

Introduction to Electricity

Electricity is the most common form of energy used in the home. Different characteristics of electricity are measured using different quantities and units, including:

VOLTAGE (symbol **V**, measured in *Volts*), which is a measure of the **force of flow of electricity** (and its 'potential strength' when electricity is not actually flowing). Imagine voltage as the pressure in a water pipe. Mains electricity in Australia is 240V.

CURRENT (symbol **I**, measured in *Amperes*), which is a measure of the **volume of flow of electricity**. Imagine current as the diameter of the water pipe (assuming the pipe is full of water).



However, neither voltage nor current is particularly useful to the average householder because neither is a measure of the rate of consumption of electricity, which is what we really want to know...

POWER (symbol **P**, measured in *Watts*) is a measure of the rate at which electricity flows through an appliance, effectively the **rate of electricity consumption**. Continuing the pipe analogy, if you multiply the water pressure in a pipe by its diameter, you will determine how much water is flowing through that pipe every second. So, to calculate the amount of power used by an appliance, you simply multiply the force of the flow (in volts) by the volume of flow (in amps) to get the rate at which electricity is flowing through it (in watts):

$$V \times I = P$$

If you look at an appliance's compliance plate or specifications, just look for 'W' or 'kW'!

A 600W hairdryer uses 10 times more power than a 60W lightbulb. Similarly, a 6kW (6000W) air-conditioning unit uses 10 times more power than a 600W hairdryer.

What does my electricity bill tell me?

Completing the water analogy, water flows out of a pipe at a certain flow rate, say 5L/min, and the total quantity of water that flows out of the tap over time is the rate the pipe flows at multiplied by the total time it flows. So, the total quantity of electricity consumed by a household can be calculated by multiplying the household's rate of power consumption (in W or kW: 1kW=1000W) by the time (t) it was consumed for (in hours):

$P \times t =$ electricity consumption in Wh or kWh

On domestic electricity bills, **electricity consumption is usually recorded in kilowatt-hours (kWh)**.

The figure under "usage" on the back of your electricity bill tells you how many kWh you have consumed during a certain period, usually about 90 days. To determine the size of the consumption charge on your bill, the usage figure is multiplied by the price charged by the utility per kWh of electricity consumed. There is also a daily charge for supplying the electricity to your home which will be located elsewhere on the bill. Adding your total consumption charge and total supply charge together will give you the final total for the bill.

Most utilities have a range of plans that vary the consumption and supply charges, and depending on how much electricity you use you might be advantaged by certain plans and disadvantaged by others. It is a good idea to get out your calculator and run the figures on each plan for your past year's electricity consumption to determine which plan you should be on to minimise your electricity bill.

How can I reduce my electricity bill?

Some of the appliances in your home use more electricity than others. For instance:

- when running, reverse cycle air-conditioners (RCAC) generally consume 3-10kW (3-10,000W!) depending on their size;
- a typical electrical storage hot water heater has a 3.6kW element;
- column heaters, fan heaters and radiant heaters generally vary from 1-3kW;
- depending on their size, plasma TVs generally use 250-600W, while cathode ray tubes (old-style TVs) and LCD TVs generally use 80-200W;
- depending on their size, refrigerator pumps vary from 700-1200W, although they need a lot more power when starting than when running;
- video/DVD/hard drive recorders, game consoles, laptop computers and other similar electronic devices generally use 30-120W;
- desk/pedestal fans use up to 50W.

If you want to know the power consumption of a particular appliance, look on the appliance for the compliance plate which should tell you the wattage, or check the appliance's specifications in its manual or online.

If you are ever purchasing major appliances such as whitegoods (or any appliances for that matter), it is preferable to buy the most energy-efficient model you can afford. A simple way to determine the most efficient model is to look at its star rating compared to other similar sized models. If you want a more accurate picture of the energy and money you will save by buying one appliance over another, you can compare the number of kWh consumed by the models (as featured on the rating sticker), then calculate the difference in kWh/yr. If you then multiply by 10 (a rough estimate of the lifetime of the appliance), and then by 20c/kWh (which allows for the rising price of electricity), you will have a reasonable estimate of the difference in ongoing cost between the models over a decade (see example 1). Efficient models, even if somewhat more expensive than inefficient models, will generally save significant quantities of ongoing operational energy (and water) consumption, and thus money, over the

life of the appliance, even accounting for the higher upfront cost.

If you want to know exactly where your electricity is going, you can do a detailed audit by recording the time you turn on and off every light/appliance you use during a week to determine a total time of use for each appliance (in hours), then multiply this total time of use by the wattage of the appliance. This will give you a reasonable estimate (it will not include standby power consumption – see below) of the total power consumption of each appliance during the fortnight in Watt-hours (Wh), which you can then divide by 1000 to give you the consumption of the appliance in kWh. Add up the number of kilowatt hours for all appliances, divide by 7 days, and you will have the number of kWh consumed per day. Some appliances are difficult to measure in this way because they run on thermostats and thus turn on and off (e.g. most heaters, refrigerators, electrical storage hot water heaters).

Example 1

**Fridge 1 uses 500kWh/yr, costs \$1000.
Fridge 2 uses 600kWh/yr, costs \$900.**

Over 10 years, Fridge 1 will consume 1000kWh less than fridge 2.

Assuming 20c/kWh average electricity price during the next 10 years (probably an underestimate), Fridge 1 will cost \$200 less than fridge 2 to run and thus save you \$100, as well as saving the environment from about 1t of CO₂ emissions.

Example 2

A kilowatt-hour (1 kWh) of electricity is used by the following:

- a 500W boiler running for **two hours**
- ten 100W light bulbs running for **one hour**
- a 2000W bar radiator running for **half an hour**
- a 6000W air-conditioner running for **ten minutes**

Standby power.

Even when turned off, many electrical appliances still use electricity if they are plugged in at the powerpoint and the powerpoint is switched on. This is called standby power. Any appliance with a clock, a light, a remote control, or a transformer (which produces heat) has some level of standby power. TVs, set-top boxes, recording devices, game consoles, computers and associated peripheral devices, washing machines and dryers are some of the kinds of appliances that often have significant standby power loads. These appliances should be turned off at the powerpoint when not in use. In fact, a good rule is to turn off all appliances at the powerpoint when not in use. Turning off difficult to reach powerpoints can be made easier using timer switches or wireless remote switches.

Standby power for many appliances is typically in the range of 0.1-15W, which does not sound like much until you realise that the power is being drawn 24 hours a day, 365 days a year. Every 10W of standby power in a household translates to roughly 80kWh/yr of electricity consumption, so a house with 50 W of standby power (which is quite typical) uses about 400kWh/yr of standby power!



The Energy Star Programme is a voluntary programme designed to reduce the standby power load generated by many appliances (sticker shown above). For more information, see: <http://www.energystar.gov.au/>

Also note that some appliances which operate around the clock can use large quantities of energy unnecessarily. For example, towel warmers use 50-150W and are generally left on all the time. A 100W towel warmer left on year 'round would consume 800kWh/yr of electricity! If you must use a towel warmer, a good way to avoid this problem is to put it on a timer so that the warmer operates only for one or two hours a day.

Up to 10% of your electricity bill may be attributable to standby power!

What is peak/off-peak electricity?

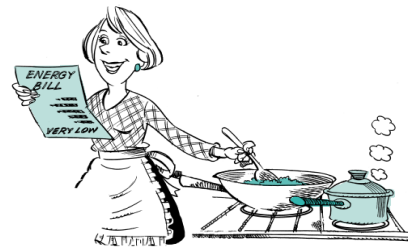
There are certain times of day when the demand for electricity is low, such as late at night and in the middle of the morning. However, over 80% of Australian electricity is generated from coal-fired power plants which take days to start up and shut down, so they are left running at all times. This means that when demand for electricity is low, far more electricity is generated than is required by consumers, so electricity at these times is cheaper than at times of higher demand. Off-peak electric storage hot water heaters turn on during low-demand periods and avoid periods of high demand, and are therefore cheaper to run.

As mentioned above, the price of electricity varies during the day according to the level of supply and demand. When demand is high, such as during peak periods (6.30-8.30am/5.30-7.30pm), electricity is far more expensive than at other times, although this is not currently reflected on your electricity bill because utilities charge a cost-averaged price. However, utilities are currently rolling out new flexible metering devices which will be able to record electricity consumption related to periods of the day. In the medium-term future, when the new meters have been distributed to all customers, utilities will begin to charge different prices for electricity at different times of day, which is called time-of-use metering. One of the goals of time-of-use metering is to switch customers away from using electricity during peak periods in order to avoid building more power plants (which are very expensive) to cater for ever increasing peaks in demand, particularly those generated on hot summer days by air-conditioner use.

What is Green Power?

About 82% of Australia's electricity is generated by coal-fired power plants, which are very inefficient and emit large quantities of greenhouse gases. About 11% of Australia's electricity is generated by gas-fired power plants, which also generate greenhouse gas emissions, although less so than coal-fired power plants. Only about 7% of Australian electricity is generated from renewable energy sources such as hydroelectric turbines, wind farms, and photovoltaic panels. These methods of electricity generation produce no ongoing greenhouse gas emissions but tend to produce more expensive electricity than coal-fired electricity, primarily because the costs of the damage done by generating electricity from coal are not incorporated in its price.

'Green Power' is often used as a generic term to refer to renewable energy in general, but it is also the brand of the Federal Government program for accreditation of new (constructed post-1996) clean renewable electricity generating infrastructure. If you purchase a Green Power product offered by a utility, it will place an additional charge per kWh on your electricity bill, and on your behalf the electricity supplier will buy the equivalent amount of electricity from renewable sources. This is achieved via a mechanism called the Renewable Energy Certificate (REC) market. One REC represents 1000kWh of renewably generated electricity. So, the electricity transmitted to your house may come from anywhere on the grid, but the quantity of renewable electricity bought by the utility on your behalf is fed into the electricity grid as a whole, which has the same effect. If you want to buy Green Power, look for the logo below to ensure that it is accredited and your money is being spent on genuine renewable energy.



One last point about energy

Other kinds of energy, such as gas, are measured in joules, or, more conveniently, in millions of joules, or megajoules (MJ). To convert kWh to MJ, multiply by 3.6.

More information

This fact sheet is produced by the Home Energy Advice Team (HEAT) to provide you with some basic information on electrical energy.

If, after reading it you'd like more free information about this or any other topic to do with saving energy in your home, don't hesitate to contact us:

