusses the steps the City should take once it adopts the Energy Plan goals. For example, the City should establish an Energy Management Team to provide guidance and direction on project implementation. The team should have City staff at its core and include, as appropriate to the strategy, members of the community, such as Irvine Unified School District, University of California, Irvine, Chamber of Commerce, The Irvine Company, etc.

Sections 7 and 8 list strategies that can be employed separately and in combination to achieve the goals listed above. Section 7 addresses strategies for municipal facilities and fleet; Section 8 addresses strategies Citywide. The highest priority for the City will be to implement the strategies for its own facilities, operations, and fleet prior to encouraging the community to do the same.

No single strategy will achieve the ambitious energy and emissions reduction goals set forth in this Plan; instead, a wide range of strategies will have to be employed in order to meet the Energy Plan goals within the proposed timeframes.

Included in the Energy Plan are three appendices. Appendix A provides more in-depth information on Irvine's energy use patterns, Appendix B provides an overview of current and anticipated developments in low carbon energy technologies, and Appendix C provides resources for additional information.

SECTION 1 – INTRODUCTION

In recent decades the earth's average temperature has been rising. Recognizing that this warming could have severe consequences for the natural environment, the economy, and public health within several decades, 141 countries codified the Kyoto Treaty in February 2005, the international agreement to address climate change. In a February 2007 report, the Intergovernmental Panel on Climate Change (IPCC) stated that the main cause of this warming has been determined, with greater than 90 percent accuracy, to be the emissions of greenhouse gases (GHGs) from human activities[1].

The same year 141 countries were codifying the Kyoto Treaty, the US Conference of Mayors created the US Mayors Climate Protection Agreement to demonstrate the leadership and commitment of mayors around the country. The Mayor of Irvine, Beth Krom, signed the Agreement in April 2005 and it was endorsed by mayors from around the country through a resolution in June 2005.

In September 2006, California's governor signed into law Assembly Bill 32 (AB 32), the "Global Warming Solutions Act of 2006." State officials are aware that the impacts of climate change in California are likely to be many and varied, and will affect all sectors of the economy. For example, higher average temperatures are likely to lead to more air-conditioning use, which will lead to an increased demand for energy, and as a result, new power plants will need to be constructed. Inevitably, this may mean higher energy costs in order to pay for those additional power plants.

Reduced snow pack [2] from higher temperatures will result in reduced hydro-electric generation and add to the state's need for additional electricity generation. This will also obviously have a major influence on the state's water management practices. In addition, a range of other non-energy impacts are anticipated, including impacts on agriculture, fisheries, and wildlife; increased likelihood of forest fires; damage to buildings and infrastructure, especially low-lying roads, bridges, levees, sewage treatment plants, etc; increases in insect-borne diseases; and impacts on those least able to adapt, including the elderly, infirm, and the very young.

The reaction to climate change should be twofold. First, to prepare and adapt to the myriad of impacts brought on by climate change, and second, to reduce the GHG emissions that are likely contributing to climate change. Because of its geographic location, the adaptation strategies for Irvine will include addressing water shortages, increased wildfires, and changes to flora and fauna. Together that will create imbalances in the natural environment that will make it difficult to

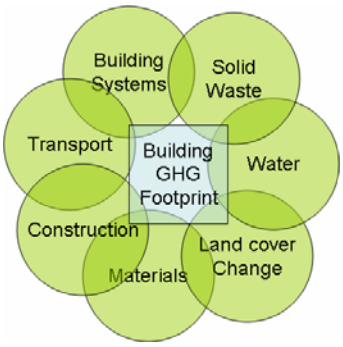
[1] The Intergovernmental Panel on Climate Change was created in 1988 by the United Nations Environmental Programme and the World Meteorological Society to study the causes of climate change.
[2] Some estimates of the possible decline in California snow pack run as high as 70 percent reduction over the next 100 years according to California EPA..

predict exactly how that will affect the health and safety of the community. Reducing GHG emissions by increasing energy efficiency and diversifying to renewable energy resources will also help the community to conserve monetary resources and adapt to an increasingly expensive carbon fuel based economy.

AB 32 formally commits the state to reduce its GHG emissions to 1990 levels by 2020 through an enforceable statewide emissions cap. A major influence on the development of State [3] and other energy goals is the direct correlation between climate-changing GHG emissions and the generation and use of energy, either in buildings or in transportation.

A community, such as the City of Irvine, is a nexus of multiple GHG emission sources including:

- Buildings (air-conditioning, heating, equipment)
- Transportation (direct and indirect emissions)
- Street and exterior lighting (electricity use)
- Water use (embodied energy)
- Landscaping (water and maintenance)
- Solid waste (embodied energy)
- Construction materials (embodied energy)
- Land use/land cover change (sequestration)



[3] Refer to, for example, the "California Climate Action Team Report to Governor Schwarzenegger and the California Legislature" issued by California Environmental Protection Agency, (EPA) March 2006.

1.1 – City of Irvine's Efforts

The objectives of creating this Energy Plan are to eliminate energy waste, improve the efficiency with which energy is used, encourage the use of renewable energy, such as the sun and wind, and increase awareness of energy issues in Irvine. Defined energy goals at a local level will provide City decision makers and the community with a clear direction for Irvine's energy management efforts. Goals also provide milestones against which the City's efforts can be evaluated.

The Energy Plan will serve as a road map for integrating comprehensive alternative strategies into the community in ways that make economic sense and help the City in adapting to the changing climate. The plan will take into account the relevant incentive programs and technological resources of the local utilities and other public agencies. The plan presents strategies and provides a starting point for pursuing funding opportunities from outside groups, such as utility companies, the State, and/or the Federal Government. The Energy Plan could also serve as the starting point for a cohesive energy program, which would include implementation elements such as inspection, education, measurement, monitoring, and verification.

Many aspects of the current energy systems in Irvine and elsewhere are not sustainable over the long term. They are dependent upon non-renewable resources drawn from the natural environment and once consumed, they are gone forever. In contrast, sustainable systems draw, from the environment, only those resources that are necessary and that can be used perpetually, or that can be recycled back into the environment in a form that nature can use to generate more resources. As resources such as water and crude oil become scarcer, communities will suffer, unless they consciously move to a more sustainable economy.

The City of Irvine has already taken proactive steps to address energy issues and adaptability through a number of programs and policies, including the Irvine Redevelopment Agency's Plan to develop a sustainable community in the Orange County Great Park Redevelopment Project Area, the creation of a "Green Team" to address collaboration in achieving sustainability in the Great Park and the Great Park Neighborhoods, regulations in the City's Zoning and Building Code that address wildfire protection, the City's adoption of a voluntary green building program in 2006, the City's aggressive recycling efforts culminating in the adoption of a Zero Waste Ordinance in 2007, and the distribution of 60,000 compact fluorescent light bulbs to the community to, both, reduce energy use and GHG emissions, and to educate people on these issues.

The City's earliest efforts at energy efficiency and sustainability can be traced back to the early 1990s, when it began its association with John Phillips and his non-profit organization called The Energy Coalition (formerly The California

Energy Coalition). Through The Energy Coalition's Aspen Accord, early partnerships were forged among the utilities, Southern California Edison and The Gas Company, and the City. These partnerships resulted in energy savings projects for the City, the creation of the PEAK energy efficiency education program in Irvine schools, and have evolved into the current Community Energy Partnership.

The seeds of change were being planted in the City's General Plan around the same time. During an update of the General Plan, the Land Use, Transportation, and Waste Management Elements were enhanced to include objectives that embraced sustainable concepts. Additionally, the City added an Energy Element to the General Plan and the Sustainability Landscaping Guideline Manual was published. This Energy Plan is a direct result of the City's Energy Element. It was a request by the City's Planning Commission to the City Council to implement the policies contained in the General Plan's Energy Element. This resulted in the City Council's decision in September 2005 to direct staff to prepare this Energy Plan.

1.2 – The Process

In late January 2007, a request for proposals was issued for a consultant to assist in preparing an energy plan for the City that will guide it in achieving its long-term objective of being a leader on energy efficiency, the use of renewables, and carbon emissions reductions. Specifically, the consultant was to be responsible for delivering a draft Energy Plan that characterizes current energy use, presents long-term goals for the City's consideration, and proposes strategies for achieving the goals. Once the Plan was adopted, the consultant was to assist in defining metrics and methodologies to monitor progress.

HDR/Brown Vence & Associates (HDR/BVA) was hired in early March 2007 to work on the Energy Plan. The first step was to gather the energy use data from the utility companies and compile it in an easy to read format. This Plan details current energy use for City-owned and leased facilities, vehicles, and equipment. It also details current energy use citywide for residential, commercial, institutional, and other governmental facilities.

A Technical Working Group was formed to provide ideas and feedback on the development of the Energy Plan. The Technical Working Group is composed of representatives of the Irvine Planning Commission, City staff, Irvine Chamber of Commerce, University of California, Irvine, the local utilities, and local experts in sustainability and energy issues. After reviewing goals set by other local agencies, the State of California, the US Conference of Mayors, and the International Council for Local Government Initiatives (ICLEI), this Plan lays out proposed goals for the City of Irvine.

Once the City Council has approved the Energy Plan, staff can move forward with developing proposed programs and budgets to bring back to the City Council for its approval.

1.3 – The General Approach

There is no single approach available to meet the goals outlined in The Energy Plan; instead, a wide range of strategies will have to be employed. The first step is to greatly improve the efficiency with which energy is being used both in buildings and for transportation. For buildings and other facilities, improved efficiency must then be followed by a transition from energy produced from fossil fuels, over to renewable energy resources such as solar and wind. The renewable energy will likely be a combination of on-site generated energy with off-site generated energy in order to fully support facility operations.

For transportation, reduced dependency on cars, more efficient vehicles, alternative fuel vehicles, and much greater use of transportation alternatives such as mass transit (e.g., rail, shuttle systems, and buses), car and van pools, bicycling, and walking, will be necessary.

Many of the strategies recommended reducing energy and greenhouse gas emissions have initial costs associated with them, but there will also be economic benefits. A 2006 study at University of California, Berkeley on economic growth and greenhouse gas mitigation found that reducing CO_2 emissions to 1990 levels by 2020 would result in $74 billion being added into the state's economy.[4] Similarly, a study for the United Kingdom Treasury on the global impacts of climate change, found that climate change was likely to reduce global gross domestic product (GDP) by about 5 to 20 percent each year over the coming decades. Mitigating the most serious impacts of climate change will cost only about 1 percent of global GDP each year.[5] Closer to home, a study for Santa Barbara County, using a scenario in which the county produced the equivalent of 100 percent of its energy needs from a mix of renewable resources and energy efficiency, found that the county would save $418 million annually or about $830 per resident each year by 2020 and $3,015 each year by 2030[6].

For business owners reducing energy use, reusing materials, whenever possible, and conserving resources will be cost-savings strategies. Replacing fossil fuels with renewable alternatives will have an initial cost, but will save money over the long term. As power becomes more decentralized in the form of solar panels, fuel cells, and wind energy, businesses will also be able to increase the reliability of their power supply. This will become an especially important economic adaptation as fossil fuels become scarcer, and supply becomes more intermittent causing disruptions in service.

1.3.1 *Reducing Building Energy Use*

To reduce energy use and emissions from both existing and new buildings and to

[4] David Roland-Holst, U.C. Berkeley. "Economic Growth and Greenhouse Gas Mitigation in California." August 2006

[5] Sir Nicholas Stern, former chief economist of the World Bank, Head of the U.K. Government Economics Service and Adviser to the Government on the economics of climate change and development, London, UK "Stern Review Report on the Economics of Climate Change", October 30, 2006

[6] Santa Barbara Community Environmental Council, "A New Energy Direction: A Blueprint for Santa Barbara County", October 2007

move homes, schools, and other public buildings toward passive survivability[7], there are several broad sets of actions that will need to be taken.

The first and most important step is to get the fundamentals correct. For example, passive heating and cooling, correct building orientation, color and choice of materials, the use of day lighting and building integrated shading, together with natural ventilation, will all help to reduce energy use and increase the passive survivability of buildings with minimal maintenance costs.

Once the fundamental strategies have been effectively employed, then it is time to focus on the addition of high performance building technologies. These include high performance lighting systems, energy efficient appliances, solar hot water systems (solar thermal), solar electricity generation (photovoltaic), mechanized shading devices, and sophisticated control systems. At the neighborhood level, this second category would also include neighborhood scale wind, solar, and the use of bio-mass and co-generation.

Existing buildings present a major challenge; they cannot be ignored since they already represent a very high percentage of the building stock that will still be consuming energy and contributing to climate changing emissions in 2030. The focus for existing buildings must be on avoiding the unnecessary use of energy, retrofitting as many passive measures as possible (e.g., insulation, shading, cool roof coatings), improving the efficiency with which energy is used, shifting to renewable energy, and changing consumer behavior.

1.3.2 *Use More Renewable Energy*

Replacing energy derived from fossil fuels with renewable energy will enable Irvine to substantially reduce its climate changing emissions. There are two ways of accomplishing this; first, through the use of renewable energy generated on-site, for example, solar power; second, by purchasing renewable energy generated elsewhere. New buildings should all be equipped with solar or other renewable energy systems, or be designed 'solar-ready' for easy retrofitting later. Where it is technically feasible, existing buildings should also be retrofitted with solar photovoltaic and/or solar thermal systems to reduce their use of fossil fuel generated power.

Many buildings cannot easily meet their entire electricity demands through the use of on-site renewable energy systems; requiring continued energy supplies generated elsewhere. In these cases, the alternative is to purchase renewable energy generated off-site, probably well outside the city, through use of Renewable Energy Credits (RECs) or 'Green Tags.' (Refer to section 6.4.6 for

[7] Environmental Building News, December 2005, April 2008 – In a future of more intense storms that could cause extended power outages, with an ever present risk of terrorism that could target energy distribution networks, and with higher energy costs and the prospect of fuel and water shortages, it makes sense to design homes and apartment buildings – along with certain other public buildings, such as schools and community centers – so that they will maintain livable conditions in the event of extended power outages. Passive survivability can be achieved with such features as a highly insulated building envelope, passive solar design, cooling load avoidance and natural ventilation.

another scenario for RECs)

1.3.3 *Reduce Vehicle Emissions*

Over 40 percent of greenhouse gas emissions in California are from transportation. The use of lower carbon fuels, such as ethanol and biodiesel, as well as electricity and compressed natural gas (CNG), can help reduce vehicle emissions. However, since Californians rely on petroleum-based fuels for 96 percent of their transportation fuel needs; these alternative fuels still represent a very small percentage of fuel use. The California Air Resources Board has proposed a number of greenhouse gas emission reduction programs; these include regulations to reduce climate changing emissions from passenger cars and light trucks, regulations requiring the displacement of a percentage of diesel fuel by biodiesel; increased use of ethanol, and "CA H2 Net," which is a State initiative to promote the use of hydrogen as a means of diversifying California's sources of transportation fuel.

In addition to the State's initiatives, a strategy this Plan recommends is Irvine considers implementing a wide range of programs, including requesting a major behavioral shift by residents and City employees. According to the Southern California Association of Governments, 77 percent of the area's commuters currently drive alone. Residents would be encouraged to reduce the number and distance of trips they take, carpool more, ride the bus, walk, or ride a bicycle or motorcycle to work. The advantages of doing so include avoiding the need to pay expensive gas prices for commuting, as well as the cost of repairs and maintenance on vehicles. In addition, there are the non-economic benefits which include reductions in greenhouse gas emissions; reduced smog, noise, childhood asthma, water pollution, suburban sprawl, parking lots; and other changes that result from driving less. For many people, these changes may not be easy to make; reducing vehicle use remains one of the most intractable problems for cities attempting to reduce local emissions.

SECTION 2 – ENERGY USE IN MUNICIPAL FACILITIES

In this Section, the current amount of energy being used in the City of Irvine municipal (City) facilities is discussed and analyzed. This will set the stage for a later discussion about what strategies can be employed by the City to reduce that use and associated greenhouse gases.

This data has been compiled using utility records for 2006. If the City chooses, it could use this data as a baseline against which all future energy projects and programs can be measured against and compared to. Using 1990 data would be more difficult to obtain, but would correctly reflect much of the City's efforts to reduce energy use throughout the 1990s, such as building retrofits and traffic signal conversion to LEDs. Therefore, this Plan recommends that the year 1990 be used as a baseline.

The section also presents information on energy efficiency initiatives and projects that have already been undertaken by the City and, where applicable, presents energy savings achieved from those programs.

2.1 – Municipal Energy Use

In 2006, the City of Irvine municipal government used approximately 150 billion BTUs of energy in its buildings, street lights, and vehicles at a cost of $4.2 million. Of the City's annual energy expenditures, 45 percent is attributed to facility energy use (electricity and natural gas), 29 percent is for street lighting and park lighting, 5 percent is for traffic signals, and 21 percent is for fleet vehicles (refer to Figure 1 and Table 1).

Figure 1: Municipal Energy Use by Major End Use

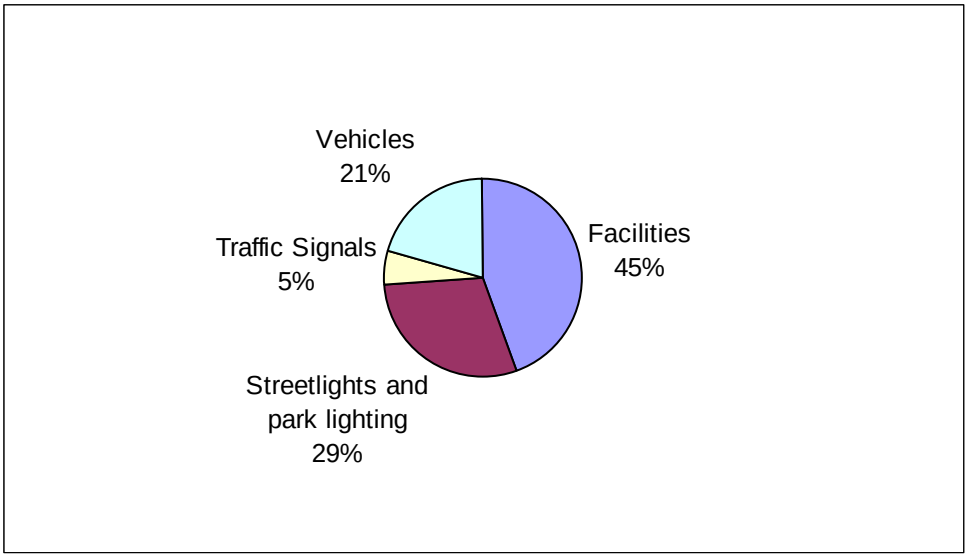


Table 1: Municipal Energy Use by End Use

Energy Type	Annual Units Consumed	Annual KBtu	Annual Cost	Percent of Cost
Electricity Use (kWh)				
Pumping (AG-TOU)	21,636	73,844	2,995	0.1%
Domestic Service	14,234	48,581	1,970	0.0%
Small facilities and irrigation (GS-1)	1,440,701	4,917,113	199,427	4.7%
Large facilities (GS-2, TOU-GS)	10,051,267	34,304,974	1,391,333	32.9%
Street and Park Lighting	8,910,571	30,411,779	1,233,434	29.2%
Traffic Control (TC-1)	1,644,578	5,612,945	227,649	5.4%
Subtotal Electricity	22,082,987	75,369,235	3,056,808	72.4%
Natural Gas (therms)	318,927	31,892,700	287,034	6.8%
Vehicles (gallons)	341,953	42,402,172	880,429	20.8%
Total		149,664,107	4,224,271	100.0%

2.1.1 *Electricity*

The City obtains its electricity from Southern California Edison (SCE). The Community Services Department pays all facility electricity bills and the Public Works Department pays for traffic signals, irrigation, and street lighting electricity bills.

The total use at the highest, or peak, time for all of the City's facilities and lights is approximately 3,000 kilowatts (kW) or 3 Megawatts (MW). Annually, all municipal facilities consume 22 million kilowatt hours (kWh) of electricity. In 2006, the highest electricity demand occurred in the months of March, May, and October probably due to higher than normal temperatures.

Municipal electricity use has increased 25 percent in the past ten years. Electricity use was 17.7 million kWh in 1997, compared to 22 million kWh in 2006. The City of Irvine's population has increased by 38 percent over approximately the same time period. Assuming there is a direct correlation between the increased energy needed to supply services and the increase in Irvine's population, a projection of municipal energy use can be made based on the projected population growth. If Irvine's population increases as planned , from the current population of about 198,000 up to about 270,000, then this 35 percent population increase may result in an increase in municipal electricity use of a further 25 percent. That would be an annual cost increase of perhaps $1 million at 2006 energy prices.

This forecast assumes that the growth rate in energy use by the City relative to population growth rate stays constant. The actual future increase in municipal energy use and costs will depend on a number of factors, for example, the standard of energy performance achieved by any new municipal facilities, and the extent to which the existing facilities can continue to adequately serve the expanding population.

2.1.2 *Natural Gas*

The City purchases natural gas from The Gas Company. Natural gas consumption is approximately 320,000 therms at an approximate cost of $290,000. The Public Works Department tracks and pays the natural gas bills. The largest users of natural gas among the City facilities are primarily the two aquatics centers, Woollett and Northwood High, where natural gas is used to heat swimming pools nearly year-round. The Fine Arts Center, where there are four natural gas kilns, also uses a considerable amount of natural gas, but not on the scale of the aquatics centers.

2.1.3 *Gasoline, Diesel and Compressed Natural Gas*

The City operates 424 vehicles which consume about 342,000 gallons of fuel (including 50,000 gasoline-equivalent gallons of compressed natural gas (CNG) annually at a cost of $880,000). Gasoline and diesel fuel is purchased through a cooperative agreement with a percentage based on rack, or wholesale, cost. CNG is purchased from Clean Energy.

2.2 – Where Energy is Consumed

2.2.1 *Buildings*

The City purchases electricity and gas for 444 facilities (based on the number of electric meters). The 22 larger facilities are buildings and parks. The 424 small facilities are irrigation meters, pumps, and traffic signals. All of the facilities are owned by the City. In the buildings, each department is charged for electricity and natural gas use based on per-square-foot of occupied space that covers the maintenance and operations cost of the building. The top ten of the City's 22 large electric and gas users account for 77 percent of the City's energy use. A list of these "top 10 electric and gas users" is provided in Table 2.

Table 2: Annual Energy Use of Top 10 Energy-Using Municipal Facilities

Building	Electricity Use (kWh)	Electricity Cost ($)	Gas Use (Therms)	Gas Cost ($)	Total Energy Cost ($)
City Hall, 1 Civic Center Plaza	4,042,939	421,166	7,984	8,521	429,687
William Woollett Jr, Aquatics Center, 4601 Walnut Ave.	1,290,720	163,593	167,443	148,938	312,531
Operations Support Facility 6427 Oak Cyn.	1,020,833	120,212	N/A	N/A	120,212
Lakeview Senior Center 20 Lake Front	722,794	89,126	N/A	N/A	89,126
Fine Arts Center 14321 Yale	265,920	39,217	16,319	16,055	55,272
4515 Portola Pkwy, Pool at Northwood High School	103,640	14,418	38,167	36,947	51,365
Heritage Park 14301 Yale	354,720	46,778	63	268	47,046
Animal Care Center, 6443 Oak Cyn	242,520	33,218	9,016	9,534	42,752
Irvine Transportation Center 15215 Barranca Pkwy	342,060	41,099	-		41,099
Turtle Rock Park/Community Center, 1 Sunnyhill Rec	252,840	36,612	N/A	N/A	36,612

The City plans to add two new community parks and one community center in the next five years. Assuming the community center and the parks are similar in energy use patterns to Turtle Rock Park Community Center, municipal energy costs for all three combined will grow by another $36,000 (2007 dollars) annually.

2.2.2 *Street, Park, and Traffic Lighting*

SCE owns and operates most of the streetlights in the City of Irvine, except for 500 lights on 150 bridges, which are owned and maintained by the City. The park lighting, which includes thousands of lights on trails in parks and green belts, is owned and operated by the City. The traffic signals are also owned and operated by the City. There is a Lighting, Landscape, and Park Maintenance Assessment that covers the entire city proper. Those assessments help to pay the electricity expenses for street lighting, park lighting, trail lighting, and the landscape maintenance of the City's parks.

2.2.3 *Fleet Vehicles*

The City owns and operates 424 vehicles and leases one electric car (refer to

Table 3). Vehicles are refueled at the Operations Support Facility and the Civic Center. Compressed natural gas is available only at the Operations Support Facility through a fueling station open to the public and leased and operated by Clean Energy. The annual mileage for the municipal fleet, including police vehicles, is about 2,941,000 miles.

Vehicle fuel use accounts for 21 percent of the City's annual energy bill. The City fleet consists of 43 compressed natural gas vehicles and 3 hybrid vehicles with the remainder being conventional automobiles, trucks, and heavy equipment. Annual fuel purchases by fuel type are listed in Table 4. The City does not track the annual mileage of individual vehicles. The average overall fuel efficiency (miles per gallon) of the City's fleet is low because it is skewed by a number of vehicles that have secondary uses, such as police and maintenance vehicles that are left idling to provide lighting, and/or power on-board equipment.

Table 3: Municipal Vehicle Types

Vehicle Type	Quantity
Heavy Duty Trucks	9
Light Duty Trucks	135
Buses	11
Vans	36
Large/Intermediate Cars (Primarily Patrol Cars)	80
Small/Compact Cars	16
Hybrid cars	3
Compressed natural gas (CNG) vehicles	43
Other (inc 7 battery-electric carts)	91
Total	424

Table 4: Annual Municipal Fuel Purchases

Fuel Type	Gallons	Cost/Gal	Total Cost
Gasoline	270,599	$2.65	$717,087
Diesel	20,920	$2.80	$58,576
Compressed Natural Gas (CNG)	50,434	$2.10	$105,911
Total	341,953		$881,575

2.3 – Energy Efficiency

Since all of the City's facilities were constructed after the introduction of the State's Title 24 Energy Code, the City's buildings have higher levels of insulation and better heating, ventilation and air-conditioning (HVAC) systems and controls relative to many older cities. In addition, the City has been implementing energy efficiency upgrades over the last 10 years. For example, a number of facilities that still have outdated T12 fluorescent lighting are currently being upgraded to more efficient systems. A more detailed description of these activities can be located in Section 2.3.2.

Street lighting and park lighting represent 29 percent of the City's total energy costs. All of the street lights are high pressure sodium lights, which is one of the more energy efficient types of lamp. Exterior lights are controlled with photocells or timers to eliminate daytime use. The City is also phasing in the use of lumen maintenance controller and group re-lamping of park lighting to improve energy efficiency (e.g., Musco "Light Structure Green").

Traffic signals account for only 5 percent of City's total energy use. To reduce the energy consumed by traffic lights, the City has already replaced incandescent red and green signals with Light Emitting Diode (LED) signals; the City will have completed the phase-in of yellow LED signals in the next two to three years. All new signal lights are required to be fully LED. The traffic signal control cabinets have also continued to evolve. While more complex control technology is being used now than in the past, the efficiency of the control systems has also improved dramatically in the last 20 years, so that the cabinets use about as much more energy as they did before.

2.3.1 *Building Efficiency*

City buildings account for 45 percent of total municipal energy use. Most of the City's buildings are relatively new. The 10 buildings with the highest energy use have all been constructed since 1978; 70 percent of the City's facilities have been built within the last 20 years.

One simple method for comparing building efficiencies is to calculate the energy use per square foot of comparable types of buildings, such as community centers and offices. Table 5 illustrates the energy use/square feet for the largest energy using facilities, excluding buildings with large process loads, such as the swimming pools and the transportation center, for which building size has no correlation to energy use.

Table 5: Energy Use per Square Foot

Building	Size (Square Feet)	Year Built	Electricity Use (kWh/ Year)	Gas Use (Therm/ Year)	Total Energy Cost ($/Year)	Total Energy Use (KBtu/ SF)	Total Cost/ SF	Comments
City Hall, 1 Civic Center Plaza	191,233	1989	4,042,939	7,984	429,687	73	2.25	Includes Police Station occupied 24 hours per day
Operations Support Facility 6427 Oak Cyn.	77,791	1984 -88	1,020,833	N/A	120,212	45	1.55	
Lakeview Sr Ctr 20 Lake Front	30,361	1993	722,794	N/A	89,126	81	2.94	Large commercial kitchen on-site
Fine Arts Center 14321 Yale	12,300	1979	265,920	16,319	55,272	74	4.49	4 gas kilns and 2 electric kilns
Heritage Park 14301 Yale	19,772	1978	354,720	63	47,046	61	2.38	
Animal Care Ctr 6443 Oak Cyn	20,670	1984	242,520	9,016	42,752	44	2.07	Hot water used for daily cleaning
Turtle Rock Park/ Community Center 1 Sunnyhill Rec	19,856	1979	252,840	N/A	36,612	43	1.84	

Unfortunately, there are no published databases of the typical energy cost per square foot of government building to compare to. This information is useful for comparing energy use among the City's own buildings. Knowing energy use per square foot is helpful in identifying buildings that may have room for improvement. For example, the Lakeview Senior Center's energy use on a square foot basis is higher than that of City Hall while the Senior Center's operating hours are lower than City Hall's. An energy audit of Lakeview Senior Center may be warranted to determine why its usage is higher. If the analysis is completed on a regular basis, change can be detected which may point to malfunctioning control systems, air leaks, or other repairable problems that are driving up energy costs. Billing errors can sometimes be detected as well.

2.3.2 *Past Energy Efficiency Projects*

Since technology is always evolving and the efficiency of buildings can degrade over time, maintaining peak energy efficiency is an ongoing process. A good municipal energy efficiency program contains the following elements:

- Track energy use
- Retrofit existing buildings with more efficient equipment and/or renewable energy
- Develop operations and maintenance practices that support energy efficiency
- Provide energy education programs for staff
- Improve efficiency in new construction
- Reduce fleet energy use

The City has implemented multiple energy efficiency projects in the last few years, some of the main achievements include:

- In 1994, the City, in partnership with SCE, The Gas Co, and The Energy Coalition, implemented an Energy Efficiency Demonstration Project at three facilities: Irvine City Hall, the Heritage Park, and Northwood Park Community Centers. That project included an upgrade from T12 to T8 lights and modifications to the HVAC systems.
- Upgraded lighting from T12 to T8 at Lakeview Senior Center, Bill Barber Park, and the Irvine Transportation Center.
- Installed occupancy sensors and programmable thermostats in most locations.
- In 2001, the City installed photocells and time clocks to control athletic field lighting energy use.
- Replaced air-conditioning units at the Operations Support Facility with new high efficiency units.
- Installed Musco "Light Structure Green" athletic field lighting at Harvard Park Fields 3, 4, and 5. This system combines lumen maintenance controls with group re-lamping to reduce energy use.
- Retrofitted all of its red and green incandescent traffic lights with LED traffic lights and has replaced 15 percent of the yellow traffic lights.

2.3.3 *On-going Energy Efficiency Projects*

Several of the ongoing energy efficiency activities include the following:

- Upgrading T12 to T8 lighting at a number of facilities in the next five years, including the Operations and Support Facility, the Fine Arts Center, the Rancho Senior Center, and the Turtle Rock Community Center.
- Installing wireless rain sensors at tennis courts to turn off lights in rainy conditions.
- Installing high SEER (Seasonal Energy Efficiency Rating) air-conditioning units as they need replacement.
- Replacing spot incandescent lamps with compact fluorescent lamps.
- Purchasing Energy Star rated appliances for community facilities.
- Continue conversion of incandescent exit signs to LED exit signs.
- Continue conversion of analog to digital timers to control exterior lighting.

At City Hall, the Information Technology (IT) department is consolidating data onto fewer machines through "data virtualization." Vendors of virtualization and data file management software claim the potential for energy savings is 60 to 70 percent of data center energy use.

The building retrofit projects are initiated and managed by the Community Services Department and funded through the City's General Fund Rehabilitation Program. The rehabilitation program's budget is $3.7 million for fiscal year 2007-2008, a portion of which is being used for energy efficiency upgrades. The City typically evaluates projects on a simple payback basis and in the past has considered implementing projects with up to a 5-year payback.

2.3.4 *Planned Energy Efficiency Projects*

A number of the planned energy efficiency and renewable projects include:

- Utilizing light-colored roof coatings that reflect heat in rehabilitation projects,
- Conversion of exterior mercury vapor lights to metal halide lights,
- Investigate solar photovoltaic technology at the Operations Support Facility building No. 3,
- Installing solar photovoltaic system mounted on shade structures at the William Woollett Aquatics Center, and
- Installing a solar photovoltaic system atop the Transportation Center parking structure.

2.3.5 Additional Savings Opportunities

Based on interviews with City staff, a review of recent energy audits, and a walk-through in four facilities, HDR/Brown, Vence and Associates made observations regarding additional energy efficiency measures that may be applicable in the largest energy using buildings. The measures are presented in Table 6. A thorough energy audit is required to confirm the potential cost and savings of the measures.

Table 6: Additional Potential Opportunities

LOCATION	POTENTIAL OPPORTUNITIES
City Hall	Replace chiller inlet guide vanes with Variable Frequency Drive. Use outside air to cool data center at night. Upgrade to premium (next generation) T8 lamps and electronic ballasts in the areas with 24 hour occupancy (e.g. Police Station). Retro-commission all controls.
Aquatics Centers	Install Variable Frequency Drives on filtration pumps. Reduce rate of filtration pumping when pool is unoccupied. Install cogeneration system. Install solar water heating for the pools and/or domestic hot water, and showers depending on the load match to the panel areas.
Operations Support Facility	Replace mercury vapor and metal halide lighting fixtures with fluorescent fixtures with T8 lamps. Install skylights for Administrative Building hallways. Install translucent rolling doors to bring in more natural light into shops.
Park and Trail Lighting	Install motion-activated lighting. Solar powered fixtures in new areas to avoid need for electrical connections. Install photocell control of interior lighting for restrooms with skylights.

2.4 – Current City Energy Programs and Policies

2.4.1 *Operations and Maintenance*

Community Services Department operates and maintains all of the City buildings except the Civic Center, which is maintained under a 3-year contract with an outside maintenance firm. The City has a preventive maintenance program that utilizes a computerized system to identify service needs, which includes items such as replacing filters and checking programmable time clocks, which are important for maintaining building energy efficiency. The City also prepares facility condition assessment reports for every building indicating what equipment should be replaced and when, based on its age and repair history. The City's practice is to maintain temperatures in occupied spaces between 68 and 72 degrees during working hours.

2.4.2 *Purchasing*

The City has a green purchasing policy. However, none of the components of the policy appear to address the energy efficiency of equipment purchases.

2.4.3 *Fleet Vehicles*

The City is installing Global Positioning Satellite system (GPS) units in all new vehicles purchased and will install GPS units in all vehicles over the next three years. These units and software allow monitoring of vehicle use, miles driven, idle time, speed, and monitoring of smog control devices. This will allow for active management of vehicle use. The City has invested in three hybrid cars and 43 low-emissions CNG vehicles.

The current operating premise is that the City will purchase CNG vehicles for replacement of vehicles parked at the Operation Support Facility (the City's maintenance yard) because there is a CNG station on-site. Passenger vehicle replacement at Civic Center (non-Public Safety) will be with hybrids. Public Works and Administrative Services staff are working on annual vehicle replacement list to identify candidate vehicles and funding.

The current overall fleet efficiency is 8.6 miles per gallon. This overall fuel efficiency includes all vehicles such as maintenance vehicles and police cruisers. The fleet fuel efficiency will increase as vehicles are replaced with hybrids.

2.4.4 *Energy Education for Staff*

The City does not have an on-going program of energy education. The City has addressed the problem of staff leaving lights and HVAC units on after business hours by installing occupancy sensors and timers.

2.4.5 *New Construction*

The City passed a resolution in 2005 that requires that any new or major remodel of a municipal building over 5,000 square feet, will need to achieve a 'Leadership in Energy and Environmental Design' (LEED) certified rating. Most buildings that are LEED certified use less energy than the Title 24 code requires. [8] A recent addition to the University Park Community Center will be LEED certified. In smaller park facilities, such as small offices and restrooms, the Community Services department is making an effort to integrate energy efficiency into its operating practices. For example, the City is installing Mitsubishi Jet Towel dryers, which are expected to be 50 percent more efficient than traditional electric hand dryers in one new park. The City is also installing skylights in restrooms to reduce the need for electric lighting.

2.4.6 *Tracking Energy Use*

Electricity bills for facilities are processed by the Community Services Department and the natural gas, street lighting, traffic signal, and irrigation controller bills are processed by the Public Works Department. The City does not have an internal system for tracking and monitoring energy usage, but does receive summary reports

[8] A study by Greg Katz indicated that LEED rated buildings are on average 25 – 30% more efficient compared to a California Title 24 baseline. "The Cost and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force" 2003

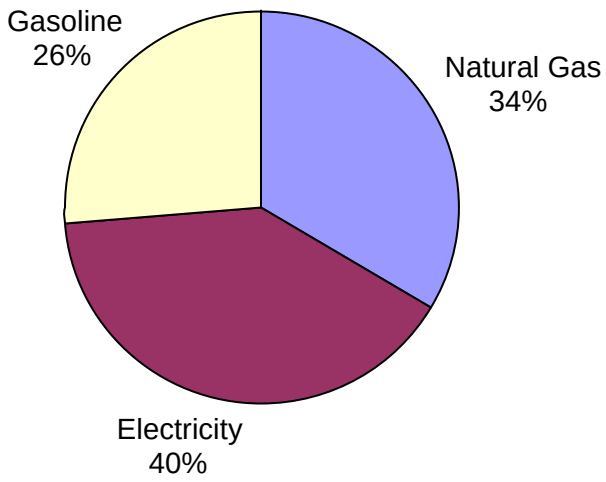
on all the electricity accounts periodically from SCE. Natural gas usage is not as well monitored. The Superintendent of Facilities has requested “Utility Manager” software as a tool to assist the City monitor its energy costs.

SECTION 3.0 – CITYWIDE ENERGY USE

3.1 – Overall Energy Use

Residential, commercial, municipal, and transportation activities within the city limits of the City of Irvine (Irvine) in 2006 collectively used approximately 18,500 billion BTUs (or 18.5 trillion BTUs) of energy.[9] 74 percent of the energy use is in buildings and 26 percent is used in vehicles. Figure 2 breaks down the energy use by type.

Figure 2: Breakdown of Citywide Energy Use



SCE electricity customers residing in Irvine, on aggregate, use approximately 294 MW of power at the highest peak, which typically occurs in September[10]. Irvine's electricity load has an overall load factor of 0.58. (A load factor is the ratio of total electricity consumption to peak use and identifies how great the difference is between the two. A factor of 1.0 would signify that a customer utilizes exactly the same amount of energy 24 hours a day, 7 days a week. Lower load factors signify that SCE needs to add large amounts of power for short periods of time, such as during a heat wave. This is both difficult and expensive, which occasionally strains the system causing rolling blackouts.) SCE supplies electricity to buildings in Irvine and The Gas Company provides natural gas. The unit cost of electricity and gas varies depending on the rate schedule assigned and the load profiles of the buildings. As with municipal energy accounts, larger facilities with higher usage are eligible for rate schedules that have lower average costs.

[9] The energy use for transportation is for 2006 while the rest of the energy use is for 2005. For simplicity's sake the two numbers have been combined as if they represented the same year.
[10] Source: *Electricity Use Report for City of Irvine*, Version 4.0, March 2, 2006.

3.1.1 *Electricity*

The state Energy Efficiency Standards for Residential and Nonresidential Buildings or "Title 24" was initiated in 1978 and predates most of Irvine's growth, (Irvine's population has more than quadrupled since then.) Therefore, most buildings in Irvine start from a relatively energy efficient baseline[11]. While there are certainly opportunities for improvement, Irvine's building stock is on average more efficient than that of older cities.

Although, about 83 percent of the approximately 69,000 electricity accounts with SCE in Irvine are residential, these comprise only 16 percent of total electricity usage. Medium and large commercial customers (GS-1 and GS-2 customers) make up about 15 percent of the accounts, but represent about 70 percent of total electric usage. This data is exhibited in Table 7.

Table 7: Electric Account Summary[12]

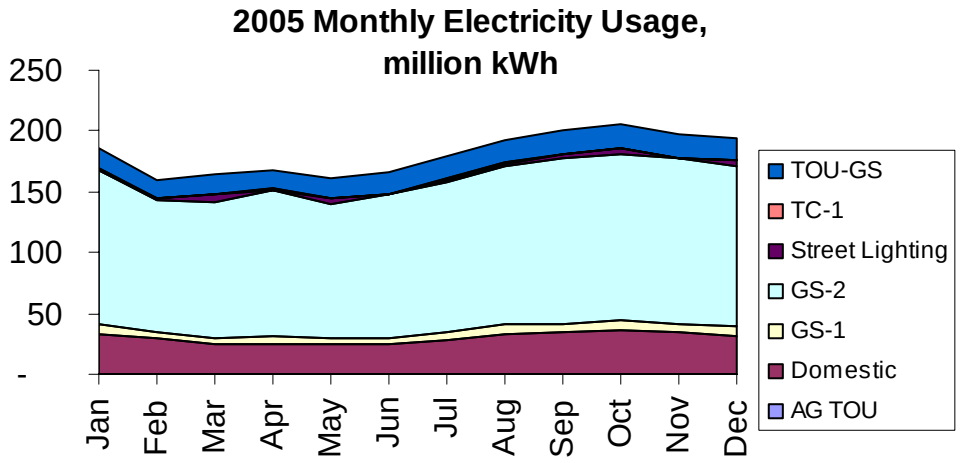
Rate	Annual kWh	% of Total kWh	Number of Service Accounts	% of Total Service Accounts
AG TOU (agriculture)	4,908,248	0.2%	40	0.1%
Domestic	353,126,189	16.2%	57,128	82.8%
GS-1 (small commercial)	80,558,220	3.7%	7,171	10.4%
GS-2 (medium commercial)	1,488,847,290	68.5%	3,169	4.6%
Street Lighting	32,132,910	1.5%	798	1.2%
TC-1 (traffic lights)	1,988,733	0.1%	360	0.5%
TOU-GS (large commercial time of use)	211,924,977	9.8%	324	0.5%
Total	**2,173,486,567**	**100%**	**68,990**	**100%**

Source: Electricity Use Report for City of Irvine

The monthly load profile for Irvine's electricity usage is exhibited in Figure 3. Overall usage for Irvine peaks in October and is lowest in February. Of the major rate groups, domestic or residential accounts show the most seasonal variability, with the peak month usage being 24 percent higher than the average value.

[11] Source: *City/County Population Estimates*, California Department of Finance - Demographic Research Unit
[12] For a more complete table of energy use for Irvine showing coincident and non-coincident electricity demand, see Appendix A.

Figure 3: Monthly Citywide Electricity Usage



Source: Electricity Use Report for City of Irvine

If the Citywide population increases, as anticipated, to 270,000 people (about a 35 percent increase over the current population) and is accompanied by an equivalent increase in commercial activity, it is reasonable to expect that Citywide energy use will also expand by at least 25 percent over the same period, even if the City allows future energy efficiency improvements.

As demonstrated in Table 8 and Figure 4, the power sold to Irvine customers by Southern California Edison is generated by various fuel resources, but primarily natural gas. The energy derived from large hydroelectric sources varies year-to-year with the amount of rainfall received in California and the Pacific Northwest. The portion of SCE's energy coming from coal is projected to decline in 2008 and can, generally, be expected to decline further, over time, as the utility complies with SB 1368. This Act prohibits new long-term contracts with generators that emit more CO_2 than a new combined cycle natural gas power plant. Similarly, the portion of renewables can be expected to rise over time as SCE complies with the state's renewable portfolio standard (RPS) requirements to derive 20 percent of the energy sold from eligible renewable sources by year 2020. (SCE has already achieved 16 to 17 percent renewable energy in its power mix). There has also been a shift in the state government to accelerate the target, requiring California utilities to sell 20 percent renewable energy by 2013 and 30 percent renewable energy by 2020.

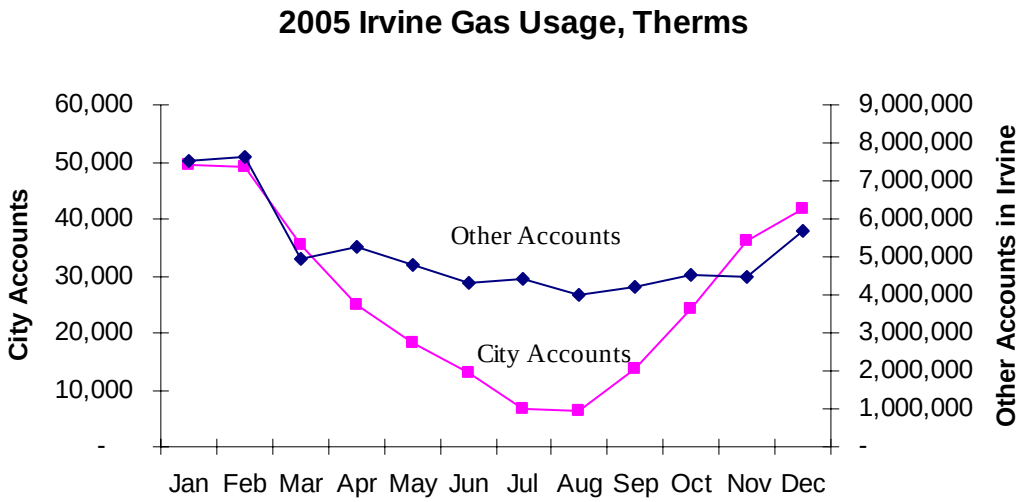
Table 8: Southern California Edison Power Content

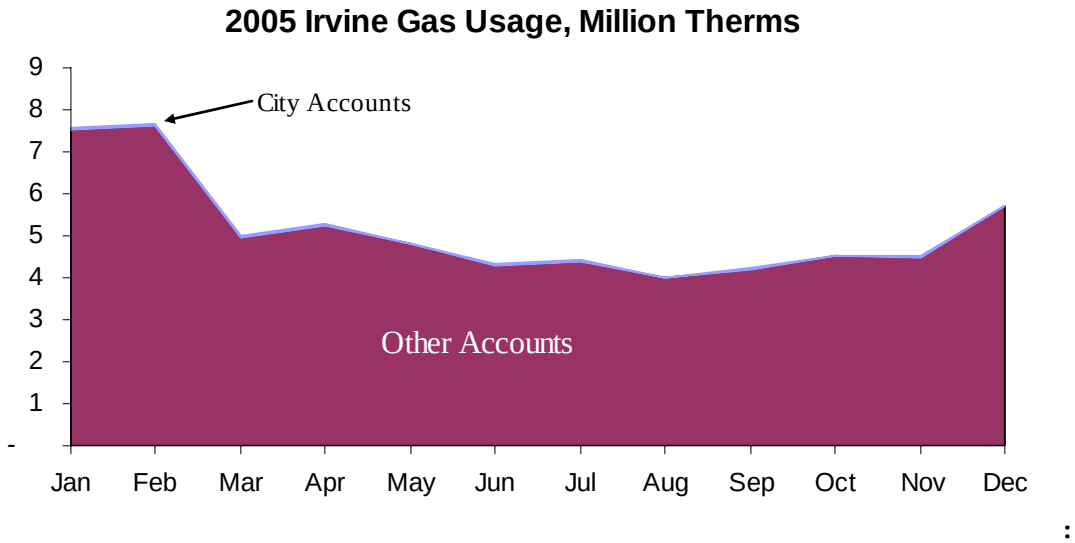
RESOURCE	2006 ACTUAL	2007 PROJECTED	2008 PROJECTED
Eligible Renewables	**16%**	**16%**	**16%**
Biomass & waste	2%	2%	2%
Geothermal	9%	9%	9%
Small hydro	1%	1%	1%
Solar	1%	1%	1%
Wind	3%	3%	3%
Coal	**11%**	**7%**	**8%**
Large Hydroelectric	**8%**	**6%**	**5%**
Natural Gas	**48%**	**51%**	**50%**
Nuclear	**17%**	**20%**	**21%**
Other	**<1%**	**<1%**	**<1%**
Total	**100%**	**100%**	**100%**

3.1.2 *Natural Gas*

About 63 million therms of natural gas are consumed, annually, in Irvine. The vast majority of Irvine's total natural gas usage is from private accounts, while municipal government accounts comprise approximately 0.5 percent of the total. However, as Figure 5 exhibits, the City's natural gas accounts exhibit greater seasonal variation than the remaining non-municipal accounts. This is because the City's use of gas is primarily for space heating, whereas other non-municipal accounts encompass industrial clients who use gas for process heating.

Figure 4: Irvine Citywide Gas Usage





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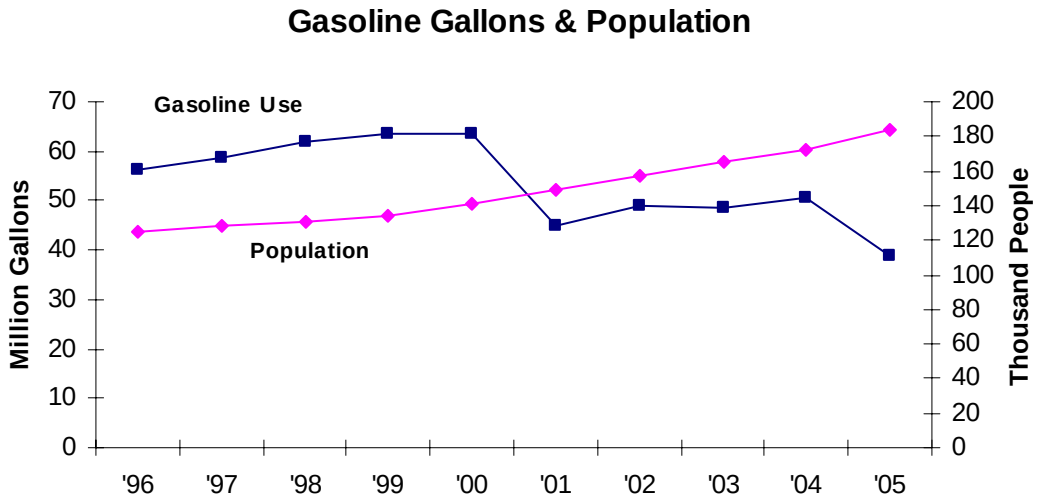
Source: Southern California Gas Company

3.1.3 *Vehicle Energy Use*

Irvine has experienced significant growth in vehicle travel as the City has grown. While it is impossible to tell exactly how much gasoline was used within City limits, a reasonable estimate can be made from the number of vehicle miles traveled annually. Figure 6 displays estimated fuel use by vehicles traveling in Irvine. Figure 8 displays the number of lane miles maintained by the City compared to vehicle miles traveled. [Note: The steep drop in vehicle miles traveled in 2001 corresponds to a drop in the number of miles of roadway maintained in the City of Irvine as reported by the California Department of Transportation's Highway Performance Monitoring System.]

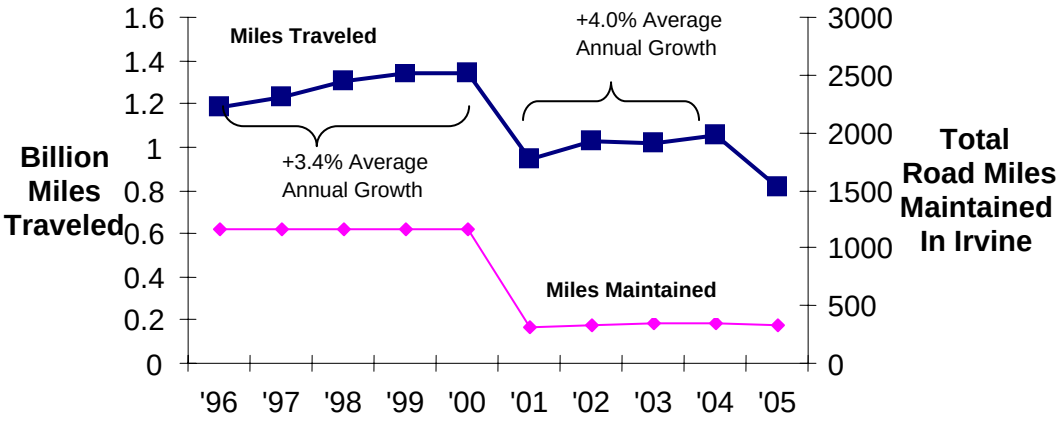
Actual miles traveled have been increasing at an average annual rate of approximately 4 percent since 2001. The increased growth rate in vehicle travel from an average of 3.4 percent in the late 1990's to 4 percent in early 2000 is probably due, in part, to the increase rate of population growth in Irvine from an average of about 2.2 percent in the 1990's to an average of 5.4 percent after year 2000. There was a steep drop in vehicle miles in 2005, but it is not clear what caused this. It is likely to be a data anomaly rather than being indicative of a downward trend. Without a concerted effort to shift auto trips to other modes, this high growth rate of gasoline use is likely to continue to track Irvine's population growth well into the future, limited only by congestion on major roadways and by any future improvements in vehicle fuel economy. Similarly, without a major shift to more efficient and/or smaller vehicles, CO_2 emissions from vehicles in Irvine are likely to continue to increase at about the same annual rate.

Figure 5: Gasoline Gallons and Population



Source: ***Highway Performance Monitoring System,*** **California Department of Transportation;** ***City/County Population Estimates*****, California Department of Finance - Demographic Research Unit**

Figure 6: Vehicle Miles Traveled in Irvine



Source: California Department of Transportation ***Highway Performance Monitoring System***

3.2 – Energy Efficiency Initiatives Citywide

Approximately, 2 percent of electricity use in Irvine is for street lighting, municipal government buildings, and other City accounts, while the vast majority of electricity is used by private customers. Approximately 16 percent of this usage is in residential accounts, while the remainder is attributable to commercial and industrial customers. Irvine has a history of numerous programs promoting energy efficiency in the community; these continue to improve the performance of the Irvine's building stock. For example:

- The City's Irvine Quality Plus, or "IQ+" program has helped to greatly reduce duct leakage in single family detached homes. Its approach and specification for maximum allowable leakage became the basis for the California energy codes section on "sealed ducts."
- The Irvine Company claims a 30 percent reduction in energy use in its commercial office buildings from, both, retrofits of existing buildings and incorporation of efficiency features in new buildings.[13]
- The City is a member of the Community Energy Partnership (CEP), a partnership program between the City of Irvine, its serving utilities (SCE and The Gas Company), and The Energy Coalition. Through this partnership program, The Energy Coalition advocates and supports community opportunities for improved energy management in Irvine. Between 2002 and 2007, residents and businesses located within Irvine have benefited from more than $700,000 worth of education, outreach, and energy efficiency installations.

3.3 – Current Utility Energy Efficiency Investment

The state's investor-owned electric and natural gas utilities are investing significant amounts of money collected through the "public goods" charge into building efficiency. Both Southern California Edison (SCE) and The Gas Company are spending a portion of their money in Irvine, during the current program. During 2006, SCE spent approximately $1,000,000 on incentive payments in Irvine[14]. This has resulted in estimated annual savings of approximately 16.6 million kWh and 3,000 kW in Irvine. This is equal to approximately 1 percent of Irvine's total electric use in 2005. Table 9 explains the estimated breakdown of these savings by sector.

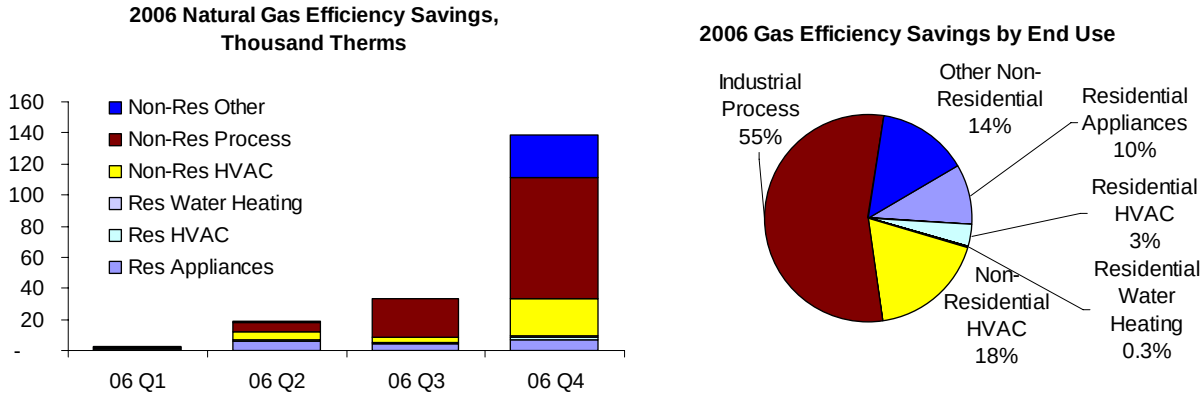
Table 9: Summary of SCE 2006 Program Spending and Savings

	Incentive Payments	Savings (kWh/yr)	Savings (kW)
Residential Programs	$592,626	9,262,452	1,235
Non-Residential Programs	$436,336	7,340,105	1,747
Total	$1,028,962	16,602,557	2,982
Total Electricity Consumption 2005		2,173,486,567	294,859
Percent Reduction		0.8%	1.0%

[13] http://www.goodplanning.org/stewardship/energyefficiency.asp
[14] Program Participation data provided by SCE.

The Gas Company's spending during 2006 on energy efficiency programs funded by Public Goods Charges is estimated at $19.7 million, approximately $350,000 of which has been spent in Irvine.[15] This has resulted in an annual savings of approximately 200,000 therms in Irvine. This represents 0.3 percent of overall gas consumption. Most of the savings from this system-wide program have come from non-residential applications; primarily industrial process savings (refer to Figure 3-7). The specific breakdown of natural gas savings in Irvine may be different to some extent.

Figure 7: The Gas Company Energy Efficiency Results in 2006



By the end of 2006, The Gas Company's savings under this program are approximately 19 percent of the total savings they expect to achieve by the end of 2008. If SCG achieves this goal, the three-year program will result in an annual natural gas savings of approximately one million therms in Irvine, a reduction of approximately 1.7 percent from 2005 levels.

[15] The incentives and savings accrued to Irvine customers was estimated by assuming that Irvine's share of The Gas Company's overall incentive payments is proportional to its share of gas usage, City-specific data was not provided by The Gas Company.

SECTION 4 – OTHER AGENCIES' GOALS

It is important to be aware that the City's local goals for energy will exist alongside energy goals and emissions reduction goals being developed and implemented by other federal, state, and local agencies, including the local utilities. Far from existing in isolation, the City's goals will be implemented as part of a web of inter-related activities, many of them outside the City's influence. So while the City's own goals are to provide clear long-term direction, the shorter term implementing programs must be flexible and adaptable to the changing economic, environmental, and political climate and to the influence of activities being managed by other agencies.

In reviewing the goals established by other agencies, the City should be concerned, first, with those of the federal, state and local utility companies because they will determine the context in which the City's own goals will have to operate; second, with those goals established by important non-governmental agencies, like the US Conference of Mayors and the US Green Building Council (USGBC), because they are the acknowledged leaders in their respective fields; and third, with those established by other cities and local agencies because they can provide inspiration and guidance on what is possible.

4.1 – Federal Government

The Energy Independence and Security Act of 2007 were signed by the President in December 2007. While it does not include a national renewable energy portfolio standard, it does promote higher fuel economy standards (often referred to as CAFE or Corporate Average Fuel Economy standards). Cars and light trucks will have to be 40 percent more efficient by 2020, raising the fleet average to 35 miles per gallon. Also, light bulbs must be three times as efficient by 2030, phasing out most incandescent by 2014. Federal buildings that are renovated or built in or after 2010 will have to cut their fossil-fuel energy consumption by 55 percent by 2010, and then by 100 percent by 2030. The bill did not extend tax benefits for solar installations and supports a seven-fold increase in ethanol production by 2022.

4.2 – Local Utilities

California's electric and gas utility goals are strongly influenced by the goals established by the State and especially by the California Public Utility Commission (CPUC). The State was the first to establish a renewable portfolio standard (Senate Bill 1078 – Sher, 2002), which required electricity providers to increase renewable energy resources by 1 percent per year until they have attained a portfolio of 20 percent renewable resources. Subsequently, the 'Accelerated Renewable Portfolio Standard' set a goal of achieving 33 percent renewable in the State's resource mix by 2020. The joint CPUC/Energy Commission September 2005 Energy Action Plan II adopts the 33 percent goal.

In October 2007, the CPUC:

> (1) "Direct[ed] the utilities to prepare a single, comprehensive statewide long-term energy efficiency plan;
>
> (2) Adopt three programmatic initiatives:
>
> * All new residential construction in California will be zero net energy by 2020;
>
> * All new commercial construction in California will be zero net energy by 2030; and
>
> * Heating, Ventilation, and Air-conditioning (HVAC) industry will be reshaped to ensure optimal equipment performance;
>
> (3) Develop the "next generation" of California utility energy efficiency programs for 2009-2011;
>
> (4) Commit in the near term to adopting utility energy efficiency goals through 2020 and reaffirm . . . previously adopted 2009-2011 goals; and
>
> (5) Establish new, collaborative processes with key business, consumer groups, and governmental organizations in California, throughout the West, nationally and internationally."

The utilities are currently working with the California Public Utilities Commission to draft the California Strategic Energy Efficiency Plan for 2009 - 2020. Although still in draft form, there is currently a large role for local governments to play.[16] It will be important for the City to follow this process carefully, since it will ultimately be tied to the ratepayer funds used for energy efficiency programs throughout the state.

4.3 – State of California

California has been a leader in promoting energy efficiency, cleaner technologies, and renewable energy since the 1970s and is today one of the most energy efficient economies in the world. As a result, per capita electricity use has remained practically unchanged since the mid-70s, compared to a growth in national per capita electricity use of about 1.5 percent per year. Furthermore, whereas national annual per capita greenhouse gas emissions average 20 metric tons, Californians' per capita emissions average only 12 metric tons – still higher than some other national average emissions, but substantially lower than the US national per capita average emissions.

California was the first government to attempt to regulate greenhouse gas emissions from vehicles and the first to set a Renewable Portfolio Standard (RPS) requiring 20 percent of electricity to be sourced from renewable by 2010.[17] It has been claimed

[16] *Draft Strawman* dated January 7, 2008, "Achieving Aggressive Energy Efficiency Goals in Local Communities and Statewide – Steps Towards a Strategic and Coordinated Approach."

[17] Subsequently through the 'Accelerated Renewable Portfolio Standard' this was increased to 33% by 2020, and this change was adopted in the joint CPUC / CEC Sept 2005 Energy Action Plan.

that by meeting the goals of the RPS standard, the State would generate more than 200,000 person-years of employment and fuel growth with payroll benefits worth $8 billion. California also established the first state-sponsored climate change research program and opened the California Climate Action Registry to facilitate public and private sector reporting of greenhouse gas emissions. California is also home to three globally competitive wind power companies, three of the world's biggest geothermal power companies, two of the world's largest solar PV plants, and the world's premier research and development consortium for fuel cell vehicles.

Additionally, the State of California is committed by executive order (S-01-07) and legislation (AB 1007) to expand the use of alternative fuels as a mechanism for reducing transportation-related greenhouse gas emissions. The State of California intends to reduce the carbon intensity of transportation fuels by at least 10 percent by 2020.

4.3.1 *California's Joint Energy Plan*

In 2003, the State's energy agencies adopted a joint plan to guide energy decision-making in California. As part of its introduction to the adopted goals, the plan clarifies the general situation that the plan is intended to address. The following are excerpts from the Plan:

"As a context for this plan, Californians must understand the essential and complex nature of the state's energy resources…. Consumption is growing 2 percent annually. Over the last decade, between 29 and 42 percent of California's in-state generation used natural gas. Another 10 to 20 percent was provided by hydroelectric power that is subject to significant annual variations. Almost one third of California's entire in-state generation base is over 40 years old. California's transmission system is aging also. While in-state generation resources provide the majority of California's power, California is part of a larger system that includes all of western North America. Fifteen to thirty percent of statewide electricity demand is served from sources outside state borders."

"Peak electricity demands occur on hot summer days… Peak demand is growing at about 2.4 percent per year, roughly the equivalent of three new 500-megawatt power plants. Residential and commercial air-conditioning represent at least 30 percent of summer peak electricity loads."

"California's demand for natural gas also is increasing. Currently the state uses 2 trillion cubic feet of natural gas per year. Historically the primary use of this fuel was for space heating in homes and businesses. Electricity generation's dependence on relatively clean-burning natural gas now means that California's annual natural gas use by power plants is expected to increase. Overall, natural gas use is growing by 1.6 percent per year. Eighty-five percent of natural gas consumed in California is supplied by pipelines from sources outside the state."

The joint Energy Plan goes on to outline the major actions the State is proposing to implement, including the following actions (not a complete listing) which are of particular interest to local governments:

Optimize Energy Conservation and Resource Efficiency

"California should decrease its per capita electricity use through increased

energy conservation and efficiency measures. This would minimize the need for new generation, reduce emissions of toxic, criteria pollutants and greenhouse gases, avoid environmental concerns, improve energy reliability, and contribute to price stability. Optimizing conservation and resource efficiency will include the following specific actions:

1. Create customer incentives for aggressive energy demand reduction.
2. Increase local government conservation and energy efficiency programs.
3. Incorporate, as appropriate per Public Resources Code section 25402, distributed generation or renewable technologies into energy efficiency standards for new building construction.
4. Encourage companies that invest in energy conservation and resource efficiency to register with the state's Climate Change Registry.

Accelerate the State's Goal for Renewable Generation

"In 2002, the Governor signed the Renewable Portfolio Standard (RPS), SB 1078. This standard requires an annual increase in renewable generation equivalent to at least 1 percent of sales, with an aggregate goal of 20 percent by 2017. The state is aggressively implementing this policy, with the intention of accelerating the completion date to 2010, and will:

1. Add a net average of up to 600 MW of new renewable generation sources annually to the investor-owned utility resource portfolio.

Promote Customer and Utility Owned Distributed Generation

"Distributed generation is an important local resource that can enhance reliability and provide high quality power, without compromising environmental quality. The state is promoting and encouraging clean and renewable customer and utility owned distributed generation as a key component of its energy system. Clean distributed generation should enhance the state's environmental goals. This determined and aggressive commitment to efficient, clean, and renewable energy resources will provide vision and leadership to others seeking to enhance environmental quality and moderate energy sector impacts on climate change.

1. Promote clean, small generation resources located at load centers.
2. Collaborate with the Air Resources Board, Cal-EPA and representatives of local air quality districts to achieve better integration of energy and air quality policies and regulations affecting distributed generation.
3. The agencies will work together to further develop distributed generation policies, target research and development, track the market adoption of distributed generation technologies, identify cumulative energy system impacts, and examine issues associated with new technologies and their use."

4.3.2 *Other State of California Energy-related Goals*

Green Building Executive Order, S-20-04

In addition to the joint agency Energy Plan, the Governor's December 2004 Green Building Executive Order, S-20-04 (CA 2004) sets a goal of reducing energy use in public and private buildings by 20 percent by the year 2015, as compared with 2003 levels. The Executive Order and related action plan[18] clarifies specific actions state agencies are to undertake with state-owned and leased buildings. The order and plan also discuss various strategies and incentives to encourage private building owners and operators to achieve the 20 percent target.

California Solar Initiative

The California Solar Initiative has a goal of installing 1 million solar roofs (or an equivalent 3,000 MW by 2017) on homes and businesses; an increased use of solar thermal systems to offset the increasing demand for natural gas; the use of advanced metering in solar applications; and the creation of a funding source to provide rebates over a 10-year period.

New Solar Homes Partnership

The California Energy Commission through its "New Solar Homes Partnership" has a goal of placing solar systems on 50 percent of new homes by 2020.

AB 32: the Global Warming Solutions Act

On June 1st 2005, Governor Schwarzenegger signed Executive Order S-3-05 committing the state to the following targets for limiting the heat-trapping gases that contribute to global warming:

- By 2010, California emissions will be reduced to 2000 levels.
- By 2020, California emissions will be reduced to 1990 levels.
- By 2050, California emissions will be reduced to 80 percent below 1990 levels.

The 2050 target is consistent with what most scientists suggest will be needed to avoid dangerous levels of global warming.

On August 27, 2006, Governor Schwarzenegger signed Assembly Bill 32: the Global Warming Solutions Act making those targets law. AB 32 calls for the State's global warming emissions to be reduced to 2000 levels by 2010, (11 percent below business as usual); to 1990 levels by 2020 (25 percent below business as usual); and 80 percent below 1990 levels by 2050. This is to be accomplished through a statewide enforceable cap on emissions phased in starting in 2012.

AB 1493 - Vehicular emissions, greenhouse gases

Also as part of a broader effort to reduce greenhouse gases from all sources by 25 percent by 2020, the State has also proposed requiring a reduction in greenhouse gases from vehicles (AB 1493) by 30 percent by 2016. This action is currently awaiting a waiver from the US EPA.

[18] The State of California 'Green Building Action Plan' provides detailed directions on the implementation of the Green Building Executive Order.

The Solar Water Heating and Efficiency Act of 2007

In October 2007 Governor Schwarzenegger signed Assembly Bill 1470 to create the nation's largest solar hot water heating program. The bill "The Solar Water Heating and Efficiency Act of 2007" (AB 1470) creates a $250 million, ten year program to provide consumer rebates for solar hot water systems.

AB 151 (Laird 2005)

Assembly Bill 151 (Laird 2005) establishes that it is the State's policy to take every technologically feasible action necessary to reduce the growth of petroleum consumption and to increase transportation energy efficiency and the use of alternative fuels. State agencies are intended to take this policy into account when adopting new rules and regulations.

4.4 – U.S. Conference of Mayors and US Green Building Council [19]

The U.S. Conference of Mayors and many of its member Mayors, including the Mayor of Irvine, Beth Krom, have long been leaders in the sustainable cities movement. On February 16, 2005 when the Kyoto Protocol, the international agreement to address climate change, became law for the 141 countries that have ratified it to date, Seattle Mayor Greg Nickels launched the Mayors for Climate Change initiative. He developed the Mayors for Climate Protection Agreement to advance the goals of the Kyoto Protocol through leadership and action by American cities. In April 2005, Mayor Krom signed the Agreement. In June 2005, the Agreement was endorsed by a resolution of the US Conference of Mayors.

In 2006, the U.S. Conference of Mayors, the American Institute of Architects, the US Green Building Council, and a number of other influential agencies, adopted a set of goals called the "2030 Challenge" originally introduced by the Santa Fe non-profit "Architecture 2030."[20] The goals are intended to provide a template for the design and construction of all future new buildings, developments, and major renovations.

The main focus of both the 2030 Challenge and the Mayors' goals is directed at reducing climate changing emissions through a major shift from the use of fossil fuel for electricity in buildings, over to the use of on-site generated renewable energy. The Mayors' recommend that this transfer happen through a serious of stepped increases in the percentage of renewable energy generated on-site, with the eventual goal of all new municipal government buildings being built 'carbon neutral' by 2030. By 'carbon neutral', it's meant that by 2030 municipal buildings will use no fossil fuel generated/greenhouse gas emitting energy in their operations. The Mayors' Resolution focuses on local government facilities, but also recommends that all non-government buildings should also be working toward these goals. Clearly, since local government buildings only represent a few percent of the nation's built

[19] These goals have also been adopted by the American Institute of Architects, the US Green Building Council, International Council on Local Environmental Initiatives (ICLEI); the goals are also supported by the Rocky Mountain Institute (RMI); the World Business Council for Sustainable Development; the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE); the National Wildlife Federation, and the American Solar Energy Society, and are being actively promoted by the Mayors of Chicago, Albuquerque, Miami, and Seattle, and a number of other cities.

[20] The 2030 Challenge is described in "eco-structure" magazine for March 2007; also at www.architecture2030.org and at www.aia.org

environment, merely improving those buildings will not by itself have much impact on reducing overall emissions.

The 2030 Challenge goals are very ambitious, but it is argued that without such radical and immediate action, future generations will not enjoy the quality of life we have today. Further, it is claimed that without such action, and under an alternative "business-as-usual" scenario, US fossil fuel use is expected to increase by about 34 percent by 2035. This represents an increase of about 34 quadrillion Btu's, or "quads" and every quad is roughly equal to forty 1,000 megawatt power plants. If even a minority of these plants burn fossil fuels, their impact on national emissions will be very significant.

The US Conference of Mayors Resolution 50 (June 2006) describing the 2030 Challenge encourages all member cities to require that: [21]

- "New construction of City buildings shall be designed to, and achieve, a minimum delivered fossil-fuel energy consumption performance of one half of the US average for that building type, as defined by the US Department of Energy."
- "Renovation projects of City buildings shall be designed to and achieve a minimum delivered fossil-fuel energy consumption performance standard of one half the US average for that building type, as defined by the US Department of Energy."
- "All other new construction, renovation, repairs, and replacements of City buildings shall employ cost-effective, energy efficient green building practices to the maximum extent possible."
- In California, where all buildings already perform at a higher level than in most parts of the country, reducing fossil fuel use in new buildings by half is a serious challenge, though by no means impossible to achieve. It requires a strong commitment to the use of on-site solar photovoltaic for building electricity needs, and solar thermal systems for the production of hot water used in buildings, and / or the purchasing of renewable energy generated elsewhere.

The 2030 Challenge asks that off-site generated renewable energy be limited to a maximum of 20 percent of a building's energy needs. The goal here is to improve the energy performance of new buildings to the point that they can become largely self-supporting. Their operation would then no longer require large amounts of energy (even renewable energy) transmitted over great distances.

The US Conference of Mayors Resolution 50 goes on to ask that mayors work to increase the fossil fuel reduction standard for all new buildings until they become

[21] On June 12, 2007 (and subsequent amendment of June 27) the U.S. House Oversight & Government Reform Committee approved H.R. 2635 "Carbon –Neutral Government Act of 2007" which incorporates many features of the 2030 Challenge and the U.S. Mayors goals. Under the act all federal agencies are required to reduce greenhouse gas emissions incrementally until reaching zero emissions by 2050. By 2030 new and significantly renovated federal buildings will be carbon neutral.

Carbon neutral by 2030; the reduction to occur in the following increments:

- 60 percent in 2010
- 70 percent in 2015
- 80 percent in 2020
- 90 percent in 2025
- Carbon neutral in 2030

By carbon neutral, Resolution 50 means that by 2030 new municipal buildings will use no fossil fuel generated greenhouse gas emitting energy at all in their operations. The Resolution further resolves that "mayors from around the nation develop plans to fully implement the above mentioned targets for all new and renovated buildings."

The original 2030 Challenge, which was subsequently adopted by the US Conference of Mayors in the form described, has the goal of requiring all new construction to meet these performance standards, whether or not they are owned and operated by a municipal government. Obviously the percentage of energy use by most local government agencies is relatively small – generally less than five per cent of a city's total energy use, and so even radically improved performance in this sector will not by itself have a large impact on overall energy use, or on the long-term goal of reducing greenhouse gas emissions.[22]

4.5 – Local Agencies

4.5.1 *University of California, Irvine*

In July 2003, the UC Regents adopted a comprehensive green policy and goals for the University of California, but UC Irvine (UCI) had been focusing on sustainable practices for almost 10 years prior. UCI is using a combination of energy efficiency approaches to reduce consumption of non-renewable energy, including incorporating locally generated renewable power for existing and new facilities; making green power purchases, and investigating other energy projects that reduce fossil fuel use. UCI also incorporates energy retrofits into all major building renovations and performs energy-only retrofits when they can be justified by future energy savings.

[22] World-wide CO2 emissions from cars, factories, and power plants grew at an annual rate of 1.1% during the 1990s. But from 2000 to 2004, CO2 emissions rates almost tripled to 3% a year. According to the Global Carbon Project, emissions need to be reduced by 90% by 2050 if we are to avoid the strongest effects of global warming. As reported in the Christian Science Monitor, May 22, 2007.
Also, according to the US Energy Information Administration, based on current policies, world consumption of energy is expected to increase by 57% between 2004 and 2030. If oil prices remain at current or higher levels, coal is expected to be the fastest growing energy resource. As reported in The Economist, May 26, 2007.
According to a report in "Waste News" of May 28 2007; US carbon emissions from burning fossil fuels decreased by 1.3% in 2006. This occurred at the same time as the economy grew by 3.3%. Factors that contributed to the reduction included weather conditions that reduced the demand for heating and cooling services; higher energy prices for natural gas, gasoline and electricity also reduced demand, plus an increased use of lower-carbon and no-carbon fuels for electricity generation.

Actions underway or completed by September 2007 include sustainable projects in seventeen areas. Among the projects in energy efficiency and carbon reduction are:

- Construction of the Palo Verde II Student Apartments to USGBC LEED Gold standard. This was the first LEED Gold certificated project in Orange County.

- Installation of a 300 KW fuel cell that will generate both electricity and thermal energy for the central campus.

- UC Irvine has the highest on-campus housing percentage of all UC campuses and among all major public universities. In addition, if student housing within half-mile of campus is considered, 64 percent of the student body lives on campus, lives within walking distance, or has shuttle access to UCI. To encourage alternative modes of transportation, students living within half-mile of UCI cannot purchase commuter parking permits. The no-commuter-permit radius will be increased as new housing facilities are made available to students on, or adjacent to, campus.

- In 2007, UCI signed an agreement with Zip Car to provide shared cars throughout campus.

- In addition to carrying over one million passengers per year, the campus shuttle system is being retrofitted for 100 percent biofuel (B-100 biodiesel). Although many campuses use B-20 biodiesel (20 percent biodiesel / 80 percent regular diesel), UC Irvine is the first U.S. campus to convert its entire shuttle bus fleet to 100 percent carbon-neutral biodiesel.

- UCI is the largest employer in Irvine and its 2006 average vehicle rider ship of 1.87 is the highest among large employers in the entire Los Angeles basin.

- UCI's combined heat and power plant, with its 53,000 ton-hour thermal storage tank, is possibly the most efficient central plant on any North American campus. This plant can capture waste heat and utilize it (or store it for future use) six alternative ways, thus maximizing the efficiency of waste heat recovery and it reduces CO_2 emissions 24,000 tons annually and NO_X emissions 58 tons annually.

- UC Irvine's thermal energy storage system, the largest above ground in the western U.S., can shift up to 4.5 megawatts of electric load to off-peak (nighttime) hours.

- Energy conservation projects currently planned or underway will reduce CO_2 emissions 5,200 tons/year and NO_X emissions 4 tons/year, while reducing overall energy consumption per unit area by 5 percent. These projects will be completed within two years. Energy-retrofit projects planned in four years will increase energy-efficiency another 13 percent and reduce CO_2 and NO_X emissions an additional 12,400 tons and 7 tons per year, respectively. Buildings on the UCI campus constructed since 1992 have outperformed

California's Title 24 (energy code) by 20-30 percent for more than a decade before the Regents adopted the goal for the UC system

Beyond instituting green build standards, energy-efficiency retrofits and renewable energy such as photovoltaic, UCI will need emissions credits to become carbon neutral. All UC campuses face this requirement, so a system-wide solution has been proposed -- a large-scale "renewable energy farm" at a, as yet undetermined, UC field station site.

All measures in UCI's sustainability plan will enable UCI to approach carbon-neutrality as early as 2025 by reducing and offsetting carbon emissions *directly* not by buying carbon offsets from the marketplace.

4.5.2 *City of Los Angeles*

In May 2007, Los Angeles Mayor Antonio Villaraigosa published a plan[23] to reduce CO2 emissions in the city as a whole by 35 percent below 1990 levels by 2030, even as the city's population of 4 million is expected to keep growing. The Mayor's plan calls for securing 35 percent of the Department of Water and Power's energy from renewable sources by 2020. The utility's renewable energy sources currently stand at 8 percent of its power mix, up from 3 percent in 2005. The Department, which supplies electricity for 1.4 million homes and businesses, is responsible for about a third of the city's total emissions, because it relies heavily on burning coal at power plants in Utah and Arizona to produce electricity.[24] About half of the CO_2 produced in the city comes from vehicles. According to the Southern California Association of Governments, 77 percent of the area's commuters drive alone.

In April of 2008, Los Angeles became the largest city in the nation to impose green building rules that would potentially cut millions of tons of pollution over the next decade. The City Council passed an ordinance requiring builders of large commercial and residential developments to adopt such measures as planting drought-resistant landscaping and using recycled materials and energy-efficient heating, cooling and lighting. The law requires new commercial buildings and high-rise residential structures with more than 50,000 square feet of floor space to meet a nationally recognized "Leadership in Energy and Environmental Design" (LEED) standard, developed by the U.S. Green Building Council, a Washington-based nonprofit organization. It also would cover major renovations and low-rise developments of 50 units or more. The rules would amount to preventing about 85,000 metric tons of carbon dioxide emissions over the next five years, the equivalent of removing 15,000 cars from the roads.

4.5.3 *City of San Jose*

In early June 2007, the City of San Jose adopted a set of greenhouse gas reduction goals for its municipal operations only ranging from 25 percent below 1990 levels by

[23] As reported in the Los Angeles Times, May 15, 2007.
[24] On May 23, 2007 the California Energy Commission imposed new rules forbidding the LA Dept of Water & Power and all other municipal utilities in California from signing new contracts with coal-fired power plants. Identical regulations were imposed on private utilities in January. Overall 20% of California's electricity is currently generated using coal-fired plants in other states. As reported in the Los Angeles Times, May 24, 2007.

2012 to an 80 percent reduction by 2045. This follows from the City's prior adoption in March 2007 of the Climate Change Agreement proposed by the U.S. Conference of Mayors. San Jose already has a 'green' fleet of over 900 vehicles using bio diesel; a wastewater treatment plant that has reduced its energy use by 25 percent; and a new City Hall that uses 25 percent less energy per square foot than required by Code.

4.5.4 *Los Angeles Community College District*

The Los Angeles Community College District has adopted a target of obtaining 15-25 percent of its electricity from renewable sources, with 10 percent of this produced off-site. The District intends constructing 44 LEED certified buildings over the next decade, and hopes to hold energy demand at 45MW, while building floor area increases by 60 percent. The District has already received $1.3 million in utility rebates to assist with its energy projects and anticipates receiving a further $5.5 million in future.

4.5.5 City of San Diego

The City of San Diego is planning to reduce its greenhouse gas emissions by 15 percent below 1990 levels by 2010, in part by producing 50MW of local renewable energy by 2013. At the Point Loma Waste Water Treatment Plant, a cogeneration facility is powered by methane gas produced at the plant and generates 4.57 MW of electricity. Also at the Point Loma Plant, there is a hydroelectric facility producing another 1.35 MW of power as the treated wastewater drops 100 feet into the ocean and a 1.2 MW generator peaking unit that runs on 80 percent digester gas and 20 percent diesel was recently added. An additional 6.4 MW of electricity is generated using landfill gas from the Miramar Landfill as fuel. Modeled after the success of the Point Loma Plant, the North City Water Reclamation Plant was built to produce 3.8 MW of energy. The City has installed 13 photovoltaic systems on City-owned facilities capable of producing 1.24 MW. The City also intends reducing its fleet's fuel consumption by 15 percent annually. The anticipated cost savings from the City's utility bills total $15 million.

4.5.6 *Sonoma County*

In September, 2005 the Sonoma County Board of Supervisors voted to establish a county-wide greenhouse gas reduction target of reducing emissions by 25 percent below 1990 levels by 2015. Subsequently, all nine Sonoma cities passed resolutions establishing this emissions reduction target for their communities.

SECTION 5.0 – IRVINE ENERGY PLAN GOALS

The goals of this Energy Plan provide general direction for Irvine's energy and emissions reduction efforts over the long term. Two of the four goals also include interim goals which, when successfully implemented, will move Irvine toward the long term goals. These goals have been defined using the General Plan Energy Element as a guide and by taking into account the strategies of the State of California. There is an emphasis on information and participation as having an informed public clears the path for initiating future change. Energy efficiency is also emphasized because it is the most cost-effective and powerful tool we have to achieve greenhouse gas reductions over the short run. Once energy consumption is as efficient as possible, the next step is to switch to renewable energy to further reduce fossil fuel use. The fourth goal addresses greenhouse gas reductions and, to some degree, encompasses each of the other three goals.

5.1 – Community Participation

Goal: Involve 100% of Irvine residents and businesses in the Energy Plan

The City would strive to make sure that the entire community is informed about energy issues and to encourage, to the greatest degree possible, its participation in achieving the long term goals of the Irvine Energy Plan. The motto would be:

"100% Participation, 100% Irvine"

The key to success here is emphasizing the important contribution that each member of the community can make by being an informed consumer and how everyone making small individual changes will produce large citywide benefits. Education of the residents, businesses and those who visit the City must be a cornerstone of this effort. An informed public is one empowered to reduce energy consumption (and thus, greenhouse gas emissions) and one that will collectively protect the environment for generations in the future. An informed public will also be more willing to make changes once they understand the impact on their future and the future of their children and grandchildren. An informed public will make the difference in Irvine's ability to succeed.

5.2 – Energy Efficiency

Goal: Irvine will reduce its energy use in buildings citywide 30 percent by 2015 compared to 2003 levels.

The goal of achieving a 30 percent reduction in building energy use by 2015 exceeds the Governor's Green Building Executive Order (S-20-04) goal of reducing energy use in public and private buildings by 20 percent by 2015. Irvine has shown leadership in adopting the voluntary program, Irvine Build Green, and can reach beyond what the state has envisioned. The year 2003 was chosen as a base year to match the Green Building Executive Order. Becoming more efficient not only saves energy, but also saves residents and businesses money. Meaningful energy

efficiency can be effectively accomplished using existing technologies.

5.3 – Transition to Renewable Energy

Goal: Increase the percentage of renewable energy used in new buildings citywide:

- ***40 percent of the energy used by new buildings citywide will be derived from renewable sources by 2015***
- ***60 percent of the energy used by new buildings citywide will be derived from renewable sources by 2020***

While these goals for renewable energy use may seem ambitious, it is important to recognize that electricity supplied by Southern California Edison (SCE) is already 17 percent renewable energy, and that SCE expects to continue increasing this percentage to at least 20 percent.

5.4 – Greenhouse Gas Emissions

Goal: Reduce greenhouse gas (GHG) emissions:

- ***to 2000 levels by 2010 (This reduction is equivalent to about 11 percent below the anticipated 2010 emissions under a business-as-usual scenario.)***
- ***to 1990 levels by 2020 (25 percent below the anticipated business-as-usual scenario)***
- ***to 80 percent below 1990 levels by 2050***

These goals follow those established in the State's AB 32: *Global Warming Solutions Act*. An early step in implementing the emissions reduction goals will be to conduct an inventory to provide a baseline picture of Irvine's current emissions. Additionally, an emissions reduction plan will need to be created to be able to effectively track the total amount of emissions reduced from the established baseline.

Current best practices for achieving a reduction in greenhouse gas emissions includes: (1) conducting an initial assessment of neighborhoods or communities, to identify its potential sources of greenhouse gases emissions and it's likely exposure to the consequences of climate change (e.g., rising temperatures, changing precipitation patterns, wildfires), (2) developing a quantitative greenhouse gas emissions inventory, (3) using information from the inventory to identify and prioritize emission reduction strategies, (4) use information from the initial assessment to identify and prioritize opportunities to make the neighborhood or community more resilient to changing conditions.

Planners and developers who take these actions jointly will be able to reduce the risk of regulatory surprises, minimize future liabilities, and potentially create new business opportunities.

The City government will need to lead by example before it asks for the cooperation of the community in achieving the goals as set out. This effort will build upon the City government's history of commitment to energy efficiency, but must now include the use of renewable energy, reduction of carbon emissions, and will require a comprehensive approach to energy management for its own operations. This will involve, for example, retrofitting and monitoring all existing City facilities, ensuring that new City facilities are built to the highest energy performance and green building standards, altering purchasing practices, providing education and training to the municipal users of energy consuming equipment, changing operations and maintenance practices, and shifting facilities from fossil fuel generated electricity over to the widespread use of renewable energy resources.

SECTION 6 – NEXT STEPS

In this section is a set-by-step process for the City to follow as it leads the way for the community on the Energy Plan Goals. First, the City will need to assemble a management team that will guide the process and implementation. That same team can be augmented with community representatives as it transitions to dealing with citywide strategies. Next, the City will have to formally monitor and track its efforts in order to check its progress towards the goals. Most importantly, the City will need to investigate all avenues of financing in order to make the most cost effective decisions while pursuing the goals. Below is a more detailed description of these steps.

6.1 – Step 1: Create an Energy Management Team

Successful implementation of a comprehensive citywide Energy Plan requires participation and support from elected officials, Commissioners, staff in all the City's departments, as well as residents and representatives of the commercial and business sectors. New energy projects can affect many people and, sometimes, those that are negatively impacted feel they have cause to impede a proposed project or to bypass an energy saving system after it has been installed. Meeting these challenges requires a team of key participants, who can come to a unified vision of the kind of energy activities Irvine should undertake and how they will be implemented.

The energy team can help identify difficulties during the early project development stages to ensure that everyone who may be affected by the project also understands the benefits that will result from its success. Successful energy teams increase collaboration, help build consensus, and allow those who will be affected by decisions to also participate in making them. Key requirements for energy team success are:

- A clearly defined long-term direction
- Strong political support from the City's top decision makers
- Members who are energy champions in each department or city sector to be impacted, and at all levels of the department or sector. This must include decision makers, City management, and in the business leaders.

6.1.1 *The Core Team*

The core membership of the energy team is provided by the City and may involve personnel from many different departments. Core participants may vary depending on current project priorities, but is likely to include the following:

- Environmental Programs Administrator – coordinates the activities of the energy team.
- Finance Department – provides assistance on budgetary, accounting, and economic analysis of energy projects. Finance may also help track energy costs and inform the Environmental Programs Administrator of billing anomalies.
- Public Works Department – provides experience with the agency's infrastructure and with current maintenance practices. For some retrofit

projects, like the transportation center, Public Works staff may be the actual project implementers.

- Community Services – as the manager of many of the City Government's buildings, the department has a major role in determining when, where and what energy projects will be implemented for the City, and how they will be financed and operated.
- Community Development Department – to ensure that planning and building codes do not present barriers to energy efficiency, especially in the residential and commercial sectors. For example, building height limits and aesthetic concerns may sometimes present barriers to the installation of renewable energy systems. Also, as a major decision-maker in the redevelopment of the Great Park, the department needs to be involved in energy-related decisions affecting this and similar future projects.
- Utility Representatives – to ensure that the City is coordinating effectively with its utility providers and aware of all existing utility programs available to support the Energy Plan efforts.

Other team members may be added on a project specific basis to provide specialized skills such as legal, human resources, purchasing and contracts, transportation, etc.

For the City's own facilities this core group can form the City's in-house 'energy team,' that can guide energy projects in municipal facilities. This in-house team can help the City set its internal energy priorities, establish implementation projects, and advocate for energy project funding. This core group should be supplemented by representatives of the wider residential, commercial, and business communities as the City moves to implement programs that affect the City as a whole.

For projects directed at the private residential and commercial sectors, there are also local non-profit energy interest groups and business community leaders who, while perhaps not permanent energy team members, can also be essential supporters of local energy efficiency projects. Other possible community supporters include local environmental organizations, including those concerned with the relationships between energy use and human health. For example, childhood asthma is of growing concern, and has been strongly linked to local air quality, which is in turn directly impacted by local energy use. U.C. Irvine is obviously a strong local resource; and as the major developer in Irvine, a representative of The Irvine Company would ideally also be included on the Core Team.

6.2 – Step 2 - Calculate Irvine's Greenhouse Gas Emissions Baseline

The City should establish both its baseline greenhouse gas emissions and its current greenhouse gas emissions to use for generating a target reduction plan. The State of California has recognized climate change as a threat to people and the environment. The Global Warming Solutions Act (AB 32) sets ambitious, economy-wide targets for greenhouse gas reductions, including a return to 1990 levels by 2020. This goal reflects approximately a 25 percent reduction from "business-as-usual" trends. This baseline analysis evaluates opportunities for the City to demonstrate consistency with state goals by showing a substantial break from

business-as-usual patterns of development. This can be done by identifying development features within the City that contribute to tangible reductions in greenhouse gas ("carbon") emissions intensity. One measure of performance could include a 25 percent decrease in emissions compared to a "business-as-usual" baseline (i.e., 25 percent reduction in the net increase in emissions associated with building a similar project under conventional parameters). Achieving a 25 percent reduction in emissions would be an indicator of consistency with the state's goals for long-term emissions reductions.

6.3 – Step 3: Track and Monitor Progress

The ability to regularly and effectively monitor progress is critical to long-term energy program success. Without quality information on whether programs are or not meeting their goals, it may become very difficult to make informed decisions about project schedules and the future disposition of financial, staffing, and other resources.

In general, different types of energy programs will have their own appropriate metrics for program evaluation. For example:

- Programs focusing on energy efficiency measures should track the initial program target savings, the number and type of measures being installed, anticipated and actual savings per measure, and costs per measure. Long-term energy savings also need to be verified through persistence studies at a fixed-period after a measure's initial installation.
- Programs to install renewable energy systems can use similar metrics – number and type of installation, estimated annual energy production, costs for installation and operations and maintenance.
- Staff energy education programs should track the numbers of staff participating in the program, number of workshops held, and the types of education / information service offered. Post-participation surveys can be conducted to demonstrate how behavior has changed and to evaluate its persistence over time.

Information on City energy use needs to be available to the Energy Management Team, to individual building managers, and to City decision makers, though the different users will typically require different levels of detail. The Energy Management Team will have principal responsibility for gathering the City's energy information together, identifying the key information – especially that indicating long-term trends, and for reporting the findings to the relevant commissions and to Council. Facilities managers will be more interested in the energy performance of the specific facilities under their control and in tracking energy use trends to identify anomalies in facility energy use. All are dependent on information derived from an effective utility information management system. The local utilities can provide technical assistance for the development of these energy information resources.

6.3.1 *Energy Tracking in Municipal Facilities*

For the City's facilities the Energy Plan recommendations focus on improving the energy performance of existing facilities, on ensuring that any future building are

built to a high standard of performance, and on shifting the City's electricity use from fossil fuel generated electricity over to renewable resources. Therefore, the City needs to be capable of tracking energy use and costs in its existing and new facilities. As buildings equipped with renewable energy systems begin to appear on line, the City should also be capable of tracking the contribution these systems make toward their host building's energy use.

Electricity bills for City facilities are currently received and paid by the Community Services Department, and the City's natural gas, street lighting, irrigation controller, and traffic signal bills are paid by the Public Works Department. The City does not currently have an internal system for tracking and regularly monitoring its energy use, but does periodically receive summary reports on the electric accounts from SCE. Natural gas use, although tracked, seems to be somewhat less well monitored. The City should establish a procedure to inform facilities managers of ongoing building performance.

The City's Facilities Maintenance Superintendent has requested proprietary utility software ("Utility Manager"[25]) as a tool to help the City monitor its energy use and costs. An energy tracking and accounting system such as Utility Manager allows an energy user to record, analyze, and report energy use and energy costs. It keeps track of utility bills for facilities and provides information on trends in energy use. A good system will also assist with evaluating the effectiveness of an energy management program and help with identifying the most cost-effective energy conservation measures to implement. Certain systems will also allow you to track other utilities such as water, sewer and natural gas, as well as electricity.

Most energy accounting software easily adjusts for variations in weather, facility operating hours, and square footage, so the City can also track year-to-year changes in energy use that are truly due to improved energy efficiency. Another advantage is that utility companies and utility accounting software developers have coordinated their electronic data interchange systems to enable utility billing data to go directly into a City's energy accounting system. This greatly simplifies the process of entering information into the energy tracking and accounting system, and ensures that energy use data and cost information is always current.

Access to such information allows City decision makers to make fully informed decisions about the City's energy programs. A system can help provide information on which projects are meeting their goals; enable adjustments in project timelines and staffing; and inform the future disposition of program resources.

Energy accounting can help the City:

- Measure energy savings and track the performance of energy projects
- Understand where energy is being used and when
- Track energy use trends overall and in specific facilities
- Communicate energy use data to the staff that manage building operations
- Catch billing errors and unusual energy use activity
- Calculate the avoided costs associated with completed energy efficiency projects.

[25] For information on "Utility Manager" and its capabilities, go to: info@utilityaccounting.com

- Allow accounting staff to track energy cost trends over time and identify billing anomalies

6.3.2 *Benchmarking Municipal Facilities*

Benchmarking is a way of rating the energy efficiency of a building, using the federal government's Energy Star system. This provides a performance "score" which ranks the building on a percentile basis against other comparable buildings. Energy Star also provides the energy intensity, or annual energy use per square foot, which can be useful for comparing smaller groups of buildings.

The benchmarking process uses a year's worth of energy consumption, adjusted for the size of the building, its occupancy, operating hours, number of computers, the climate and other factors. A building's final score reflects both the physical efficiency of the building and its equipment, and its operational efficiency, and this information can help managers identify the performance of their buildings compared to other similar facilities.

The State's 'Green Building Action Plan' requires that all State-owned buildings undergo benchmarking for energy efficiency by 2007. [26]

6.3.3 *Tracking City Vehicle Energy Use*

The City currently tracks the quantities of gasoline and diesel fuel used each year together with the associated costs, but the City does not presently have a formal program to reduce the annual miles traveled by fleet vehicles, or to raise the average fuel efficiency per vehicle mile traveled. The City does track annual fleet vehicle miles traveled which could provide the necessary baseline information for initiating a program to increase the efficiency of the City's fleet.

As described in Section 2.4.3, the City is installing GPS (Network Car) units in all new vehicles purchased and will install GPS units in all vehicles over the next three years. These units and software allow monitoring of vehicle use, miles driven, idle time, speed, and monitoring of smog control devices. These units allow for active management of vehicle use.

The current overall fleet efficiency is 8.6 miles per gallon.[27] This overall fuel efficiency is likely to increase as vehicles are replaced with various hybrid and alternative fuel vehicles that are proven to be more fuel efficient and use less fossil fuel.

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[26] For further information on benchmarking go to the Green California website at: www.green.ca.gov/EnergyEffProj
For information on the Energy Star program including its benchmarking support information go to: www.energystar.gov/index.
Information on estimated annual energy savings attributable to efficiency and renewable energy installations, including typical values for estimating the cost of efficiency measures, annual energy savings, and effective useful lifetimes can be found in the State-sponsored Database for Energy Efficient Resources (DEER) at www.energy.ca.gov/deer

[27] Vehicles left idling to be able to use on-board equipment (e.g. police lights, maintenance equipment) brings this average down.

6.3.4 *Tracking Private Residential and Commercial Energy Use*

Most local energy efficiency programs directed at the private residential and commercial sectors are currently funded by the California Public Utilities Commission (CPUC) and managed by the local utilities, or by third party program managers in cooperation with the utilities. For all these programs, the CPUC has set high standards for the required measurement and evaluation of program results. Since this is public information, the energy reduction impacts of implementing the various programs are available to the City.

Reductions in local energy use that result from individually financed, owner-managed private sector projects may be more difficult to track. At present these represent a relatively small percentage of completed installations, but hopefully this will increase. Private sector efficiency projects, and renewable energy systems installed through participation in programs such as the Irvine Build Green program, which require participant registration in the program; and projects that require building, plumbing, or electrical permitting by the City are all relatively easy to track.

Information on transportation usage is available from regional transit agencies and from the State Department of Transportation “Highway Performance Monitoring System.”

6.4 – Step 4: Energy Program Financing

The two fundamental activities for most municipal energy programs are retrofitting existing municipal buildings to improve their energy performance and ensuring that any new municipal facilities are built to the highest energy performance standards. To be effective, both activities need long-term support and a serious commitment to continued funding. This allows staff to build its technical and management skills, and to develop the relationships with staff in other municipal agencies that are so critical to implementing successful energy projects. Unfortunately, local government energy programs are often seen as amenities rather than necessities, and so expenditures on energy programs fluctuate over time along with national and local political interest in energy issues. However, maintaining continuing funding is the key to long-term program success.

Municipalities have responded to the need for consistent long-term energy program funding in a variety of ways. Some programs depend largely on outside funding from state government or their local utilities. Other local government programs have had to rely on the annual budgeting process, and have had no choice but to make their arguments for funding regularly each year. This obviously makes these programs very vulnerable to current perceptions of the importance of energy efficiency at that particular moment in time, and it can make long-term energy program planning and implementation very difficult.

Some municipal governments, such as the City of Phoenix, have instead tried to protect their programs from annual fluctuations in financial support. Obviously these city councils still retain general financial control, but the energy programs are much less vulnerable to shifting short-term priorities. Other cities, such as Portland with its 1 percent add-on to departmental energy bills, and Boulder, CO with its climate action tax have developed different program funding mechanisms. In California the

CEC has for many years provided a loan program for local governments. The program is structured so that the loan repayments are less than the savings that result from installing the energy measures, so there is no additional net cost to the city. These alternative financing mechanisms are described briefly below.

6.4.1 *Revolving Funds*

For some cities the solution to the energy project financing problem has been to put in place an administrative device, sometimes called a "revolving fund," that provides continuing long-term financial support to the energy program. To some extent, this device operates outside the annual budget review process, and so energy program staff can be confident that funding will continue to be available. This allows the energy staff to make longer-term commitments to the energy program's many stakeholders.

A typical revolving fund works as follows:

- The energy program obtains initial seed funding from a city's general fund, or from the local utility, or as a grant or loan from a state or federal agency. Occasionally funding may be received from a non-profit foundation interested in environmental and energy related issues.
- This initial "stake" money forms a kind of "bank account" from which energy projects in the city's facilities may then be funded.
- The dollar value of the energy savings that result from the funded energy projects, are reinvested in the bank account to provide funding for subsequent energy projects.

When the revolving fund program is fully operational, and savings are accumulating in the fund, then a decision may be made to either leave all the funds in the energy account, or to split the accumulated savings with the general fund, or to share the savings with a recipient client department if they have also been contributing toward energy project costs.

The best known local government example of a fully operational revolving fund is that operated by the City of Phoenix. The City of Phoenix began its energy management program following the energy crises of the late 1970's. The program initially funded no-cost / low-cost energy retrofits, especially lighting projects. By 1983 the program had fully established its credibility and City Council felt confident enough of the program's via percent of documented energy avoided costs to be reinvested in further energy efficiency improvements. Any avoided costs [28]over a set amount would be attributed to the City's general fund. The funds are all spent on retrofit work in the general fund departments. Any activities related to new construction are funded separately, and in general the program is entirely self-supporting.

[28] Program staff in Phoenix have made it a habit to refer to the dollar benefits from completed energy projects as "cost avoidance" rather than as "savings," in order to avoid giving the impression that money saved by energy projects is sitting around waiting to be spent.

6.4.2 *The City of Portland's 1 Percent for Energy*

Portland has used a very different method of financing staff supported energy projects in the city's existing facilities. Portland imposed a 1 percent surcharge (with a ceiling of $15,000 per department) on departmental energy bills. The money went into a central fund to support a city energy specialist who acts as the representative on energy issues for the departments, interfacing with the utilities, staying in touch with current rebates and other assistance available, and providing technical support for departmental energy projects.

6.4.3 *The City of Boulder's Climate Action Tax*

In November 2006 the City of Boulder's voters approved Initiative 202 – the Climate Action Tax Plan that went into effect on April 1st, 2007. The revenues generated through the tax will be targeted at reducing greenhouse gas emissions generated by energy use in buildings, the operation of vehicles, and landfill gas emissions. The tax is a surcharge based on a per-kilowatt-hour usage with an annual cap. The tax is collected by the utility as part of the normal billing process; however, customers who subscribe to the utility's premium priced renewables portfolio will be exempt. In 2007 the tax is expected to generate more than $860,000, though in future this could go as high as $1.3 million. The specific programs established under the plan include weatherization services, energy audits, contractor training and public workshops, promoting renewable energy, recognition programs for high achievers, light bulb incentive programs, and neighborhood sweeps where conservation kits and information will be distributed to residences.

6.4.4 *CEC Local Government Loan Program*

The California Energy Commission (CEC) has for many years provided a loan program to support local government energy retrofit and some new construction projects. The program provides low interest loans (currently as low as 3.95 percent and fixed for the term of the loan) for feasibility studies and the installation of cost-effective energy projects in schools, hospitals and local government facilities.

The loans are repaid out of the energy cost savings, and the program will finance lighting, motors, drives and pumps, building insulation, heating and air-conditioning modifications, certain energy generation projects, including renewable energy projects and cogeneration, streetlights and traffic signal efficiency projects. Loans can cover up to 100 percent of project costs and there is a maximum loan amount of $3 million. [29]

6.4.5 *Acceptable Energy Project Payback Periods*

There are a number of alternative ways of evaluating the cost-effectiveness of a proposed energy project, including total life-cycle cost, net savings, savings to investment ratio, and internal rate of return. By far, the most common project evaluation method is simple payback. This method ignores the time value of money and assumes that future savings occur in even amounts each year over the lifetime of a proposed measure. The simple payback period is equal to the investment cost

[29] For more information see www.energy.ca.gov/efficiency/financing

divided by the annual savings. For example, a $1,000 investment that saves $500 each year has a two year simple payback.

In the recent past it has been the City of Irvine's general practice to look for payback periods as short as two years to five years. These are very short payback requirements and they severely limit the kinds of projects that can be supported. They also exclude many otherwise worthwhile projects with longer payback periods and inevitably increase the City's overall long term energy costs. The City should institute a payback policy for future energy projects in City facilities to have a longer payback period than 2-5 years.

Like most local governments, Irvine is primarily an owner / occupier of its facilities. The City's financial interests therefore, are best served by taking every cost-effective opportunity to implement energy projects that lower the City's energy costs. The federal government has chosen to implement all efficiency projects with a payback of ten years or less, but in principle any project that pays back its initial investment in less than the measure's anticipated lifetime can reasonably be considered worthwhile. Another way other government agencies have dealt with energy project payback periods is to implement comprehensive energy projects that include a range of different measures, where the shorter payback measures can subsidize the cost of longer payback items, to produce an acceptable overall payback period.

6.4.6 *Local Renewable Energy Credit Projects*

Many companies and individuals wishing to reduce their carbon footprint buy Renewable Energy Credits, or RECs. A REC is nothing more than an assurance that the money paid will be used to fund a renewable power facility that would not otherwise have been funded. The City of Irvine could set up a program to fund those projects in Irvine using the money that would have been paid for projects in other parts of the country or even the world. It would be an option for businesses and individuals in Irvine or in neighboring communities to be sure their money is used for the purpose intended and it will benefit them more directly.

6.5 – Step 5 - Initiate "100% Participation, 100% Irvine" Campaign

This must be an on-going campaign because the residents and business are constantly in flux. Energy efficiency, renewable energy, and reducing carbon should become core values for the community. It is only when everyone is doing their part that the goals set out in this Energy Plan can be achieved. "100% Participation, 100% Irvine" will need to become part of everything the City does. Whenever the City hosts an event, the elements that contribute toward achieving the goals of the Energy Plan should be highlighted for all who attend to see. Every City employee should be trained in the basic precepts of this Plan so that they can either answer questions about the goals or direct people to information about how they can help achieve the goals. A comprehensive and on-going program to accomplish this will need to be developed. It will need to include such entities as the Chamber of Commerce and the Homeowners' Associations in order to be successful.

6.6 – Summary of the Next Steps

Table 10 summarizes the steps as described, and includes the staffing and cost impacts to implement.

Table 10 – Next Steps in Implementing the Energy Plan

ACTION	PURPOSE	COST TO IMPLEMENT	STAFFING IMPACTS
Establish an Energy Management Team	Provides direction to the energy programs, helps build consensus, and allows those affected to participate in decision making	Low initial cost, but on-going	Environmental Programs Administrator is only permanent member, but requires time from all participants
Prepare citywide CO2 emissions inventory and reduction plan by 2009	Provides a baseline picture of current local climate-changing emissions	Approximately $150K	Data gathering and/or preparation of inventory by consultant, with project management by Community Development Environmental Programs staff
Establish energy tracking and monitoring program	Ability to track and communicate energy and cost trends, measure program savings, and identify billing anomalies	Relatively low cost to purchase software, but requires ongoing maintenance	Ongoing by both Community Development Environmental Programs and Finance staff; access should also be available to individual dept and building managers
Establish short term and long term energy program financing methods	Provides near-term financing of current Municipal retrofit opportunities, and on-going funding for long-term switch to renewable energy systems	Loans from CEC to finance retrofit opportunities which can be met from energy savings. Long term costs for renewable energy systems are high, with long paybacks; rebates are available	Ongoing by both Community Development Environmental Programs and Finance staff
Establish 100% Participation, 100% Irvine Public information campaign	Essential component of Irvine's public information campaign. Provides vehicle for all sectors to demonstrate commitment to the city's energy goals	Requires ongoing financial support from public and private sectors	Ongoing support from Community Development Environmental Programs staff, management, and elected officials; plus participation and support from influential private sector commercial and residential decision makers and local energy interest groups

SECTION 7 - MUNICIPAL IMPLEMENTATION STRATEGIES

The City will need to lead the way towards accomplishing the goals of this Energy Plan so this section lays out the strategies that would do just that. The first set of strategies listed is those that improve the energy performance of existing facilities and thereby reduce the demand for energy. The second set of strategies ensures that all new facilities are designed and constructed to be as energy efficient as possible. When a facility's need for energy has been reduced as far as possible, then meeting the remaining demand with renewable energy is much easier and more cost-efficient. The third set of strategies addresses the City's fleet vehicles and employee transportation.

Selected strategies, along with a budget, will make up an implementation plan that would be approved by City Council before staff could proceed. They are presented here to provide an overview of what kind of actions will need to be taken by the City to achieve the four long-term goals presented in the previous section.

7.1 – Existing Municipal Facilities

7.1.1 *Conservation & Improved Efficiency*

These "higher impact" strategies would do the most toward helping achieve the long-term goals:

a. Determine the status of previous audits of municipal facilities; identify cost-effective energy efficiency retrofit measures, and evaluate alternative project financing mechanisms. (A discussion of cost-effectiveness is included in Section 6.3.5 Acceptable Energy Project Payback [30])

b. Consolidate smaller energy retrofit projects, and identify potential funding sources.

c. Implement all cost-effective retrofit projects, and select certain projects for certification under the LEED Rating System for Existing Buildings (LEED EB) to provide a benchmark for future retrofit projects.

d. Re-commission all major energy using facilities to ensure that their energy using systems are operating at maximum efficiency. (Note that Southern California Edison and The Gas Company have programs to assist with some aspects of re-commissioning.)

e. Identify all non-building energy uses such as exterior lighting and irrigation systems, and evaluate performance. Identify and implement cost-effective ways to improve efficiency and/or reduce lighting during low usage time periods.

f. Certify all municipal facilities under LEED for Existing Buildings (LEED-EB).

[30] A complete evaluation of the cost of implementing a potential energy efficiency project should also include the "cost of delay." For example, if a proposed retrofit project will save $5,000 annually but for financial or other reasons its implementation is delayed for two years, then the cost of delay is $10,000. Quite often the cost of delay is greater than the savings that may result from delaying a project in order to downsize the work in hope of reducing the project's cost. The obvious conclusion is that cost-effective energy efficiency projects should, whenever possible, be implemented without unnecessary delay.

These "lower impact" strategies would still move the City toward achieving the long-term goals, albeit at a slower pace:

g. Evaluate replacing conventional systems with off-grid systems such as using solar powered lights for conventional park trail lighting.
h. Work with Southern California Edison to pursue the testing and introduction of new technologies, such as electronic ballasts for high pressure sodium street lights (and possibly LED street lighting) through the installation and monitoring of pilot projects.
i. Continue to work closely with Southern California Gas Company and Southern California Edison to ensure the City is taking full advantage of their many technical and financial energy efficiency resources.
j. Evaluate and, where appropriate, incorporate demand response technologies such as programmable communicating thermostats.
k. Adopt operations and maintenance practices, staff education, and purchasing policies that support energy efficiency goals.

7.1.2 *Administrative / Institutional Changes*

Higher impact strategies:

a. Conduct an internal review of City policies for the financing of energy retrofit projects, the current use of one-time carry-over funds, and develop a payback policy for the future financing of municipal energy projects. 31.
b. Evaluate energy project financing mechanisms (e.g. general fund expenditures, a revolving fund, or using California Energy Commission loans) and put a project financing system in place using one or more of those mechanisms.
c. Evaluate energy project delivery methods (in-house staff install v. contractor v. energy service company (ESCO) v. etc) and select preferred alternative to match City's current needs, and implement retrofit projects. 32
d. Evaluate various utility management systems; select and purchase a system together with staff training and technical support.
e. Participate in State and Federal energy programs such as EPA Green Lights and Energy Star Purchasing and other similar programs, which promote the use of energy-efficient technologies and provide services to help agencies identify, specify and purchase energy efficient office equipment, lighting equipment, appliances, etc.
f. Work with utilities and local energy interest groups to ensure information on energy and related issues is widely available, especially to 'hard-to-reach' communities.

[31] Section 6.3.5 of this Plan includes a discussion of payback criteria.
[32] Different project delivery methods have varying advantages and disadvantages. For example, certain project delivery systems can minimize the administrative burden on staff but are likely to be more expensive; in contrast certain types of project may be installed more cheaply using in-house labor, but they obviously are more demanding of staff, which may then not be available for routine maintenance work.

g. Work with utilities and adjacent local and regional governments to ensure that available local energy resources such as landfill gas opportunities in the County are fully exploited.

Lower impact strategies:

a. Evaluate existing available staff training and energy education programs;[33] identify incentives for improved energy efficiency performance by staff.
b. Develop a reward system for staff ideas leading to a reduction in energy use.
c. Expand energy efficient transportation alternatives for staff such as van pool programs.
d. Work with UCI and Toyota to make the ZEV-NET program available to City employees to encourage commuting by rail.
e. Consider joining the California Climate Action Registry and registering all future qualified energy efficiency projects.
f. Develop an energy emergency contingency plan to provide initial guidance to City departments on the appropriate operation of municipal facilities in the event of a future disruption to energy supplies.
g. Track the development of "White Tags" which are intended to provide a tradable market value for installed energy efficiency projects.

7.1.3 *Renewable Energy Systems*

Higher impact strategies:

a. Survey and map all existing City owned properties to determine their potential for the installation of renewable energy systems – primarily solar photovoltaic and thermal systems.
b. Determine the percentage of renewable installation potential available on-site at each municipal facility, and the amount of remaining energy demand that is to be met by purchasing renewable energy generated off-site.
c. Establish a multi-year plan to finance and install renewable systems at the selected facilities, completing all installations by 2015.
d. Identify and evaluate alternatives for the provision of off-site generated green energy.
e. Pursue the development of educational/informational renewable energy demonstration projects at the Great Park.

7.2 – New Municipal Facilities

The US Conference of Mayors long-term goal for new facilities is to eliminate fossil fuel use in new city owned facilities by 2030. Since Irvine anticipates reaching full build out by 2025, ideally new buildings constructed during the latter part of this time period will already meet that standard. Buildings constructed earlier can reach the goal through a stepped increase in the percentage of renewable energy used over time, as recommended in the Mayors' Resolution 50.

[33] For example, the US Dept of Energy has produced a CD-ROM staff training aid called "Power Check Low and No-cost Tips for Saving Energy." The Gas Company has also developed an employee training program that would be available to City employees.

7.2.1 Conservation & Improved Efficiency

Higher impact strategies:

a. Design and construct high performance facilities exceeding the requirements of the State energy code Title 24 by a minimum of 20% and adopting a LEED certification level of Gold as the standard for new municipal facilities[34]. Purchase energy efficient equipment and materials for those facilities thus lowering building energy operating requirements.
b. Ensure that all new municipal facilities are built to provide a very high level of energy performance, easily exceeding code requirements, through careful architect/engineer selection, expert energy design review of proposed projects, appropriate specification preparation, etc.
c. Develop selection criteria for the architects/engineers of new municipal construction projects that will ensure adequate previous green building and renewable energy system experience.
d. Ensure new municipal construction projects are taking maximum advantage of utility assistance programs such as 'Savings by Design' that provide design assistance, and owner and design team incentives.
e. Require extensive use of day lighting in the design of all new municipal facilities.

Lower impact strategies:

f. Since pumping water is a major user of electricity, measures to reduce water use also save energy. Therefore, all toilets in new municipal construction projects, and replacement toilets in major remodel projects in municipal facilities could be required to meet the water efficiency standards (January 2006) of the 'Uniform North American Requirements (UNAR) for Toilet Fixtures.' [35]
g. All urinals in new municipal construction projects and in major remodel projects in municipal facilities shall be high-efficiency fixtures using less than 0.25 gallons per flush (0.95lpf) or be waterless fixtures.

7.2.2 *Renewable Energy Strategies*

Higher Impact Strategies:

a. Provide all new facilities with on-site renewable energy systems, which over time meet a steadily increasing percentage of facility energy needs, until new buildings reach the US Mayors Conference goal of carbon neutrality in 2030.
b. Where necessary, purchase renewable energy generated elsewhere to bridge the

[34] The City currently has LEED Certified as the required standard for new construction projects. A survey of 33 LEED buildings reported by Greg Katz indicated that the surveyed projects had an average increased cost premium of 1.8%, or about $4 per square foot. Katz also describes the results of a survey of 60 LEED rated buildings that indicated that green buildings are 25-30% more energy efficient when compared to conventional buildings. The LEED Gold buildings surveyed experienced an average reduction in energy use of 37% compared to conventional buildings, and LEED Certified a reduction of 18%. The total 20 year net present value per square foot of a LEED Gold building was $67.31, and $48.87 for a LEED Certified building. "The Cost and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force. 2003, Greg Katz; Capital E, Principal Author.

[35] UNAR is a voluntary qualification system that can be adopted by water authorities who want to ensure both that toilet fixtures achieve water savings that persist over time and that customers are satisfied with toilet flush performance. UNAR incorporates both minimum performance standards and the Los Angeles Supplementary Purchase Specification to ensure performance is maintained.

gap between a building's energy needs and the energy provided through on-site renewable energy generation.

c. All new public swimming pools, gymnasia, and related community facilities should be required to have water heating provided (at least in part) by renewable energy sources, especially by solar hot water systems, and/or by cogeneration.

7.3 – Transportation

Higher impact strategies:

a. When replacing fleet vehicles, maintain the current practice of purchasing Compressed Natural Gas (CNG) vehicles for the replacement of vehicles parked at the Operations Support Facility (OSF) (i.e. the maintenance yard) since there is a CNG fueling station on site. Non-police passenger vehicle replacements for Civic Center should be high mile-per-gallon hybrid vehicles. Public Works and Administrative Services staff are currently working on an annual vehicle replacement program to identify candidate vehicles and funding sources. (Alternative fuel vehicles typically cost more than standard vehicles.)
b. Review the perceived need for vehicles with large capacity engines and downsize engines in replacement vehicles whenever possible.
c. Continue to emphasize the maintenance of existing vehicles through regular tune-ups, tire pressure maintenance and smog inspections; and encourage driver training to maximize fuel efficiency and reduce impacts on local air quality.
d. Investigate the use of telecommuting technologies to allow some City employees to work out of their homes at certain times to reduce the traffic congestion and environmental impacts of city employee commuting.
e. Provide preferential parking for van pools / car pools, and as rewards for energy efficiency ideas; also provide preferential parking for neighborhood shuttles, and for City employee's use of personal hybrid cars. Provide information to employees on how to use transportation alternatives.
f. Encourage the use of car pools, transit, walking, bicycles, and other forms of alternative transportation by City employees by offering preferred parking, cash and/or other incentives to those who use alternatives to driving alone to and from work.
g. Negotiate a contract to make the ZEV-NET vehicles at the Irvine Transportation Center available to employees. This will reduce the number of older "station" cars used, and encourage more employees to commute by train.

Lower impact strategies:

h. Track mileage driven per driver and department, and encourage strategies to minimize numbers of trips and to optimize routes.
i. Continue to look for effective alternatives for heavy duty vehicles such as street maintenance trucks.
j. Create a link on the intranet to Renewable Energy Credits (REC's) for employees to purchase to offset their commute emissions. The cost to offset the average commuter's emissions (3 tons/year) is $30 - $40. By making this available on the City's intranet, people who are environmentally proactive could take advantage of the opportunity. The City could also encourage this by paying a portion of the cost of the offsets.

k. Create a City carpool tool on the City's intranet that would allow employees to register for carpooling, connecting them to other employee's living close-by, with similar work schedules. A small number of commute surveys indicate that 10 percent of employees cite difficulties with finding others to share a ride as the primary reason for driving alone to work, and indicate that as many as 40 percent of employees surveyed cite car pooling as their preferred alternative to driving solo.

Table 11 - Municipal Implementation Strategies

MUNICIPAL IMPLEMENTATION STRATEGIES	PURPOSE	COST TO IMPLEMENT	STAFFING IMPACTS
Establish policy of purchasing energy efficient products	Ensures that the City purchases the most cost-efficient energy using equipment	Relatively low cost to establish, but requires ongoing maintenance	Ongoing by CD Environmental Programs, Purchasing and Finance staff, and by each dept.
Investigate use of telecommuting technologies and alternative staff work schedules	Allow certain employees to work from home at certain times to reduce traffic and vehicle emissions	Variable depending on numbers of employees involved and equipment provided	May reduce space required for staff offices and for staff parking
Prepare survey of existing buildings for future solar system installation	Provides picture of future solar generation potential in City facilities	$30 - $50k depending on scope	Preparation of survey by consultant, with project management by Environmental Programs Administrator

SECTION 8.0 CITYWIDE IMPLEMENTATION STRATEGIES

Citywide implementation strategies are divided among three sectors – Commercial/Industrial, Transportation and Residential. In working together in a collaborative fashion, both the City and the private sector can achieve significant reductions in energy usage through the following suggested implementation strategies. Controlling the increasing costs and reliability of energy can prepare businesses for the long-term and support their ability to compete in a changing world. Passive survivability strategies will also help to keep operating costs down and to allow for some business to continue in the face of adverse conditions such as a temporary loss of power.

8.1 – Commercial / Industrial Sector

The State of California has been investing in energy efficiency and enforcing stringent energy standards in the commercial sector for more than 25 years. About 9,000 megawatts of energy have been saved which is equivalent to the output of eighteen 500 MW power plants, and adding 3 percent to the state's rate of economic growth.

In total, the commercial sector electricity consumption accounts for about 35 percent of the state's demand, and 38 percent of total peak demand. Peak demand in the commercial sector is dominated by energy for air-conditioning (45 percent) and by lighting (33 percent). Office buildings are the single largest energy user in the state's commercial sector accounting for 28 percent of all commercial demand. [36]

Although more than 80 percent of Irvine's 69,000 electricity accounts with Southern California Edison are residential, these accounts comprise only 15 percent of total electricity use. Medium and large commercial/industrial customers (GS-1 and GS-2 accounts) make up only about 16 percent of the accounts, but represent 70 percent of total electricity usage citywide. This means that successfully reducing overall energy use in Irvine is highly dependent upon reducing energy usage in the commercial sector.

As with municipal facilities, the long term goal for new commercial/industrial construction should be to work toward meeting the US Conference of Mayors goal of eventually eliminating the use of fossil fuel generated electricity, and substituting renewable energy generated either on-site or off-site.

The first step in achieving this goal is to reduce the need for energy supplies through improved energy conservation and greater efficiency. This should result in cost savings for businesses that can be directed towards producing and/or procuring renewable energy. There are a number of strategies available to accomplish this.

[36] For more detail on energy use in commercial buildings and examples of successful commercial sector energy projects, see www.fypower.org/bpg/index

8.1.1 *Conservation & Improved Efficiency*

Higher impact strategies:

a. All new commercial / industrial construction should be encouraged to exceed the State's energy code Title 24 by at least 15 percent. (Under Irvine Build Green for commercial buildings, exceeding Title 24 energy efficiency requirements by 20 percent garners 25 of the minimum points needed for certification).
b. Develop incentives for high performance design and construction in the private sector, such as reduced fees and expedited processing.
c. Provide incentives for achieving higher standards of energy efficiency alone, such as fast-tracked permitting for proposed projects that exceed Title 24 by 15 percent or more.
d. Encourage businesses to power all decorative lighting, advertising, and other non-safety related exterior lighting by renewable energy.
e. In cooperation with locally-based non-profit agencies, provide technical and other assistance to local small businesses to replace existing inefficient lighting and refrigeration systems.
f. Work with local utilities, energy and business interest groups to develop a program for re-commissioning existing commercial buildings.
g. Work with the utilities, local energy interest groups and local business and civic organizations to provide training and educational programs about energy efficiency and conservation, demand response programs and renewable energy resources especially wind and solar, for local businesses. [37]

Lower impact strategies:

h. Recommend that all new commercial and retail construction projects to be designed and built 'solar ready' with an accommodation for the necessary electric service, wiring, water storage tank and pipe work to be provided at the time of initial construction, ready for the future installation of solar photovoltaic and/or solar hot water systems. [38]
i. Encourage less paved areas and more shading adjoining buildings to reduce the 'heat island effect.' Trees help moderate the temperature through evapotranspiration, and provide shade that reduces the amount of solar radiation absorbed by pavement and buildings. Properly located trees can reduce the cost of cooling buildings, reducing air-conditioning needs up to 30 percent[39], thereby reducing the amount of fossil fuels required to produce electricity.
j. Encourage the more widespread use of grey water for permitted non-potable purposes such as toilet flushing and irrigation on-site. Grey water is different than reclaimed water. It is the wastewater from all water-using fixtures except toilets and sinks with food grinders; it contains far less organic material than normal waste water and so can potentially be managed in different ways. In

[37] The PEAK program currently provides energy education in the IUSD. This effort could be expanded.
[38] The 'solar-ready' construction guidelines could be based on the 'Montana Guide to Building Energy Star Solar Homes' developed by the National Center for Appropriate Technology.
[39] Michigan State University Extension, Urban Forestry #07269501, "Benefits of Urban Trees."

some buildings, as much as 50 percent of water use can be recaptured and reused to flush toilets.[40]

k. Encourage the use of waterless urinals in new construction and major remodeled projects.
l. Consider adopting (and adapting as necessary for commercial areas) the Model Lighting Ordinance and Design Guidelines jointly developed by the International Dark Sky Association and the Illuminating Engineering Society of North America. The Model Ordinance requires outdoor lighting appropriate to communities, the environment, and the natural habitat.

8.1.2 Energy Information and Education

m. In cooperation with the Irvine Chamber of Commerce, provide a regular energy information and education column in the Chamber's newsletter, describing new opportunities for saving energy and money.
n. Work with the Irvine Chamber's Go Green Committee to develop a recognition program to showcase high performance local energy projects.

8.2 – Citywide Transportation

Currently, according to the Southern California Association of Governments (SCAG), 77 percent of the area's commuters drive alone. Reducing transportation energy use requires requesting a major behavioral shift on the part of residents, the many commuters who come to Irvine to work, and City employees, who would all be encouraged to carpool, bike, ride the bus, walk, or ride a motorcycle to work and on their every day errands. When taking advantage of alternatives to driving alone, employees and residents avoid the need to pay expensive gas prices for commuting, as well as the cost of repairs and maintenance on vehicles. In addition, there are the non-financial benefits: reductions in greenhouse gas emissions, reduced smog, noise, childhood asthma, water pollution, suburban sprawl, parking lots, and other changes that come from driving less.

The California Air Resources Board's proposed greenhouse gas emission reduction strategies include regulations to achieve the maximum feasible and cost-effective reduction of climate change emissions from passenger cars and light trucks (adopted 2004); measures to limit idling by diesel-fueled commercial vehicles (2004); new standards for light duty vehicles to be phased in by the 2017 model year; regulations requiring the displacement of a percentage of diesel fuel by biodiesel; increased use of ethanol; as well as the California Hydrogen Highway Network (CA H2 Net) – a State initiative to promote the use of hydrogen as a means of diversifying transportation fuel sources.

Beyond the above initiatives, reducing vehicle miles traveled is the strategy most likely to achieve an early reduction in vehicle originated emissions. However, reducing vehicle use remains one of the most intractable problems for cities attempting to reduce local emissions. The importance of land use planning and transportation planning via the General Plan's Land Use and Circulation

[40] Irvine's existing commercial Green Building program includes a voluntary requirement that buildings use reclaimed water for toilet flushing.

elements cannot be overemphasized. Land use patterns which facilitate non-auto travel and such things as a robust network of bike trails give people the option to use alternative modes of travel. It also offers them a healthier way of getting around and helps break the pattern of a sedentary lifestyle that most Americans lead.

Higher impact strategies:

a. Encourage Irvine employers to use telecommuting technologies and to examine the possible benefits of alternative work schedules to allow some employees to work out of their homes at certain times and to reduce the traffic congestion and environmental impacts of employee commuting.
b. Encourage businesses to provide preferential parking for van pools / car pools, and as rewards for energy efficiency ideas; also provide preferential parking for neighborhood shuttles, and for employee's personal hybrid cars.
c. Work with businesses to provide their employees up-to-date information on how to use transportation alternatives particularly the new I-shuttle recently launched in the Irvine Business Complex. Include tips on driving, and energy, health and pollution impacts of driving.
d. Implement policies in the City's Circulation Element that are likely to result in a decreased use of fossil fuel energy, especially those recommendations that encourage walking, transit and bicycling.
e. Encourage businesses to enter into a contract to make the ZEV-NET vehicles at the Irvine Transportation Center available to its employees, to reduce the number of older "station" cars used, and encourage more of its employees to commute by train.
f. Encourage the use of new car rental / car sharing options such as Flexcar.
g. Discourage the provision of ample free employee parking. Free parking is a strong incentive to drive alone, and represents a subsidy those who bike or walk, or use rideshare or public transit does not receive. [41]
h. Another alternative would be to give all employees who choose some other mode of transportation a cash subsidy equivalent to the cost of paid parking. Those employees may use the cash to pay for their commute and pocket the difference. Such a system offers employees who take public transit or bike to work similar subsidy-payments to those presently benefiting from free parking.

Lower impact strategies:

i. Evaluate construction of covered parking areas to provide preferential parking which also serve as solar PV generation sites. Provide employee free plug-in hybrid refueling stations at City facilities with solar PV electricity generation systems.
j. Encourage businesses to facilitate employee purchases of Renewable Energy

[41] Free, employer-provided parking is one of the most widespread transportation practices in the country. Wilson and Shoup point out that "Free gasoline for employees who drive to work would seem like a reckless offer, yet employer-paid parking is a much stronger incentive to drive to work alone." Wilson, R.W. and Shoup, D.C. *Employer-Paid Parking.* Transportation Quarterly, Vol. 46, #2, pp. 169-192.

Credits (REC's) to offset their commute emissions. The cost to offset the average commuter's emissions (3 tons/year) is between $30 and $40. Employees who are environmentally proactive could take advantage of the opportunity. To encourage participation, the business could offer to pay a portion of the cost of the offsets.

k. Work with OCTA to provide lunch time shuttle bus use in the other areas of the City. Employee commuter surveys often indicate that about 15 percent of drivers commute alone because they need their cars for personal business such as banking, dry-cleaning, or small shopping accomplished during the lunch hour at adjacent shopping centers. A personal auto is not needed if alternative transportation is available during the lunch hour.

8.2.1 Policies to Encourage Transportation Alternatives

a. In all new developments, prioritize the implementation of circulation system improvements, incentives and disincentive measures to reduce single-occupancy automobile travel, and promote bus transit, rail transit/fixed guide way systems, carpooling, bicycling and walking.
b. Encourage local businesses to use incentives and disincentive measures to reduce single-occupancy automobile travel by their employees, and to promote the use of bus transit, carpooling, bicycling, and walking to work.
c. Promote and expand alternatives to single-occupancy driving, advocate at county and regional levels for increased supply/increased frequency, reliable and convenient public transportation. Promote regional public transit, especially between major Orange County urban centers.
d. Work with regional transportation agencies to develop and promote a regional on-line car pool rider connector to help residents who wish to car pool to connect with other drivers using similar routes.
e. Encourage all new commercial/office centers to include food services, a gym with showers, bike lockers, etc. to reduce employees' need/desire to leave the area during lunch breaks. Bike lockers safely store bicycles during the day, together with helmets and other bike equipment and make bike commuting more appealing.
f. Discourage the provision of free parking in commercial, educational, and other centers. [42]

8.3 – Residential Sector

The general long-term goal for new construction in the residential sector is the same as for the City's own new facilities. That is, over time and through incremental steps, to eliminate fossil fuel generated energy use, and to substitute a mix of on-site and off-site generated renewable energy.

However, establishing effective polices and practices to improve the performance of existing residential buildings are more difficult. The difficulties range from

[42] When Palo Alto began charging students for parking at Gunn High School, the number of students driving alone was reduced from 250 to 85. The number of students carpooling rose from 85 to 225. Parking fees were also used to subsidize transit passes for students.

homeowners' investment preferences that discourage spending on energy efficiency, to difficulties with energy program design. For example, many homeowners perceive that energy costs are mostly fixed costs and that little can be done to reduce them. Many homeowners prefer to make investments in their homes that improve its comfort and appearance, and thereby enhance its resale value, rather than investing in 'behind the scenes' energy efficiency measures. This limits a homeowner's willingness to invest in improving energy efficiency in the home.

On the program design side, there are also difficulties. For example, many programs designed to encourage improved efficiency are 'information only' programs which, unless the homeowner is already close to making a decision, are unlikely to have a major impact on homeowners investment decisions. The most effective programs combine education and information and regulation, together with incentives. Fortunately, since most housing in Irvine is relatively new, it is already more efficient than in many older cities; nevertheless, there remains many opportunities in Irvine to improve residential building performance.

The general goal for existing residential buildings is to improve their energy performance over time, through a gradual upgrading of buildings and their energy using systems. There are basically two opportunities to do this – the first by encouraging homeowners to improve the performance of their home using education, information, and incentives, etc. And secondly, to require improved performance at time of sale, when there is typically financing available to also implement projects to improve energy efficiency. For maximum impact, Irvine could do both.

The requirement to upgrade the existing housing stock can be accomplished through a residential conservation ordinance (RECO) that requires the upgrading of a residence at the time of sale. [43] Typically a RECO will focus on the space heating system, hot water heating, lighting, attic insulation, weather-stripping, and replacing inefficient showerheads, toilets, etc.[44] In multifamily buildings, a RECO would also focus on improving energy use in public area lighting and in shared laundry facilities.

Another consideration for existing housing will be working with the many homeowners' associations (HOAs) throughout the Irvine. The HOA Boards regulate much of the architectural changes that occur in their associations through implementation of the covenants, Conditions and Restrictions.

[43] The proposed residential energy conservation ordinance (RECO) could be based upon those currently in effect in Berkeley and San Francisco, but since Irvine's housing stock is so much newer it would probably exclude some measures considered necessary for the older housing in those cities. Who pays, buyer or seller, could be negotiated at the time of the sale.

[44] Pumping water is a major energy user in California; reducing the use of water therefore also saves energy. Many homes in Irvine are now more than 20 year old and thus are equipped with older less efficient fixtures and appliances. The Pacific Institute estimates that while great progress has been made in California, "Indoor residential use could be reduced by approximately another 40%... by replacing remaining inefficient toilets, washing machines, showerheads, and dishwashers, and by reducing the level of leaks, even without improvements in technology." Pacific Institute for Studies in Development, Environment, and Security, *"Waste Not, Want Not: The Potential for Urban Water Conservation in California."* November 2003

Anecdotally, solar installation companies have expressed some frustration with these HOA boards or architectural committees opposing installation on the southern exposure or the look of the panels. It would facilitate implementation of renewable energy such as solar thermal, photovoltaic, wind, etc. if the City were to work closely with the HOAs to develop guidelines for renewable installations that are consistent throughout the City.

Many of the necessary measures for reducing energy use in new residential; construction are already part of Irvine's existing voluntary green building program, Irvine Build Green. Irvine Build Green also includes a requirement to install conduit to, and provide a proposed layout for, a future solar photovoltaic system. At present, however, most residences are not built with solar systems included. A straightforward way of both improving energy efficiency and emphasizing on-site renewable energy would be to make the energy and renewable energy measures in the green building program mandatory instead of voluntary Citywide, and to require that a percentage of residences be built with renewable energy systems at the time of initial construction.

The US Conference of Mayor's goal of reducing the use of fossil fuel generated energy, and providing an increasing percentage of renewable energy can be interpreted either to mean that all residences shall have renewable energy systems supplying 60 percent of their required energy, or that 60 percent of the residences in a development shall receive 100 percent of their electricity needs (on a net-metered basis) from renewable energy. The first of these options is likely to be more acceptable to the marketplace at this time.

As described, under the Energy Plan, the percentage of permitted fossil fuel generated electricity will decrease over time, to be replaced by a mix of on-site and off-site generated renewable electricity. If Irvine chooses to follow the guidelines of the US Conference of Mayors by 2015, 70 percent of the electricity required by a new home will be supplied by on-site generated renewable energy; and 80 percent by 2020. Irvine is expected to be fully built out by 2025. Under the US Conference of Mayor scenario, newly constructed dwellings will be required to be carbon neutral by 2030.

8.3.1 *Energy Information and Education*

Higher impact strategies:

a. City to work with homeowners' associations throughout the City to develop uniform guidelines citywide for renewable energy installations.
b. City to work with the utilities and local energy interest groups to provide public information through community facilities, public libraries, permit counters, etc; especially on renewable energy, energy efficient appliances, and utility and state energy equipment rebates, etc.
c. Establish an outreach program through the City's newsletters, website, and other media to inform the public on measures taken by the City to reduce energy use in its facilities, and to promote increased awareness of energy conservation and renewable energy strategies throughout the community.

d. Work with the utilities, local energy interest groups, business groups and other interested agencies to provide public information on the energy and water efficiency benefits of fixtures and appliances such as faucet aerators, low-flow showerheads, high-efficiency dishwashers and water heaters, etc. all of which save both energy and water.

Lower impact strategies:

e. In cooperation with the utilities and local energy interest groups, establish a regular energy policy review workshop for senior City staff, Commissioners, elected officials, and the public, to update participants on current trends and developments in national and local energy policies and practices.

8.3.2 *Changes to City Policies and Practices*

a. Identify and remove current policies such as in the Zoning Code, which present barriers to the installation of renewable energy systems on existing residential and commercial buildings.
b. Consider development of a residential energy conservation ordinance (RECO) based on those currently operated in San Francisco and Berkeley. [45] Coordinate RECO with other local programs such as IRWD rebate program for the replacement of pre-1992 toilets.
c. Provide incentives for achieving higher standards of energy efficiency, such as fast-tracked permitting for proposed projects that exceed code requirements by 15 percent, and/or that meet Irvine Build Green guidelines for energy and renewable energy.
d. Establish a policy of evaluating all existing City energy related policies and practices at five year intervals, as part of the process of updating the City Energy Plan, and preparing detailed interim energy program designs for the upcoming five year period. The process to also include reporting on progress toward the goals to City Council.
e. All new homes to be energy rated using a State approved rating system.

8.3.3 Renewable Energy Strategies

a. Encourage the builders of all new single family homes to provide buyers with the option of including renewable energy systems at the time of initial construction.
b. Where residences are built without on-site renewable energy systems, they should be designed and built 'solar-ready' with a minimum of south-facing roof, and with accommodation for the necessary electric service, wiring, (and water storage tank and pipe work for solar thermal installations) ready for the future

[45] California's Public Resources Code Section 25402.1(h) 2 and Section 10-106 of the Building Energy Efficiency Standards establishes a process which allows local adoption of energy standards that are more stringent than the Statewide standards, though the standards must be approved by the Energy Commission.

installation of renewable systems. [46]

c. Enforce the applicable State and any local Solar Rights Acts to provide for passive and natural heating/cooling opportunities, including beneficial site orientation, and which authorizes local governments to require the dedication of solar easements. [47]
d. Strongly encourage all new private swimming pools, spas and hot tubs to be heated (at least in part) by renewable energy sources, especially solar hot water systems or by cogeneration. [48]
e. Advocate for a statewide system under which utility companies could own and operate renewable energy systems installed on privately owned residences.
f. Work with local residents and energy interest groups to establish cooperative installation of solar PV systems on residential properties. [49]
g. Investigate the ability of the City to set up bulk-rate purchases of solar systems similar to Solar Santa Monica.[50] If feasible, set up the procedure by which an Irvine homeowner can use municipal bonds to pay for renewable energy and energy efficiency system upgrades to their home.[51]

[46] In the new 144-home Carsten Crossings project in Rocklin near Sacramento developed by the Grupe Company, all the homes are being built with a 2.4 kilowatt (kW) roof-integrated solar system designed to meet 50% of a home's electricity demand. The "Environment California" website includes a list of current residential developments equipped with solar systems. For example, the list at May 2007 includes four solar equipped residential developments at Ladera Ranch in Orange County, with a total of 360 homes equipped mostly with 2.4 kW solar systems.

[47] California law protects the right to own and operate a solar system for a home or business. For example, Civil Code 714 prohibits any covenant, restriction, deed, contract, or security instrument from effectively prohibiting or restricting the installation or use of a solar system. For a detailed analysis of California's solar rights laws, visit the Energy Policy Initiatives Center at University of San Diego School of Law – http:www.sandiego.edu/epic

[48] On June 6 2007 the California General Assembly approved "The Solar Water Heating & Efficiency Act" (AB 1470) which provides $250 million over 10 years to provide consumer rebates for solar hot water heating systems. AB 1470 heads to the State Senate Energy & Commerce Committee in July.

[49] For example, the company 'SolarCity' operates a 'Collective Power' program to install solar pv systems in existing communities. www.solarcity.com

[50] Solar Santa Monica facilitates the installation of solar photovoltaic by having information, expert advice and standardized solar packages available to residents and businesses of Santa Monica.

[51] The City of Berkeley, CA has been proposing such an arrangement and legislation has been proposed to make the process easier.

Table 12 – Citywide Implementation Strategies

RESIDENTIAL / COMMERCIAL PRIORITY STRATEGIES	PURPOSE	COST TO IMPLEMENT	POLICY REQUIREMENTS
Encourage all new buildings to exceed State energy code (T24) by 10 percent	Improves energy efficiency performance of new buildings, and saves $$ long-term	Average cost premium of 0 - 2 percent of construction cost, or about $4 sq ft. Saves 15 – 20 percent on energy	Changes to local building / planning codes
All new buildings to be built 'solar-ready'	Simplifies future installation of solar energy systems on buildings	Very low cost for solar-ready photovoltaic systems; higher for thermal systems due to the need for space for future hot water storage tank	Changes to local building / planning codes
All residential builders to provide buyers with solar system option, plus information on solar costs / benefits	Provides home owners with choice of buying solar and including system cost in with initial mortgage	Average $15 - $25k depending on photovoltaic system size and rebates available	Changes to local building / planning codes
Work with utilities, local energy interest groups, business and civic leaders on energy and CO2 emissions issues	Increase awareness of energy and CO2 emissions issues among City Commissions, elected officials, business leaders and the general public	Some existing funding for energy education/ information already exists, together with skills and knowledge in existing utility and interest group programs	No policy change required. Provides additional role for Energy Management Team in providing general direction
Encourage local businesses to use incentive and disincentive measures to reduce single-occupancy vehicle commuting	To reduce single occupancy vehicle commuting by employees, and to promote use of transit, car-pooling, bicycling, walking, etc.	Variable depending on scope of program	No policy change required. Provides additional role for Energy Management Team in providing general direction

Appendix A – City of Irvine Electricity Demand

This table is an expanded version of Table 7 electrical Account Summary for Irvine. This includes the detailed data for electricity demand among those accounts where demand is measured.

Rate	Annual kWh	% of Total kWh	Non-coincident Peak Demand (kW)	Estimated Coincident Peak Demand (kW)	Number of Service Accounts	% of Total Service Accounts
AG TOU (agriculture)	4,908,248	0.2%	2,556	1,584	40	0.1%
Domestic	353,126,189	16.2%	-	-	57128	82.8%
GS-1 (small commercial)	80,558,220	3.7%	-	-	7171	10.4%
GS-2 (medium commercial)	1,488,847,290	68.5%	374,201	265,683	3169	4.6%
Street Lighting	32,132,910	1.5%	-	-	798	1.2%
TC-1 (traffic lights)	1,988,733	0.1%	-	-	360	0.5%
TOU-GS (large commercial time of use)	211,924,977	9.8%	52,060	27,592	324	0.5%
Total	**2,173,486,567**	**100%**	**428,817**	**294,859**	**68,990**	**100%**

Appendix B – Emerging Energy Technologies

There are a variety of reports and documents available that outline a number of policies and project recommendations to increase the use of renewable energy[52] technologies over the next 20 years. Many of these reports contain projections of renewable energy technology improvements and costs over the next 20 years, as well as necessary policy actions needed to further integrate renewables into the US energy supply. This section aims to outline renewable energy technology projections for the US over the next 20[53] years, as well as policy options and recommendations, with a particular emphasis on the State of California.

Many of the supporters of renewable energy technologies project that 25 percent of the energy produced in the United States by 2025 will come from renewable energy resources. This number varies depending on the source. For example, the Energy Information Agency (EIA) projected electricity generation share from renewables for 2030 is much lower at 9 percent, and suggests a slight increase to 11 percent in a "high renewables" scenario[54]. The "high renewables" scenario projects greater use of wind, biomass, and geothermal. A group of representatives from several national laboratories show a 20 percent share by 2020[55]. As an increasing number of states adopt Renewable Portfolio Standards[56], and adopt other targets such as greenhouse gas emission reductions, the percentage of renewable energy project installations may continue to grow at the higher percentage rate. A group of renewable energy advocates are currently trying to push through legislature a 'Federal Renewable Portfolio Standard' that would establish a goal of 15 percent electricity generation for all of the United States from renewable energy by 2020. Many individuals and organizations are optimistic that a federal target would create the public awareness and help create other incentives such as a long term Production Tax Credit (PTC) to encourage the increased development of the renewable energy market. The PTC is a tax credit of 1.9 cents per kWh of electricity for the production of electricity from qualifying resources (including wind, biomass, poultry waste, geothermal, municipal solid waste, irrigation power, refined coal, and hydropower). The tax credit is due to expire on December, 2008 which means facilities must be in service before January 1, 2009. There is currently a bill to extend the expiration date for an additional 5 years. The tax credit is a great incentive for renewable energy project development.

[52] Renewable energy is any naturally occurring, theoretically inexhaustible source of energy, such as biomass, solar, wind, tidal, wave, geothermal and hydroelectric power that is not derived from fossil or nuclear fuel

[53] Due to inconsistencies in the projection year that varies from report to report, some examples will refer to 2020, 2025 or 2030.

[54] Projections from Annual Energy Outlook, 2007. Energy Information Administration, US Department of Energy, http://www.eia.doe.gov

[55] Martinot, E, "Renewable Energy Futures: Targets, Scenarios and Pathways. Pre-Publication Draft (April 2007), forthcoming in *Annual Review of Environment and Resources 2007,* Annual Reviews.

[56] The Renewables Portfolio Standard (RPS) is a policy that obligates each retail seller of electricity to include in its resource portfolio a certain amount of electricity from renewable energy resources, such as wind, solar, geothermal, hydro, and various forms of biomass and ocean energy.

Individual states, counties and cities are primarily responsible for actions that are driving forward the renewable energy agenda in the United States. Many cities are adopting future targets of 10–20 percent of electricity from renewables. Targets typically aim for some year in the 2010–2020 timeframe. For example, the City of Los Angeles established a 20 percent renewable energy goal by 2010. Depending on the city, some targets are for a share of total energy consumption, whereas other city targets address installed capacity. For example, cities will target 10 percent of homes to have solar hot water by 2010 or require on-site renewables for *all* new buildings over specific size thresholds. Urban planning that envisions a greater share of clean energy for the future is gaining hold in many cities, often with participation from a variety of stakeholders, including universities, municipal government and the local energy utility. The City of Irvine is wise to take this opportunity to develop realistic renewable energy and carbon reduction targets as part of this Energy Plan.

Many US cities are also establishing CO2 reduction targets which can be achieved in part by increasing renewable energy project development. New York City had set a target in 2002 for 20 percent reduction by 2010 from 1995 levels; this was supplemented by a "U.S. Mayor's Climate Protection Agreement" in 2005 initiated by the Mayor of Seattle, targeting 7 percent reduction from 1990 levels by 2012. As of April 2007, 471 mayors have signed on to the agreement, representing a large percentage of the population dedicated to reducing greenhouse gas emissions. Many renewable energy advocates are optimistic that the current emphasis on global warming will be a catalyst for many of these renewable energy goals.

The State of California has adopted both a Renewable Portfolio Standard (SB 1078) and a CO2 emission reduction target (AB 32). The RPS requires an annual increase in renewable generation equivalent to at least 1 percent of sales, with an aggregate goal of 20 percent by 2017. The state is aggressively implementing this policy, with the intention of accelerating the completion date to 2010. Accelerating achievement of the RPS goal to 20 percent by 2010 would mean adding 4,200 MW of renewables over 7 years, or 600 MW per year[57].

The City of Irvine has already demonstrated commitment to smart energy management through its collaboration with the Energy Coalition since the early 1990's, and other initiatives such as the compilation of the Green Building Resource Guide. Combined with the state mandates to increase renewable energy electricity generation, the City of Irvine is in a good position to develop and set reachable renewable energy targets as part of its long term planning process.

Policy Recommendations

There are many non-profit organizations dedicated to the development and promotion of policy options for increased renewable energy installations. Many of these groups agree upon several policy recommendations that could be enforced

[57] State of California Energy Action Plan, 2003.

at the federal, state of local level to meet specific goals such as the 20 percent by 2020 as noted in many RPS policies. These policy recommendations generally include:

- Increasing production of renewable energy
- Delivering renewable energy to markets
- Expanding renewable energy markets
- Improving energy efficiency and productivity
- Strengthening conservation of natural resources and the environment
- Reducing waste (solid, water, etc.)

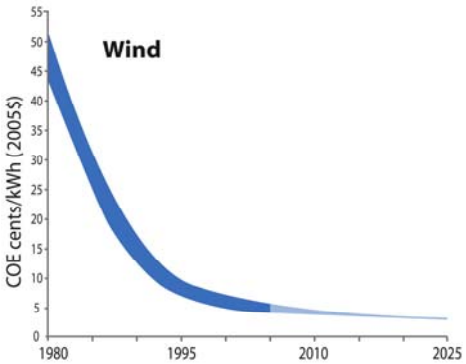
All of these recommendations are linked to long-term detailed strategies to meet RPS and greenhouse gas emissions reduction goals.

Renewable Energy Technology Future Outlook: Costs and Future Trends

The following section includes cost curves for several renewable energy technologies, as well as information about the future market[58]. The cost trends typically show a steep decline from 1980 to the present. Projections show this decline to continue, but at a slower absolute pace as the technologies mature.

Wind

The American Wind Energy Association (AWEA) recently established an aggressive goal for 25 percent of the US electricity generation to come from wind energy by 2025. Representatives from AWEA state that the current emphasis on global warming acts as a catalyst that will help met this goal. Wind technology cost projections show that lower costs will result from design and technology improvements across the spectrum from foundations and towers, to turbine blades, hubs, generators, and electronics.



The biggest challenge for the wind industry, as for other renewable energy technologies, is managing the existing transmission constraints. Many initiatives are under way to study how new large integrated transmission lines can help

[58] National Renewable Energy Laboratory Energy Analysis Office, www.nrel.gov

carry much of the wind potential from the Midwest out to the West coast to help meet the Western States RPS goals. At a local level, many states and cities are studying how to best upgrade their transmission capacity to carry intermittent resources like wind, and in general how to add additional capacity to the lines to meet new energy demands. The State of Montana has invited developers to visit the state and explore development of large-scale wind farms and building a large new transmission line to carry the energy to one of the western states, such as California[59]. Technical experts are currently exploring wind energy development in the Northern Baja region of Mexico and how this energy may be exported north across the California border. Again, transmission interconnection between the two countries would pose the greatest barrier.

In terms of technology improvements and where the wind energy industry will be in 20 years, it is projected that wind farms will increasingly be operated as conventional power plants, and advanced grid integration and upgrades will help overcome transmission barriers.

Biomass and Biofuels

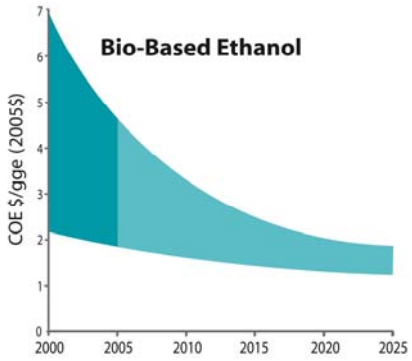
Biomass can provide energy to be used for heating and cooling, electricity and transport. Biomass fuels can easily be stored meeting both peak and baseline energy demands. In the form of biofuels (solid, liquid and gaseous) biomass can directly replace fossil fuels. Biomass and biofuels are CO2 neutral if produced in a sustainable manner. Bioenergy contributes to all-important elements of national and regional economic development.

There are varying opinions as to the percentage of contribution of biomass to the US energy supply over the next 20 years. One reason for different conclusions is that two crucial parameters—land availability and energy crop yields. Availability of land, as well as forest and agricultural residues, relate to the interaction of biomass energy with other land uses (e.g., food production, biodiversity, and soil and nature conservation), and synergies between different uses. The International Energy Agency projects that 3 percent of transport fuels will come from biofuels in the United States by 2030.

Significant progress has been achieved on biomass procurement and conversion technologies over the last decade resulting in the increase of competitive, reliable and efficient technologies. Nevertheless, new fuel chains addressing more complex resources and new applications are under development[60].

Bio-based ethanol represents a combination of corn starch in the near term and lignocellulosic ethanol in the long term. Lignocellulosic production technologies that co-produce feed products and electricity with ethanol are projected to become the lower cost technology in the latter years of the projected values.

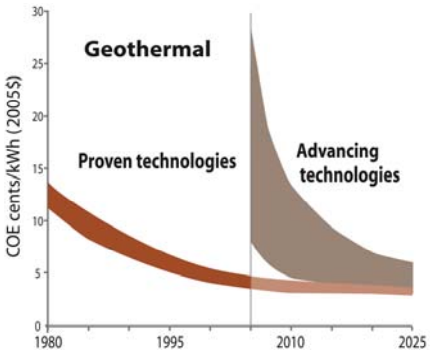
[59] Speech by the Honorable Brian Schweitzer, Governor of Montana, Windpower Conference June 2007, Los Angeles, CA.
[60] European Renewable Energy Council, http://www.erec.org



Geothermal

Geothermal power plants have the potential to contribute to an environmentally friendly and sustainable energy supply, using existing technologies to exploit steam, and hot water reservoirs. The technological developments of recent years have opened new ways to use heat in the interior of our planet.

Geothermal cost reductions will result from more efficient and productive resource exploration and characterization as well as from continued improvements in heat exchangers, fluid-handling technologies, turbines, and generators. Also, non-technical developments are critical, including administrative and policy clarity, suitable infrastructure in the form of machinery and skilled labor, as well as further educating the public.



Solar Thermal

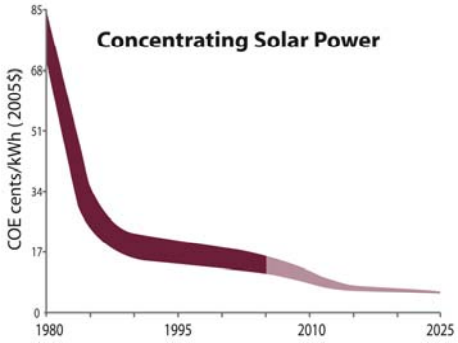
Solar thermal systems are based on a simple principle known for centuries: the sun heats up water contained in a dark vessel. Solar thermal technologies on the market are now efficient and highly reliable, providing solar energy solutions for a wide range of areas of use and potential users. Most of the systems sold today are intended to supply domestic hot water and an increasing number of systems provide

thermal energy for space heating[61].

As in all industrial sectors, manufacturing will be more exposed to global competition as the market develops. However for solar thermal, nearly half of the jobs are in retail, installation and maintenance. Technological innovations are expected to improve solar thermal technologies for domestic hot water, space heating, cooling and air-conditioning, solar desalinization and advanced heat storages.

Many countries have set high targets for solar heating and cooling, and in many cases the success lays in future building design and construction, and new building standards. In Europe a 100 percent active solar roof target by 2030 has been established. The Million Solar Roof Initiative in the United States is another example of a positive policy move that will help contribute to solar thermal goals.

Cost reductions will result from improved reflectors and lower-cost heliostat designs, improved solar thermal receivers, heat exchangers and fluid handling technologies, and turbines and generators, as well as from volume manufacturing.



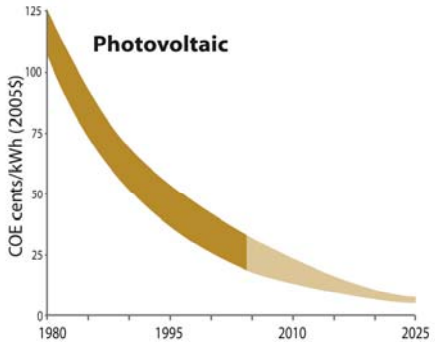
Photovoltaic

Photovoltaic (PV) solar electricity has a very high potential, since solar energy is a practically unlimited resource available everywhere. Therefore, it is ideally suited for distributed generation of electricity near the user, everywhere around the globe. Many scenarios show PV as holding a small portion of the renewable energy market share by 2030, at about 3 percent, although a Greenpeace reports shows a more optimistic view of 10 percent of the global share by 2030[62].

The production of PV cells is constantly improving as a result of both technology advances and changing industrial processes. Production costs need to be reduced considerably to penetrate the major electricity markets. Consequently the main effort of research and industrial technology development is directed towards reducing the production cost.

[61] European Renewable Energy Council, http://www.erec.org
[62] Martinot, E, "Renewable Energy Futures: Targets, Scenarios and Pathways. Pre-Publication Draft (April 2007), forthcoming in *Annual Review of Environment and Resources 2007,* Annual Reviews.

The PV cost projections below are based on increasing penetration of thin-film technology into the building sector. Thin film makes up about 10 percent of the solar market, whereas crystalline solar cells have a market share of over 90 percent and will probably remain the dominant technology for the next 10-15 years. Likely technology improvements include higher efficiencies, increased reliability (which can reduce module prices), improved manufacturing processes, and lower balance of system costs through technology improvements and volume sales.



Other Technologies and Future Trends:

Distributed Generation

Much of the literature that discusses future renewable energy trends present scenarios that assume the electricity system will remain highly centralized, and many do not address the issue of distributed power generation. However, most advanced scenarios for Europe and some global scenarios do envision community-level or "distributed" generation becoming a prominent part of power systems. A survey of European experts found a large consensus about the trend towards a more decentralized electricity supply, estimating a 30 percent share of decentralized power by 2020[63.] Many scenarios envision solar PV as a primary form of distributed generation from renewables, although European scenarios also include large shares of biomass (in combined-heat-and-power plants) and geothermal power. Thus the share of distributed generation from renewables depends on solar PV technology advances and cost reductions.

The share from solar PV also depends on fairer cost comparisons, and that solar PV is much closer to being competitive with conventional power if compared on the basis of delivered electricity or peak power costs. Under a decentralized paradigm, renewables have an advantage because they compete with the end-user cost of power rather than centralized generation costs, avoiding transmission and distribution costs.

[63] Martinot, E, "Renewable Energy Futures: Targets, Scenarios and Pathways. Pre-Publication Draft (April 2007), forthcoming in *Annual Review of Environment and Resources 2007,* Annual Reviews.

Hydrogen Combined with Renewables

Much of the literature refers to the 'ultimate hydrogen economy' as fueled entirely by renewables, with electricity and hydrogen as the dominant and largely interchangeable energy carriers. But transitionally at least, until 2030-2050, studies envision hydrogen from nuclear and fossil fuels (some with carbon sequestration)[64]. Some studies show hydrogen infrastructure emerging after 2030, with natural gas as "bridge" to hydrogen from renewables after 2050. Some scenarios limit renewables-produced hydrogen because of high projected electricity demand that requires the renewable electricity. Others show hydrogen from renewables emerging only after power grids are strengthened to accommodate intermittent and distributed renewables. Many Europe and global scenarios don't show significant hydrogen production until after 2030.

There are differing opinions as to how, when and to what degree hydrogen will penetrate the marketplace. The International Energy Agency (IEA) projects minimal contribution from hydrogen, while other organizations envision cost reductions in fuel cells and other technology breakthroughs making hydrogen 9 percent of transport energy by 2050. The Europeans are more optimistic projecting that 13 percent of world final energy from hydrogen by 2050, produced from nuclear (40 percent) and renewables (50 percent)[65]. The World Business Council for Sustainable Development projects widespread use of fuel-cell vehicles by 2050 and 25 percent of world transport energy from hydrogen (including 17 percent in China, 27 percent in the US/Canada, 32 percent in Europe, and 100 percent in Japan), with renewables-produced hydrogen in some countries[66].

There are also varying opinions as to whether hydrogen infrastructures would be centralized or decentralized, employing local renewable electricity and biomass for decentralized hydrogen production, or large-scale renewables like wind and solar thermal power for centralized production. Others envision hydrogen as a decentralizing technology that promotes community energy systems. Some claim that neither centralized nor decentralized hydrogen visions are practical or desirable, because of the view that hydrogen combined with renewables deceptively hide an agenda – hydrogen from nuclear and fossil fuels – or that such visions force renewables into current energy paradigms rather than create new paradigms better suited to renewables. It will be interesting to continue to observe the hydrogen agenda unfold.

Electric Vehicle Technologies

Beyond long-term visions of renewables-produced hydrogen for transport, most scenarios only discuss the contribution of biofuels to the transport sector. A topic that is often overlooked is the direct contribution of renewable electricity for transport. There has been growing interest in hybrid gasoline-electric vehicles,

[64] Ibid.
[65] European Renewable Energy Council, http://www.erec.org
[66] World Business Council for Sustainable Development website: http://www.wbcsd.org

including “plug-in hybrids” in which the battery can be recharged from an external source such as renewable electricity. Plug-in hybrids could allow shorter trips to be made entirely on renewables, with stored gasoline used for longer trips. There has also been a recent increased interest in electric-only vehicles, following the decline of earlier models in the 1990s[67]. A growing number of authors envision a future with transport technology closely tied to electric power and renewable electricity rather than liquid or gaseous fuels. This future also includes potential use of electric vehicle batteries as mediums for electricity storage, for example charging a car at night and then using the power during the day or selling it for peak-power prices. Wind power could be a good match for electric vehicle technologies as vehicles can be charged with cheap off-peak wind power, and because battery charging is ideally suited to intermittent wind power. The key barrier remains battery technology. Ongoing technology developments may accelerate beyond what some literature projects.

Advanced Storage Technologies

Energy storage is a key enabling technology for the integration of renewables. Many experts believe energy storage will be used widely by early 2020 to support renewables. However, very few energy scenarios address the storage issue specifically. A number of energy storage technologies have the potential to shape the use of renewable energy, including centralized storage to stabilize power grids containing large shares of intermittent renewables, local distributed storage, and storage on-board vehicles. Some scenarios envision advanced battery storage in homes to compliment local solar PV generation. Advanced research and development on the storage issues is critical to the long-term integration of renewables into the energy system.

Nuclear Power

There is much debate as to how nuclear will play a role in the future of our energy supply. Many global scenarios envision nuclear retaining roughly the same electricity share as today (15 percent), which means increasing at the same rate of world electricity demand[68]. The World Business Council for Sustainable Development shows a 12 percent share for nuclear by 2050.[69] Some scenarios show an even higher share for nuclear, 30 percent more. At the other extreme, some global scenarios envision the complete elimination of nuclear power by 2050 and consequently high levels of renewables. The policy debate surrounding nuclear will surely play an important part in the role of nuclear in the future.

[67] Martinot, E, “Renewable Energy Futures: Targets, Scenarios and Pathways. Pre-Publication Draft (April 2007), forthcoming in *Annual Review of Environment and Resources 2007,* Annual Reviews.
[68] Ibid.
[69] World Business Council for Sustainable Development website: http://www.wbcsd.org

High Performance Commercial Buildings and Renewable Energy

Making commercial buildings more energy and resource efficient represents an enormous opportunity to save money and reduce pollution in every community across the country. Greater cost competitiveness of photovoltaics, fuel cells, and combined heat and power could make on-site power generation an increasingly viable option for commercial buildings. Demand is already growing for energy-efficient buildings, particularly in areas with high power costs or reliability concerns. In states or cities with climate action plans, or mandated greenhouse gas emissions reductions, such as in California, future controls on carbon dioxide emissions will accelerate the demand for 'green' buildings.

According to the Department of Energy, annual expenditures in the commercial building sector currently exceed $100 billion.[70.] An efficiency improvement of 30 percent would result in a $30 billion per year in energy savings, which also translates into important environmental benefits such as reduced sulfur dioxide, nitrogen dioxide and carbon dioxide from fossil-fueled power generation. A 30 percent reduction in energy usage in commercial buildings could realistically be achieved through existing technologies. A more aggressive agenda of reducing energy in commercial buildings by 50-80 percent could be achieved with a long-term approach to research and development. Ultimately, the appropriate use of heating, cooling, and power systems, optimized building controls, solar and other forms of renewable energy, and energy-efficient building shells and equipment can produce commercial buildings that generate more electricity than is consumed. The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System has made important steps in this direction by establishment of a framework for meeting energy efficiency goals in buildings and communities[71].

The Energy-Water Nexus

It is impossible to discuss the future of renewable energy technologies without mentioning the dependency on water. Energy and water are inextricably linked: energy and power production requires water, and water production, processing, distribution and end-use requires energy. Many experts researching this issue raise concerns about water supplies being sufficient to meet energy demands in 20 years. The energy industry competes for water with agriculture, domestic use and other industries, and climate change and energy-industry operations could impact water supplies, quality and energy demand[72].

Future energy development will put new demands on water in that many new technologies will be more water intensive, such as the hydrogen economy that would require even more water. Likewise, future water supplies and treatment will be more energy intensive. Readily accessible fresh water supplies are limited, and new technologies to access and/or treat non-traditional water

[70] US Department of Energy website: http://www.doe.gov
[71] US Green Building Council website: http://www.usgbc.org
[72] Energy-Water Science and Technology Roadmap Summary: www.sandia.gov/energy-water

resources will require more energy per gallon of water. As advanced research and development continues to improve renewable energy technologies, a parallel investment in addressing the energy-water nexus is critical to meet the needs of each community.

Conclusions

There are many challenges facing communities, states, countries and the world as a whole when designing energy strategies for the next 20 years. Recent changes in the political environment as well as improved technologies and costs have increased the focus on clean energy technologies that are efficient reduce total energy consumption and that reduce greenhouse gas emissions. There is, as a whole, an optimistic view towards renewable energy playing a more important role in our energy supply over the next 20 years.

The average view from most of the literature shows that the share of electricity from renewables to be about 15 percent by 2040-2050, medium scenarios show a 30-40 percent share, and high scenarios show a 50-80 percent share, compared to 19 percent in 2005. For individual countries and states, there are many targets and scenarios for 15-25 percent share of primary energy and 20-35 percent share of electricity by 2020. Scenarios for 2050 show up to 50 percent share of primary energy and 50-80 percent share of electricity under policy-intensive or advanced scenarios.

Factors affecting scenario outcomes include aggressiveness of policy action, cost-competitiveness driven by technology development and fuel price changes, and aggregate energy demand. Other factors include carbon prices, speed of capital-stock replacement, and business strategies. Many scenarios show large reductions in aggregate energy demand from energy efficiency that allows renewables to supply nearly a majority share.

The future of renewables appears promising to many. Cost reduction and technology development – from incremental technological improvements to large-scale policy change – will be important, but ultimately the decisions of business managers, policy-makers, and households will determine those futures.

Appendix C – Resources and Further Information

Benchmarking information can be found on the Green California website
www.green.ca.gov/EnergyEffProj

California's "Flex Your Power" program
www.flexyourpower.ca.gov

California Energy Commission
www.energy.ca.gov

California Climate Registry
www.climateregistry.org

"Energy Conservation under the Sun: A Resource Book for Local Governments"
Local Government Commission
www.lgc.org

Energy Information Administration, U.S. Department of Energy
http://www.eia.doe.gov

Energy Policy Initiatives Center at University of San Diego School of Law
www.sandiego.edu/epic

Energy Star program information, including its benchmarking support information go to: www.energystar.gov/index.

Estimated annual energy savings attributable to efficiency and renewable energy installations, and useful lifetimes can be found in the State-sponsored Database for Energy Efficient Resources (DEER)
www.energy.ca.gov/deer

Energy-Water Science and Technology Roadmap Summary
www.sandia.gov/energy-water

European Renewable Energy Council
http://www.erec.org

Federal Energy Management Program
www.eren.doe.gov.femp

Life cycle cost assessment model information is available at
www.green.ca.gov/LCCA/FactSheet.htm

National Renewable Energy Laboratory Energy Analysis Office
www.nrel.gov

Santa Monica Green Building Design and Construction Guidelines
www.greenbuildings.santa-monica.org

U.S. Green Building Council
www.usgbc.org

U.S. Department of Energy
www.doe.gov

U.S. Department of Energy – Energy Efficiency and Renewable Energy Network
www.eren.doe.gov/buildings/highperformance

World Business Council for Sustainable Development
http://www.wbcsd.org