

Southern California Household Energy Savings

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Introduction

We show that in Southern California, the three household energy domains of electricity, hot water heating, and space heating use about equal energy. We provide a simple strategy to reduce greenhouse gases from electricity and hot water heating to a third of their present values at modest cost. Space heating will require more detailed attention from homeowners.

Data Source:

[The California Statewide Residential Appliance Saturation Study, 2004](#). Numbers have been rounded off to make the relative magnitudes easier to perceive, and any errors in the calculations are my own.

Total Electricity usage (all applications) per year for comparison:

USA 12,000 kWh per capita
California 8,000 kWh per capita

Average of SC Edison and San Diego Gas and Electric

Household electricity use: 6,000 kWh per household per year for 3 residents average per household. So the household use per capita is 2,000 kWh or about 1/4 of per capita electricity from all applications.

Household Natural Gas use: 400 therms per household x 30 give 12,000 kWh equivalent electricity. Since much of the electricity is generated by natural gas, it is not totally unreasonable to compare these two in kilowatt hours. We note that heating water and households by natural gas uses twice the power of household electricity.

Total average household power usage:

6,000 kWh electricity plus 12,000 kWh gas equivalent = 18,000 kWh per year.

Proposed standards for low energy usage per year

The average household area for the above data is 1500 square feet.

A standard being considered by Laguna Beach is 0.23 kWh per square foot per month, which becomes

$0.23 \times 1500 \times 12 = 4140 \text{ kWh}$ per year. This is supposed to include the gas usage as well.

A shorter term goal to comply with the Mayor's Program would be a 20% reduction, bringing the total down to 16,000 kWh per year.

An alternative standard is a reduction to a sustainable production of carbon dioxide which is only 20% of the current rate. If that is applied separately to the household total of 18,000 kWh per year it would give a goal of 3,600 kWh which is less than the "international" standard. A

goal of 80% GHG generation below 1990 levels by 2050 has been set forward in Executive Order S-3-05 by Governor Schwarzenegger, and could be about the same as the above since per capita electricity has been stabilized in California.

Comparison: Thus the current average usage is 5 times the Governor's 2050 goal.

Solar Water Heating

Installing solar water heating for somewhere around \$3,000-\$7,000 is said to save 2/3 of the water heating section of the gas bill. (The EPA quotes 50% to 80% savings.) (You can get a 30% tax credit up to \$2,000 until Jan. 1, 2008 on a solar water system.) With an average of 400 therms total gas usage, the water heating portion average is on average 50% at 200 therms. Saving 2/3 of this cuts out $200 \times (2/3) \times 30 = 4000$ kWh. This cuts the 12,000 kWh down to **8,000 kWh** equivalent for gas. At the rate of \$1.20 per therm over baseline, the 200 therms saved results in a \$240 savings per year. Separately or in addition, low flow shower heads, turning down the hot water tank temperature, using economy cycles on the dishwasher and washing machine, and cold water clothes washing will save gas.

Compact Fluorescent Bulbs and Other Electricity Savings

The first thing we can do in the house is to replace all lighting with Compact Fluorescent Bulbs, which take only 1/4 of the power for the same light. Since lighting is 22% of home electricity, removing 3/4 of it saves 17% or 1/6 of the total 6,000 kWh, leaving only **5,000 kWh** of household electricity. At \$0.10 per kWh, this gives a yearly savings of \$100. This is where more energy efficient appliances and air conditioning come in, as well as solar adaptation by awnings, tinted or upgraded windows and use of fans to lessen the cooling needs of the house. Getting rid of a second fridge, replacing an old one, turning off equipment when not in use, and avoiding 400 watt plasma screen televisions also help.

California's Greenhouse-Gas-Free Power

The greenhouse gas free electricity production does not have to be counted in the electricity account. By 2010 or at the latest 2017, 20% of the [State of California's electricity](#) will be produced by renewable resources (currently 11%) from large scale solar thermal, concentrator solar photovoltaic, wind and geothermal. Add this to the hydroelectric share of 19% and the nuclear share of 13% will give 52% of electricity which is greenhouse gas (GHG) free. The remaining 48% of the 5,000 kWh Renewable Electricity Production h electricity gives **2,400 kWh** GHG polluting electricity per household (currently 16% coal and 42% natural gas). In this we are assuming that the almost double (1.78) CO2 polluting coal production of electricity from out of state sources is replaced by the renewable resources. (This will certainly occur by 2027 when the Coal contracts of Los Angeles and Anaheim run out.) The Governor has also proposed a 33% renewable fraction by 2020. This would bring us to 65% renewable electricity, and the remaining 35% of 5,000 kWh would be **1,800 kWh** GHG polluting. This would reduce us to only generating greenhouse gases from 30% of the initial electricity we used.

Southern California Edison Greenhouse-Gas-Free Power

The percentage of greenhouse-gas-free power is different for different power companies in the State. Hydroelectric power is mostly in the North part of the State. For SC Edison for 2006, nuclear is 17%, renewables are 16%, large hydro is 5%, coal is 8%, and natural gas is 54%. The renewable power is mainly geothermal at 9%, followed by wind at 3%, biomass at 2%, and solar and small hydro at 1% each. So for now 38% of SC Edison electricity is greenhouse-gas-free, and by 2010, when renewables are increased to 20%, 42% of SC Edison's power will be greenhouse-gas-free.

San Diego Gas and Electric Greenhouse-Gas-Free Power

For SDG&E for 2006, nuclear is 15%, renewables are 8%, large hydro is 10%, coal is 18%, and natural gas is 50%. The renewable power is mainly wind at 3%, biomass at 3%, and geothermal at 2%. So for now 33% of SDG&E electricity is greenhouse-gas-free, and by 2010, when renewables are increased to 20%, 45% of SDG&Es' power will be greenhouse-gas-free.

Comparison to LADWP, SMUD and PG&E Greenhouse-Gas-Free Power

For comparison, Los Angeles Department of Water and Power operates on 48% coal, 30% natural gas, and only 6% hydro, 10% nuclear and 6% renewables, for a present total of 22% greenhouse-gas-free. We must mention here that coal is twice as CO₂ polluting as natural gas for the same energy, further downgrading their greenhouse-gas-free percentage.

The Sacramento Municipal Utility District (SMUD) takes advantage of hydro power in the North to be 47% hydro, 12% renewable, and 41% natural gas, and using no coal or nuclear (having shut down their nuclear plant by a ballot measure). So they are the State leader at 59% greenhouse-gas-free, and by 2010 at 20% renewable will be 67% greenhouse-gas-free.

Pacific Gas and Electric (PG&E) has 19% hydro, 23% nuclear, 13% renewables, 42% natural gas, and only 3% coal. So it is now 55% greenhouse-gas-free, and by 2010 will be 62% greenhouse-gas-free.

Space Heating

Space heating is about 40% of natural gas usage or **4800 kWh** equivalent in the home in Southern California. Clearly bringing down the gas heating needs by thermostat management to not heat when we are gone, and to consider sweaters and comforters to maintain lower temperatures at night will pay off. It may also be possible to heat only the rooms we are in by shutting the heating vents to the other rooms and closing doors. Designing houses for solar heating is a longer range solution, and window coating and upgrades are nearer term aids.

Reduction of Total Household Energy Use

We are now down to about 8,000 kWh from gas and 1,800 kWh from electricity for a total of **9,800 kWh total** of GHG producing household usage, down from the initial 18,000 kWh. This brings us down to **2.4 times the proposed standard**.

But what about the 5,000 pound Gorillas sitting outside the house?

We must remember that while total electricity generates 22% of greenhouse gases, transportation generates 40%. Thus in terms of the 8,000 kWh per capita for total electricity, transportation generates the equivalent of 14,500 kWh per capita. Now the household of three has an equivalent of **44,000 kWh** per household in transportation. This is not all by household drivers of course, and includes air transport and trucking, but still in the service of the people of the household. Taking a prototypical 25 miles per gallon (mpg) car average at 15,000 miles a year requires 600 gallons of gas, which in energy is equivalent to 23,400 kWh, although it will generate more equivalent natural gas greenhouse gases by a ratio of 1.40, leading to an equivalent GHG generation of natural gas of 33,000 kWh. That is almost double the entire household energy use. The largest SUVs or light trucks get about 12 mpg average, and you can double this figure. So those use as much energy as four households. Switching a vehicle that gets 25 miles per gallon to one that gets 50 mpg or a future plug-in hybrid that gets the equivalent of 100 mpg can cut in half or a quarter one or more of the 33,000 kWh equivalent cars. Other alternatives are public transportation, car pooling, biking, walking, combining trips, or avoiding transportation through the use of modern communications.

California Greenhouse Gas Emissions From 1990-2004

Total Emissions in Million Metric Tons of CO₂ Equivalent (MMTCO₂) rose from 427 in 1990 to 492 in 2004, an increase of 15% (the rise occurred between 1996-2001).

The direct CO₂ emissions rose from 317 to 356, for a 12% increase.

California population rose from 30 million to about 36 million, about a 20% increase.

In sectors of direct CO₂ sources of emissions:

Transportation rose from 161 to 188, an increase of 17%.

Total electricity production rose from 80 to 108, an increase of 35%.

Industrial stayed flat from 66 to 67.

Residential decreased slightly from 29 to 28 (this is mainly home natural gas use)

Commercial stayed flat around 12.

Land Use Change and Forestry Sink stayed flat at around -21.

Conclusions: Most CO₂ production sources stayed flat despite a 20% population increase. But in the largest sources, transportation rose with population, and CO₂ production from electricity production increased at double the rate of the population increase.