



Steps in the Solar Electricity Series

STEP 2

1. Building and Site Assessment
- 2. Conservation and Efficiency**
3. System Options
4. System Components
5. System Sizing
6. Costs
7. Installation
8. Operation and Maintenance
9. Electricity Use Worksheet

For more energy information, go to <http://energy.tennessee.edu>.

Conservation and Efficiency

Energy conservation and efficiency provide the foundation for a smaller, more efficient and affordable solar electric system.

It is easy to get excited about photovoltaics and other renewable energy technologies, but energy conservation and efficiency measures should be considered first. Why? Because when you or a contractor sizes your system, it is based on the amount of electricity used. The less you use, the smaller, more efficient and affordable the system will be.

It is almost always cheaper to reduce energy use than to buy a larger renewable energy system. Replacing inefficient lights, appliances, equipment and machinery can significantly reduce your energy demand and the size and cost of your solar electric system. Plus, the electricity savings continue for the life of the replacements.

You or a PV system installer can review past utility bills to determine your electrical load in order to properly size your system.

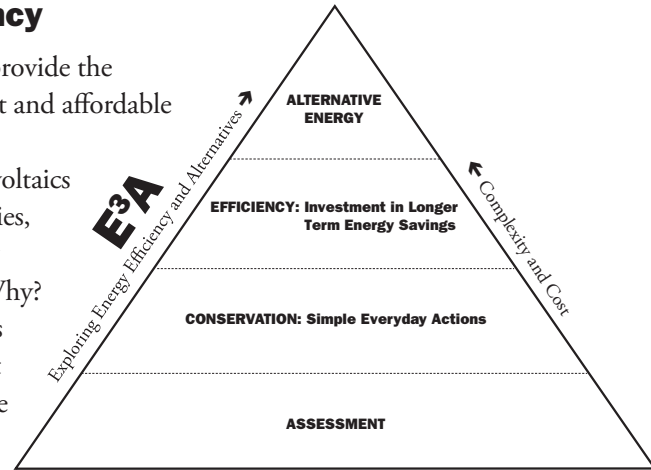
It is important to start at the bottom of the pyramid and conduct an assessment of your electricity usage in your home or building. An assessment can include a basic walk-through of the structure to determine areas where improvements could be made, such as drafty windows, unused lights that are left on, or unused electronics that are still plugged in. You can also conduct a more detailed assessment by using Step 9: Electricity Use Worksheet to make a list of everything that uses electricity and how much. This exercise will create an awareness of the electrical demand that will be offset by your PV system, how electricity use changes throughout a day, month or a season, and will help you determine ways to reduce your electrical load. The information can also be used for calculating your system size in Step 5: System Sizing. After implementing conservation and efficiency measures, complete the worksheet again to resize your system based on your own needs.

As an example, let's consider residential electricity use. Within the Tennessee Valley Authority (TVA) service area, the top three residential electricity loads in typical Tennessee homes are water heating (17 percent), heating/cooling (15 percent), and lighting (10 percent). These numbers are for homes that use electricity for both heating and cooling.

Tips to Reduce the Top Three Home-Electricity Loads

Water Heating

- Conservation Tips
 - Set water temperature at 120 degrees (a higher temperature is not needed for most uses).
 - Take shorter showers.
 - Install low-flow showerheads and faucet aerators to reduce hot water use.
 - Wash only full loads of dishes and clothes; wash clothes in cold water when possible.



Courtesy of DOE/NREL

- Efficiency Tips
 - Wrap an insulating blanket around water heater.
 - Insulate your hot water pipes.
 - Install an energy-efficient water heater.

Heating/Cooling

- Conservation Tips
 - In the winter, set thermostat to 68 degrees or less during the day and 60 degrees at night or when gone for a long period of time. In the summer, set the thermostat to 78 degrees or higher.
 - Blinds and shades (especially on the south side of the structure): During winter leave open to allow sunlight to come in, warming the structure, and close during the summer to reduce air conditioning needs.
 - Plant deciduous trees (trees that lose leaves in winter) near the south side of your house to reduce heating needs in winter and air conditioning needs in summer.
 - Wash only full loads of dishes and clothes; wash clothes in cold water when possible.
- Efficiency Tips
 - Replace furnace filters regularly so your blower can circulate air efficiently.
 - Tune up your heating/cooling system on an annual basis.



LED Bulb

Courtesy of DOE/NREL

Lighting

- Conservation Tips
 - Turn off lights when not needed.
 - Use natural daylight whenever possible.
 - Dim lights if you have dimmer switches.
 - Use motion sensors for outdoor lights normally left on all night.
 - Remove bulbs from recessed can fixtures that are not needed.
 - Use lower wattage bulbs than the maximum allowed for that fixture.
 - Use task lighting (e.g., desk lamps or under-counter lights instead of ceiling lights).
- Efficiency Tips
 - Install Energy Star compact fluorescent lamps/lights (CFL), light emitting diode bulbs (LED) or other energy-efficient bulbs/tubes.
 - Use outdoor solar-powered lights for mood or pathway lighting.
 - Install dimmer switches.
 - Install skylights and solar tubes for natural daylight.

Whether for your home or farm, upgrading to efficient lighting is one of the easiest ways to save money and reduce electricity use. Consider replacing old incandescent bulbs with more efficient lighting such as LED bulbs (Light Emitting Diodes) or CFL bulbs (Compact Fluorescent Lamps/Lights), which use 75 to 80 percent less energy and last 10-25 times longer than incandescent. Energy-efficient bulbs such as LEDs and CFLs also generate between 75 and 80 percent less heat than incandescent bulbs, making them safer to operate and cutting home or building cooling costs.

CFLs should only be considered to replace bulbs that are on for 15 minutes or more. CFLs work best and are most efficient when left on for at least 15 minutes (less than that shortens their lifespan). LED bulbs can be left on any amount of time without reducing efficiency or lifespan (do not need to be placed in fixtures where the light is left on 15 minutes or more).

LEDs and CFLs cost more at the store, but they cost less to operate (the second price tag) and are cheaper overall. They will save you money when you are paying for utility electricity and may help reduce the size or number of PV panels needed for your solar electric system! Review this comparison of an 11 watt LED, 13 watt CFL, and 60 watt incandescent bulb. All three bulbs provide a similar level of brightness (lumens). Previously you were told to shop for light bulbs based on wattage, but with the advent of more efficient technologies, it is now recommended that you buy bulbs based on the preferred brightness (lumens).

Light Emitting Diode (LED), Compact Fluorescent Lamp (CFL) & Incandescent Cost and Energy Use Comparison			
	LED	CFL	Incandescent
Equivalent Light Output Wattage	11 watts	13 watts	60 watts
Lumens	830	825	840
Bulb Cost	\$15.00	\$6.00	\$0.25
Bulb Lifespan	25,000 hours	10,000 hours	1,000 hours
Bulb Cost for 25,000 hours	\$15.00	\$6.00 x 2.5 = \$15.00 (takes 2.5 bulbs to get 25,000 hours)	\$0.25 x 25 = \$6.25 (takes 25 bulbs to get 25,000 hours)
Energy Used in kWh	25,000 hours of light at 11 watts = 275,000 watt-hours. 275,000 ÷ 1,000 watts = 275 kilowatt-hours (kWh)	25,000 hours of light at 13 watts = 325,000 watt-hours. 325,000 ÷ 1,000 watts = 325 kilowatt-hours (kWh)	25,000 hours of light at 60 watts = 1,500,000 watt-hours. 1,500,000 ÷ 1,000 watts = 1,500 kilowatt-hours (kWh)
Utility Electricity Cost for 10,000 hours of light at \$0.09 / kWh	275 kWh x \$0.09 = \$24.75	325 kWh x \$0.09 = \$29.25	1,500 kWh x \$0.09 = \$135.00
Store Purchase Cost + Electricity/Operation Cost = Total Cost	\$15.00 + \$24.75 = \$39.75	\$15.00 + \$29.25 = \$44.25*	\$6.25 + \$135.00 = \$164.25**

*Add the "value" of the time it takes to replace burned out CFL bulbs 2 times.

**Add the "value" of the time it takes to replace burned out incandescent bulbs 9 times.

Halogen bulbs are another efficient light bulb choice. They are roughly 25-30 percent more efficient (use 25-30 percent less energy to operate) than incandescent bulbs.

Larger, agricultural-based buildings can be retrofitted to use T-8 fluorescent tube lighting and other efficient lights. In large buildings with high ceilings, not only are LEDs the most efficient and economical option, but less time will need to be devoted to changing out burnt out light bulbs.

Regardless of the type lighting to be used, make sure the devices are suitable for your installation. Some CFL and LED bulbs are intended for “base down” installation, and mounting them in ceiling fixtures can result in premature failures that will negate any energy savings.

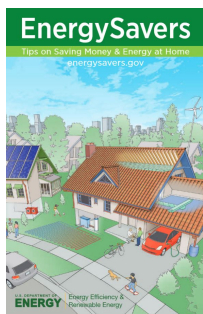
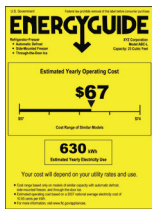
Other efficiency measures for the home or farm include modifying irrigation systems by switching from high- and medium- to low-pressure sprinkler systems and using variable speed drives for pumps, fans and other equipment. A farm can reduce electricity use by as much as 35 percent with variable speed drives alone. If energy and water resources are a concern, planting crops with lower water requirements reduces water use and the energy needed for pumping. Converting to drip irrigation or a linear/pivot system also saves both energy and water.

Conserve where you can and buy energy efficient fixtures, appliances, and machinery. Look for Energy Star labels and compare the bright yellow EnergyGuide labels.

The U.S. Department of Energy has a booklet with numerous tips on how to save money and energy: Energy Savers Booklet: Tips on Saving Energy & Money at Home: http://energy.gov/sites/prod/files/2013/06/f2/energy_savers.pdf

Note: CFL bulbs contain mercury and must be disposed of/recycled in the appropriate manner. See <http://www2.epa.gov/cfl> for information on cleaning up a broken CFL or disposing of a burnt out bulb.

If you hire a business to conduct an energy and/or water use assessment, select one that has trained and certified employees. BPI (Building Performance Institute) and RESNET (Residential Energy Services Network) are two certification programs for homes that use the HERS (Home Energy Rating System). The HERS rating system gives each individual home a HERS Index Score as compared to a reference home with an index of 100. If your home scores higher than 100, your home uses more energy than



the reference home and if it scores less than 100 it uses less energy than the reference home. This index score allows for home energy ratings to be standardized and able to be compared from one home to another. Your utility company may provide a free or low-cost assessment.

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