Setting Priorities for Home Energy Improvements

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Most homeowners are looking for ways to reduce expenses. In tough economic times, reduced expenses can help cash-strapped homeowners with debt reduction and other pressing needs. A home's monthly energy expenses can be a significant portion of the homeowner's take-home or fixed income funds; therefore, home energy savings projects are popular candidates to cut costs. However, to really get a "bang for the buck," we need to prioritize our energy projects.

There is a rule of thumb in economics and engineering called the "80/20" rule or the Pareto Principle. This basically states that 80 percent of the costs of a system, such as a home, are caused by 20 percent of the equipment or operations. Another way to think of it is the "important few" items cause most of the costs, so we should identify the important few and concentrate our efforts there.

Breakdown of Home Energy Use

Examination of Figure 1 below shows that the annual heating and cooling systems in a typical American home consume about 50 percent of the energy cost (electricity and gas or oil). The next highest energy cost contributor is water heating at about 13 percent of annual energy costs, appliances at 13 percent, and lighting at about 10 percent of annual energy costs. Everything else like entertainment centers and fans are at about 14 percent.

Therefore, the largest energy users in the home are the heating and cooling systems. From an energy priority point of view these are the systems we should look at first. However, many of us simply buy a few compact fluorescent lamps as our main energy saving project.

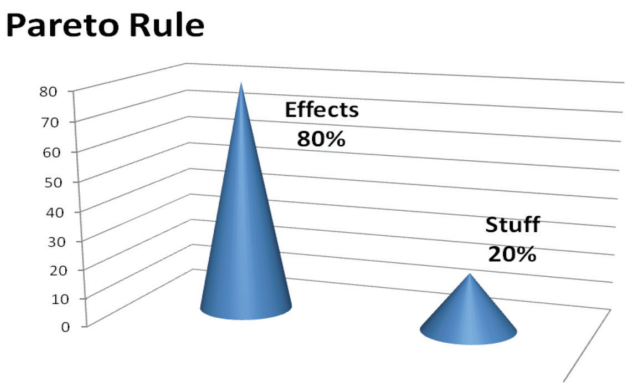

Figure 1. The Pareto Rule showing 20 percent of the "things" cause 80 percent of the "effects." Example: 20 percent of the equipment in a house uses 80 percent of the energy.

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System Interactions and Energy Priorities

What really makes the heating and cooling systems unique from an energy saving point of view is that many factors besides the main equipment can affect the operating costs. That is, we can have a very efficient air conditioner (SEER 14) but if the home has poor insulation or the thermostat is not managed well, energy costs will still be much higher than they could be.

This leads to another application of the 80/20 rule (Figure 2). When dealing with the heating and cooling system, what are the "important few" things we could do to reduce energy costs for the heating and cooling system? Let's look at some examples.

Example 1:

The heating and cooling (HVAC) system in a home is running excessively (winter and summer) and producing high monthly energy bills. We check the heating and cooling system

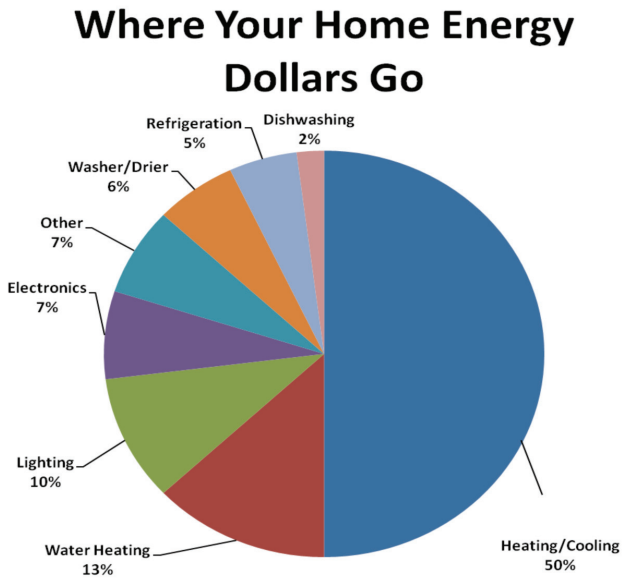

Figure 2. Relative Percentage of Annual Energy Use Cost in Typical American Home Based on National Average Energy Use. Oklahoma Cooling May be More. (Energy Star, EPA DOE, 2008)

and it appears to be in order. We examine the thermostat and it appears to be installed and operating correctly. We examine the filter and it is clean. The ductwork is fine. The HVAC system is less than 10 years old. So from a brief examination of the system, things appear to be in order. The problem must be something besides the equipment.

As we examine the structure of the home we find single pane windows with metal frames. Some of the windows and doors don't fit well in the frames due to age and weather damage. We notice when it is windy that we can feel outside air coming into the home around these problem areas. Also, when it is cold outside, the metal window frames are cold on the inside of the home. Conversely, when it is hot outside, the windows and frames radiate heat to the inside of the home.

Our first low-cost energy project could be to install seals and caulking around the window and door frames. This will dramatically reduce the heat gain in summer and heat loss in winter. The costs are minimal with a do-it-yourself "sweat equity" project like this. If the window and door sealing was very bad to start with, energy savings could be up to 20 percent of heating and cooling costs (energystar.gov). Check with your local hardware store about supplies to do this project.

Another low cost energy project for homes with old windows is to install plastic weather sealing over the insides of the windows. This acts as an air and temperature barrier. While not as effective as storm windows or new high-efficiency windows, plastic covering can be 50 percent more energy efficient than a single pane window and the cost is minimal (ase.org). The sheeting is usually attached to the inside window frame with a weak glue. A hair drier is then used to shrink-fit the plastic film so that occupants can still see clearly out of the windows. The plastic can be easily torn out of the way if the occupant needs to get out of the window in case of fire, etc. Again, most hardware stores carry these supplies.

Example 2:

Where else can we look for heat loss or gain? We look in the attic and find that what little insulation is there, has collapsed or moved to about 3 to 4 inches in depth.

We determine that adding fresh insulation to a depth of 15 inches (R38) in the attic is our plan of action, or one the "important few" things we can do to lower the heating (and cooling) costs. While this project will cost more than the window treatments mentioned above, it is still a relatively low-cost energy project. Savings from installing adequate attic insulation can be significant depending on the pre-insulation condition of the home (estimates vary from 10 to 40 percent of the heating bill).

In examples 1 and 2 we are, in effect, controlling the HVAC thermostat by limiting the amount of heat loss or gain into the building. These projects cost little but affect the largest energy user in the home.

Example 3

Another energy project might involve no cost – only a change in operations. Thermostat "set-back" in winter, or "set-up" in summer allows the inside temperatures to drift while the home is unoccupied. In the winter we might allow the inside temperature to drift down to 60 degrees from 70 degrees once everyone leaves the house for the day. This is a thermostat set-back of 10 degrees. Energy savings occur if the setback is allowed to occur for long periods of time. If the setback occurs for less than 6 to 8 hours – the energy use might actually be slightly higher than simply maintaining a steady temperature setting (energysavers.gov). However, for longer set-back times, savings should occur (Table 1).

Table 1. Thermostat Setback Energy Savings.

Set Back	*8 Hours Per Day*	*16 Hours per Day*	*24 Hours Per Day*
5°	5%	10%	15%
7°	7%	14%	21%
11°	11%	22%	33%
13°	13%	26%	39%

Thermostat set-back and set-up can be easily accomplished by using programmable thermostats. The operation can also be done manually however there will be a period when the home occupant first comes home where the temperatures will be low (or warm).

Heat pump users must be careful when doing winter set-back operations. They should use a thermostat specifically designed not to engage the backup strip heaters when changing set-back temperatures. This would be very difficult to do by hand and is not recommended. If you have a heat pump, check with your heating contractor about set-back operations.

Our examples are not unusual. Using the Pareto rule, the cost of the improvements will be relatively low but potential savings might be higher than simply purchasing a few energy efficient lamps. The savings might take a couple of years to pay back for some of the more involved HVAC projects but then they will continue year after year providing an economic benefit for the homeowner.

Move On To the Next Priority

Once the heating and cooling system is addressed, we could move on to the water heater and check to make sure the temperature is not set too high and that it is well insulated. From there we move to the lighting and other appliances to make sure there are no major issues.

We could have started our energy saving program by immediately going out and buying a more efficient refrigerator. However, the refrigerator's contribution to the overall energy bills needs to be put in perspective. Remember the 80/20 rule. If $400 worth of caulking and insulation could lower the heating and cooling bills in an old home by $400 a year and a new $700 refrigerator can lower by energy bills by $70[1] a year, the priorities are clear unless you need a new refrigerator. Note – we are not implying that purchasing more efficient appliances or lighting is not a good decision but consider addressing other prioritized problems first.

To see how you are doing, keep track of your gas and electric energy usage. This can be a bit tricky because outside temperatures change from year to year. However, for projects that impact the heating and cooling system you should see a difference over time. You may notice that your heater or air conditioner doesn't run as long as it used to. You may also notice you are more comfortable in your home as temperatures and humidity levels are more stable when systems are running well.

1 Based on EPA DOE Energy Star Calculator and 18-year-old refrigerator

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