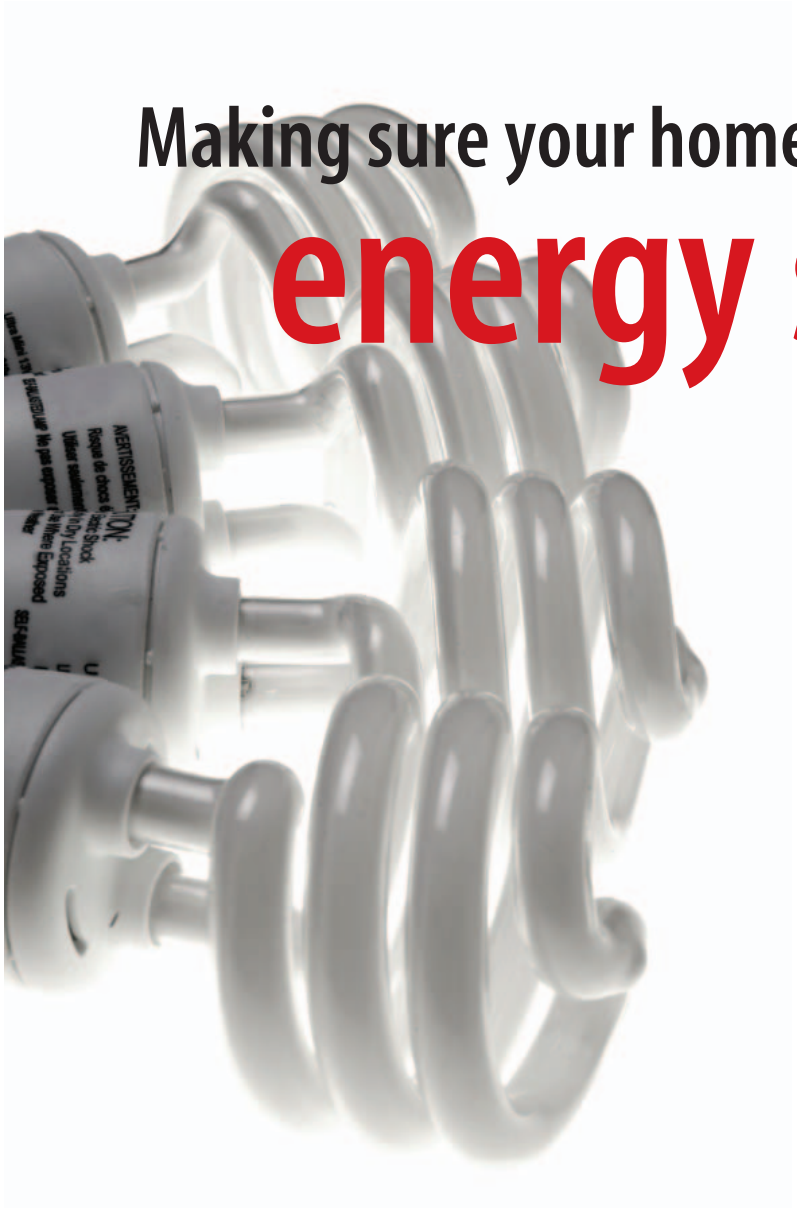
Making sure your home is not an energy sink 2



The second part of a series in which electrical engineer **Peter Seligman** reveals the hidden patterns of energy consumption and greenhouse gas emissions around the home. In this issue, domestic hot water goes under the microscope.

In the first part, I mentioned how some appliances use a considerable amount of energy when not in use. For example, my son recently installed a 5-star split-system air-conditioner. It draws 10 watts on standby.

If we do the calculations, 10 W (watts) for 24 hours a day, 365 days a year comes to 88 kWh (kilowatt hours) per year.

Now let's work out its likely usage when operating. Say we have 20 hot days a year when the system is running flat out for 8 hours. Let's conservatively assume that running flat out, it draws 550 watts. The sum of 550 watts for 8 hours for 20 days comes to 88 kWh per year.

This 5-star-rated appliance uses as much energy on standby as doing its job. Systems like this should be installed with a switch so they can be turned off completely for most of the year.

Peter Seligman calculated that he saved around 1.7 tonnes of CO_2 emissions per year from his home simply by replacing conventional light bulbs with low-energy ones.
Maciej Korzekwa

Finding the most efficient mix

When I said previously that solar water heating was an excellent idea, I lied! Well not completely. Here's the full story.

Seventeen years ago, I connected solar-water-heating panels to our electric off-peak hot water service. It's still working – that's the good news. The not-so-good news? Before the solar panel installation, we used 4300 kWh a year for water heating; since then, we've used 2800 kWh. This is a reduction of only 35 per cent.

The problem is that the solar component and the electric booster compete with each other. On cloudy days, electricity heats the water overnight. If the following day is sunny, the solar has little to do. The temptation is to turn off the electric heater altogether and go 100-per-cent solar. While this may work in the summer months, the inevitable will happen and hot water will run out on a cold day – and your family will blame you!

If you look at a map showing the proportion of solar contributions in cities around Australia, you will see that people living in Cairns, Brisbane, Perth or Darwin could get more than 75 per cent of their water heating from solar.

Let's consider water heating from a greenhouse gas perspective. If 1 kWh of electricity produced by burning coal produces 1.3 kg of carbon dioxide, our solar panels were reducing our CO_2 from 5.6 to 3.7 tonnes per year. That's moderately good.

What if we had just opted for a natural gas water heater? You can find the answer from a Rheem hot-water manual. (Rheem manufactures both electric and gas heaters.) According to the manual, a natural gas heater would use 62 MJ/day (megajoules per day), equivalent to 6300 kWh a year – more than the energy used by the pre-solar electric tank. However, the CO_2 emissions from the gas system would be only 1.4 tonnes a year – less than half that of the solar/electric system.

Rather than taking out my solar system and replacing it with a gas one, I decided to keep the existing solar as a pre-heater for one of the new-generation instantaneous hot water systems. This is no greenie Heath Robinson idea – at least four major hot-water system manufacturers now offer it. It provides the best of both worlds: a solar system that can do its best without interference from a booster, and a gas heater to do the rest.

Even better, the instantaneous system does not have heat losses associated with having a flue. I was horrified to discover that a conventional gas storage heater uses

25 MJ/day just keeping the water hot without any being used. To supply 150 litres per day, it uses 62 MJ/day. When the unit is idle while you are away on holidays, three 100 W-light-globe-equivalents of heat are going up the flue, all day, every day. It's a pretty good reason for turning it off when you go away.

The electric storage tank, having no flue, has much lower losses: one 100 W-light-globe-equivalent if it is on 24 hours a day. That's equivalent to four Melbourne–Sydney trips a year!

In short, the gas-instantaneous-boosted solar system wins handsomely over the others.

Hot water systems: energy efficiency and CO_2 emissions

Type of water heater	kWh/year	Tonnes CO_2 per year
Off-peak electric	4300	5.6
Solar with off-peak electric	2800	3.7
Gas storage	6300	1.4
Solar with instantaneous gas boost	3000	0.7

The CO_2 score card: a running total

Water heating accounts for about half the energy used in a household, so let's look at the total picture.

Our household's electricity load minus the water heating is about 2700 kWh/year. Generating this amount of electricity from coal creates 3.5 tonnes of CO_2/year. Before our change to low-energy lamps, it was about 4000 kWh/year – the equivalent of 5.2 tonnes of CO_2/year.

That was a big improvement but what's the next step? Eliminate the 3.5 tonnes!

This could be in done in two ways. We could either spend $18 000 on a grid-connected solar photovoltaic system or, for $150 per year, buy electricity from a renewable source. For a very obvious reason, we chose the second option.

Here's the CO_2 score card:

Action	Tonnes CO_2 for lights, fridge etc.	Tonnes CO_2 for water heating	Total tonnes CO_2 per year
Business as usual	5.2	5.6	10.8
Low-energy lights; solar hot water and electric boost	3.5	3.7	7.2
As above with gas-boosted water heating	3.5	0.7	4.2
Electricity from renewable sources	0	0.7	0.7

As you can see, we have reduced our domestic CO_2 output to one-fifteenth of what it was. And we did it by using standard, available, reasonably priced technology.

With the advent of the ability of individuals to buy 'green' electricity, we have a further option. If we remove ourselves from the peak load, we can remove ourselves from the off-peak load too. It is as if we eliminate ourselves from the fossil-fuel-electricity-generation system altogether. And that has to be better.

Solar pre-heating with instantaneous gas boost provides a hot water option with 'the best of both worlds'. Solahart

A word of warning about 'green' or 'renewable' electricity. You almost certainly have been approached by an electricity company offering '100-per-cent renewable' for no extra cost.

Don't believe a word of it! If you have already signed up for this, check your electricity bill. My first '100-per-cent renewable' bill said 'Total greenhouse emissions for this bill: 1.08 tonnes. Total greenhouse savings for this bill: 0.15 tonnes'! Describing that option as 100-per-cent-renewable is a mystery and pure deception.

GreenPower[1] is the national accreditation program for renewable energy run by the NSW Government that has over 590 000 subscribers around Australia. Accredited GreenPower retailers are required to use a product disclosure label on marketing material, including the percentage of your electricity consumption that will come from accredited renewable sources.

Only the accredited portion shown can be said to be reducing greenhouse gas emissions, as it is this part of your supply that comes from new renewable energy facilities built since 1997. WWF, the Australian Conservation Foundation and the Total Environment Centre provide an annual report rating retailers' GreenPower products by environmental criteria.[2] *Choice* magazine also provides an online price comparison for GreenPower products.[3]

One last point. I have only considered domestic hot water, lighting, cooking and domestic appliances. I have not mentioned space heating, transport, holidays, the workplace and the energy in all the goods and services we buy.

That comes in the next exciting episode!

Dr Peter Seligman, a biomedical engineer, was a key member of the team that developed the Cochlear multiple-channel cochlear implant. A focus of his work over the past 24 years has been the development and improvement of speech processors. He is a qualified electrical engineer, holds 25 patents and has been involved in the design of photovoltaic solar energy and solar heating systems.

1 See www.greenpower.gov.au
2 See www.greenelectricitywatch.org.au
3 See www.choice.com.au