

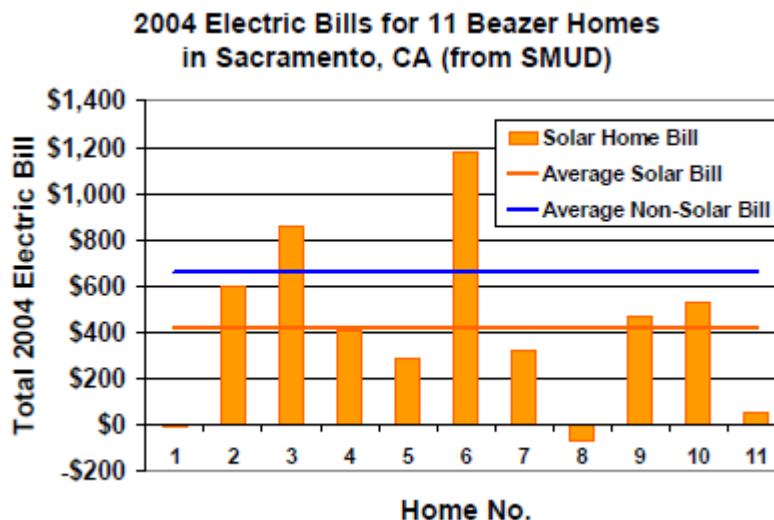


What's Wrong With My Home?

The simple answer may be...you.

So you are trying to do your part to reduce your carbon footprint. You buy an energy efficient home, but when that first utility bill comes, it doesn't seem lower than usual. Who's to blame? It could very well be poor workmanship by a builder or contractor, but it could just as easily be that you aren't as energy conscious as you believe. Regardless of how efficient a home is designed to be occupant behavior can have the greatest influence on energy use.

SWA worked with Beazer Homes and the Sacramento Municipal Utility District (SMUD) in 2004 on 11 similar homes in a development in Sacramento, CA. The goal was to build these homes to have near-zero electricity bills over the course of the year. SWA performed energy modeling to confirm that the building specifications would result in near-zero energy consumption based on typical occupancy schedules. Utility bills were analyzed after a year, and the results were telling to say the least. Looking at the graph below, you would think that these were 11 homes picked randomly for a utility bill analysis, but they are all indeed similar homes – each with a 4-kW solar electric system. Only three of the eleven homeowners can say that they achieved zero or near-zero energy home performance.



To designers of efficient homes, such variability must give pause. Despite the best efforts of designers, an uninformed homeowner in an efficient home can use more energy than a conscientious homeowner in a standard home. This is not to say that efficient design is a waste; just imagine the utility bill of Home No. 6 if these features (efficient design and PV) were not included.

These differences show that, while builders and designers can do a great deal to improve envelope performance and equipment efficiency, the ultimate responsibility in attaining “zero energy” lies with the user. As a homeowner, it is important that you become familiar with the various systems in your new home and how to maintain them so that you can enjoy all of your home’s benefits for years to come. That education should be the shared responsibility of your builder, their sales team, and your own research and persistence.

What Can You Do

So, you are living in an “energy-efficient” home. What do you need to know to operate and maintain this home?

If new construction, make sure to understand your home’s systems when you do your walk through with the builder. “How does it work?”, “What does it do?”, and “What are the maintenance requirements?” are questions that should be asked of major systems (heating, cooling, water heater, ventilation, plumbing, electrical, etc.) Technologies have evolved over the past decade, and it is worthwhile to make sure you are up-to-date on your home’s systems.

Learning how to operate your programmable thermostat is a quick and easy way to be more energy conscious. In newer, tighter homes, a home can be quite comfortable at a heating setpoint of 68°F and a cooling setpoint of 78°F. Of course, you can adjust these based on your personal comfort level. But consider setting back or up the temperature by several degrees during common periods of vacancy in the home. A “5-2” programmable thermostat (5 weekdays and 2 weekend days have separate programs) often works well; you don’t need to readjust the thermostat when you are home more during the day on the weekend. Opening windows and utilizing ceiling fans are great for keeping the home comfortable during the spring and fall (also during the summer if humidity levels aren’t too high). Remember to turn off the A/C when windows are open. Close up the house during the hottest part of the day, and open it up when it cools off. Use window shades to keep out sun in the summer and open them during the day in the winter.

Just like a car, your home needs regular maintenance. Homeowners should replace air filters regularly to maintain the performance of your space conditioning equipment and indoor air quality. Typically, this is recommended at least once per heating and cooling season (at least twice a year). In addition to this, a service technician should be scheduled at least every other year to commission the HVAC unit to ensure optimal performance. It is financially beneficial for you to perform regular maintenance on your HVAC unit. This will extend the service life of the equipment and can result in lower utility bills from a system running optimally.

Exhaust fans should be vacuumed once a year. This will remove dust build-up in the fan housing and extend the life of the fan.

Fluorescent and compact fluorescent lighting (CFL) cost a little more than regular bulbs upfront, but use significantly less energy and last much longer. They also generate very little heat which minimizes the cooling load in the summer. This lighting technology has come a long way in the past few years. CFLs are available now in a several colors (imitating warm incandescent lamps or natural daylight), and the time required for lights to warm up to full brightness is significantly shorter – often not noticeable. Dimmable CFLs are also available, but some do hum, so test them out before relamping your whole house. Light-emitting diode (LED) lights, such as Cree’s LR6 downlight, are also coming into the market. This technology fixes many of the short comings of CFLs while maintaining their benefits, but they currently first cost significantly more.

Be aware of the appliances and electronics that you are buying. Let’s take HDTVs as an example. People always consider size, LCD versus plasma, and picture quality, but what about power consumption? If you look at CNET’s review of 139 HDTVs on the market (http://reviews.cnet.com/4520-6475_7-6400401-3.html?tag=lnav), you can see a larger range of power consumption in similar models. Fortunately, the majority of HDTVs that CNET has

tested in the past year have standby power measurements of less than one Watt, but some HDTVs from a year or more ago could have standby power measurements higher than 60 Watts. Energy Star certification for appliances and electronics is growing and is a good starting point to identify those products designed to be more energy efficient.

Just like a TV, most equipment (phone chargers, computers, printers, iPod stations, stereos, etc.) that is plugged in uses standby power. If you are not using a charger to actively charge an item, you should unplug it. Another alternative is to use a power strip and turn that off when connected items are not in use.

Homeowner Usage Feedback

In addition to education, consumption feedback is needed in order to change energy usage habits. Studies have shown that making consumers aware of their consumption by providing real-time display of their electricity consumption can influence behavior resulting in reductions of up to 25%^{1,2,3,4}.

A pay-as-you-go program implemented by Woodstock Hydro, a Canadian utility, involved a display in the home that showed how much electricity occupants were using in dollars and cents per hour. The customer pre-purchased electric energy at the local variety store using a smart card. The consumers appreciated the empowerment and energy savings of 20% to 28%. The Salt River Project utility in Phoenix, AZ conducted a similar program that saw consumers use 10% to 20% less electricity with a prepay program⁴.

Many providers of solar electric (PV) systems include a display as part of their PV package that monitors and displays energy and power produced by the PV system. A National Renewable Energy Laboratory (NREL) study of solar homes in California found that awareness increased significantly. Some homeowners claimed proudly that they were “more energy conscious because of the feedback device”⁵.



Many manufacturers are working on developing home energy dashboards to provide live energy consumption feedback to interested homeowners. Several of these systems are also being developed to provide some form of controls to minimize energy consumption. Still, there are items currently in the market that can assist in educating homeowners.

Measurement of individual equipment (lamp, TV, fish pump, etc.) is commonly done with devices such as the Kill-A-Watt electricity meter (\$21) and the Watts Up device (\$131-\$196).



Kill-A-Watt



Watts Up

¹ Darby, S. 2000. “Making it obvious: designing feedback into energy consumption.” Proceedings, 2nd International Conference on Energy Efficiency in Household Appliances and Lighting. Italian Association of Energy Economists/ EC-SAVE programme.

² Farhar, Barbara 1989. “Effects of Feedback on Residential Electricity Consumption: A Literature Review.” Solar Energy Research Institute.

³ Stein, Lynn F. 2004. “Final Report: California Display Pilot Technology Assessment”.

⁴ Roth, Gary 2004. “A Successful 14-Year Experiment.” *Home Energy*. January/February.

⁵ Farhar, Barbara C. et al. 2002. “Market Response to New Zero Energy Homes in San Diego, California.” ACEEE Summer Study on Energy Efficiency in Buildings.

CARB-SWA evaluated several whole-house electrical monitoring systems that are commercially available. Some of the commercially-available products are the Cent a Meter, the EUM-2000, the PowerCost Monitor, The Energy Detective, the Wattson, the Kyocera Econonavit, and the BP Solar system monitor.



Commercially-Available Real-Time Electricity Monitors



CARB-SWA has found that The Energy Detective (TED) monitor can be a good tool for understanding a home's whole-house electrical consumption. The primary screen (shown to the left) is what is of interest to most building scientist, but homeowners tend to prefer the \$/day screen.

In terms of user friendliness, the PowerCost Monitor appears to be the most successful in displaying the necessary information to the user in a quick and precise manner. In addition, it will inform the user to the peak energy usage over a 24-period (displayed in terms of energy cost). This information is beneficial in allowing a homeowner to pinpoint and potentially address peak usage hours of the day. The Cent-a-Meter is also user-friendly, but lacks the logging capabilities of the PowerCost Monitor. The beauty of these systems is in their simplicity of a single screen with all the pertinent data available at a glance.

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