THE ECONOMICS OF WATER HEATING

Often little thought goes into choosing the hot water system for a house. However, there are energy savings, and therefore cost savings, to be found with options like solar and heat pump water heating systems.

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Despite being one of the largest contributors to carbon emissions in our homes, water heating does not receive much attention. At the design stages of a home, little consideration has generally been given to how to heat the water, how to distribute hot water around the house or how efficient the showerheads and hot water appliances are. Over time, this neglect has resulted in old and inefficient hot water systems in our homes.

Reduce hot water use and increase efficiency

The carbon emissions from water heating arise from the energy required to heat the water. To limit these emissions, energy use needs to be minimised. Water heating energy use is proportional to the amount of hot water used within the house and inversely proportional to the efficiency of the hot water system.

To reduce water heating energy use, we need to reduce the amount of water we use and increase the efficiency of the hot water system.

$$\text{Energy}_{\text{water heating}} = \frac{\text{Quantity}_{\text{heated water used}}}{\text{Coefficient of performance}}$$

Efficiency = savings

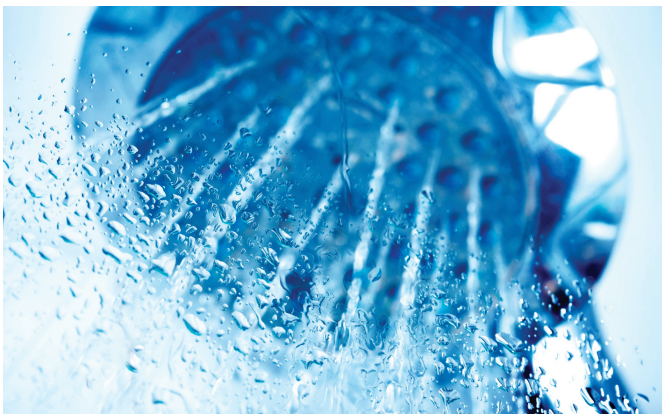
Reducing the amount of water used is hard to achieve without public support and buy-in.

The efficiency of a hot water system, on the other hand, can be improved with technical changes, which people generally see favourably. There is now a broad range of information on the performance of advanced water heating systems such as solar water heating systems and heat pump water heating systems. These can provide large reductions in the amount of water heating energy use.

Reductions in energy use from improved water heating will also result in financial savings to the users. These are not easily seen, so it's useful to show an example to highlight some of the issues involved.

Solar water heating savings

Beacon Pathway's Papakowhai Renovation project included three houses with solar water heating systems (see *Build* 115 December 2009/January 2010, page 63). The savings achieved were verified by directly measuring the energy performance of one of the solar systems (see Table 1). The system examined was from the house with the highest average hot water use (160 litres per day), which was also the system that had the highest efficiency as assessed by the coefficient of performance (COP), although all three systems performed well.



PAY-BACK PERIOD

This system cost $6,000 more than a traditional water heating system and could be expected to last 20 years. Given its efficiency, the 160 litres of hot water use per day would deliver annual energy savings of 2,500 kWh or $610 per year (taking electricity costs of $0.244 per kWh).

A simplistic approach would be to calculate a simple pay-back period of 9.8 years ($6,000/$610). As the average occupancy of homes is around 7 years, the return may not be fully realised by the occupants who installed it.

INTERNAL RATE OF RETURN

Another approach is to consider the time value of money (discounted cash flow analysis). The results of this analysis are presented in Table 1 as the internal rate of return (IRR). Despite the unfriendly terminology, the IRR is effectively the interest rate an investment would need to return to provide a better cash flow than the returns from the solar system over the 20 years.

To calculate the IRR, additional cash flows need to be considered. The wholesale price of electricity was taken as rising at a real rate of 1.6% per year. The solar water heating system will also require maintenance, and this is factored in at a cost of $100 every 3 years.

These assumptions lead to an IRR of 9.0%, well ahead of term deposit rates and higher than home loan rates currently available from banks. Should the system be eligible for the $1,000 government subsidy, the IRR would increase to 11.5%.

A solar water heating investment seems more affordable when considering the IRR, rather than the simple pay-back calculation. A further advantage is that reducing your costs is tax free, whereas if the money was invested, you would need to pay tax on the interest received.

Heat pump water heating

Heat pump water heating provides an alternative to solar water heating and can be used where a house does not have adequate solar access. Heat pump systems are typically cheaper than solar systems but may save less energy than a well performing solar system.

The performance of a heat pump water heating system is reduced when daily water draw-off is low – they should only be used when there are four or more occupants.

Repeating the IRR calculation for this situation gives an IRR of 7.6% for a heat pump water heating system. This assumes that the system was $3,500 more than a traditional system and provided savings of $300 per year.

Options to spread the cost

Care is needed when thinking about solar water heating or heat pump water heating investment in terms of IRR, as the calculation assumes that the savings accrue to the person who made the initial investment. If the house is sold before the 20 years are up, there is a transfer of savings to the new occupants.

There are ways of addressing this problem, such as spreading the cost of the system over a much longer time. An example of this is the solar saver scheme operated by Nelson City Council. This scheme spreads the cost of the solar water heating system over 10 years via a targeted rates levy. Its advantage is that repayments are attached to the property, and therefore the recipient of the water heating energy savings, rather than the initial purchaser of the system. This makes the choice of installing a solar water heating system that much easier as there is no longer a sizeable upfront cost.

New challenge

Well performing solar and heat pump water heating systems can save a considerable amount of energy over the lifetime of the systems and would make significant reductions in the carbon emissions for an individual home.

The financial returns from these types of systems are favourable when compared with bank interest rates but take a long time to break even. Previously, these types of financial calculations have been difficult to make as it has been hard to estimate how much energy the systems will save. The new challenge is assessing the balance between the changing upfront costs of these systems and how quickly energy prices will rise.

Table 1: Example calculation.

	Solar water heating	Heat pump water heating
Initial cost over a typical system	$6,000	$3,500
Savings per year	$610	$300
Simple payback	9.8 years	11.6 years
Internal rate of return (IRR)	9.0%	7.6%