We say

- The Econergy heat-pump water heater has the potential to cut household hot-water bills by two-thirds nearly everywhere in the country. But our test results show that some other models won't give worthwhile savings in all our climate zones.
- Some manufacturers/distributors have work to do to ensure that their installed products reliably work as intended.
- Large-scale introduction of heat-pump water heaters has the potential to conserve the country's electricity resources and reduce greenhouse gas emissions.
- A study should be undertaken to identify a safe minimum hot-water storage temperature. The building code should then be amended if necessary to reflect the findings.

How we tested

Our test was part funded by the Energy Efficiency and Conservation Authority (EECA) under its Innovation Fund. What we devised was a comprehensive test programme that simulates household hot-water use at various temperatures and humidity levels that reflect the country's climate. Our tests were devised from scratch because, to our knowledge, no one else has done anything similar.

The HPWHs were set up in a temperature- and humidity-controlled room. The split models were piped to a new 300-litre A-grade electric hot-water cylinder with the normal element disconnected.

The water tank was filled and the heat pump started up. Electricity consumption and the water temperature were measured continuously. When the HPWH had heated the water to 60°C, a simulated 24-hour controlled hot-water draw-off was started under computer control.

This draw-off included a bath, two showers, a load of laundry, and some dish washing – all at different times and designed to simulate the hot-water use of a typical house of two adults and two children during one day. In total 125 litres of hot water were drawn off during the 24-hour period.

The temperature and volume of the water was measured as it was drawn off. From this test sequence we calculated how much heat was delivered by the heat pump and how much electricity it took to do it.

Two test runs were performed for each model at ambient temperatures of 15°C, 7°C and 2°C (a total of six runs per model). We used three different sets of temperatures to mimic different local climatic conditions.

Performance at low ambient temperature is important, because households tend to use more hot water during the cooler months.

To give us a reference point, the standard electric hot-water cylinder was put through the same test programme. This gave us a performance baseline to compare the heat pumps' energy use against.

In our results we've used the term "relative performance" to show how much more efficient the heat pumps are compared with a standard electric hot-water cylinder setup.

WE RECOMMEND

ECONERGY HP4000LT (SPLIT MODEL)
Price: $4345
GOOD POINTS: Best energy efficiency in test. Uses one-third (or less than one-third) of a standard electric hot-water cylinder's energy. Smallest model in test. Can be installed in a variety of locations. Suitable for connection to a ripple-controlled supply.
BUT: Water temperature not adjustable.

WORTH CONSIDERING

STIEBEL ELTRON WWK 300 (INTEGRAL MODEL)
Price: $6825
GOOD POINTS: Best energy efficiency of the integral models. Uses half (or less than half) of a standard electric hot-water cylinder's energy – except at very low temperatures. Suitable for connection to a ripple-controlled supply.
BUT: Water temperature not adjustable.

QUANTUM 270-11AC3-134 (INTEGRAL MODEL)
Price: $4998
GOOD POINTS: Close in performance to the Stiebel but costs less. Uses half (or less than half) of a standard electric cylinder's energy – except at very low temperatures. Adjustable water temperature. Suitable for connection to a ripple-controlled supply.
BUT: Not quite as energy efficient as the Stiebel at low temperatures.

OTHER STUFF Hot Water Association: www.nzhwa.org.nz » EECA: www.energywise.govt.nz

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Hot water for less

TEST: BILL WHITLEY

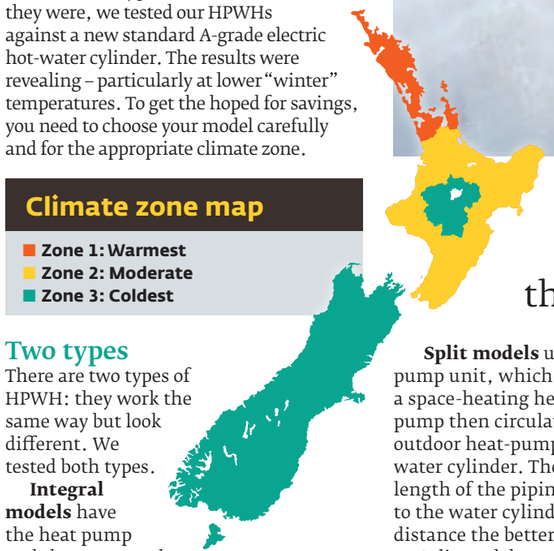
Many people are familiar with heat pumps used for home heating. They've often transformed cold homes into comfortable ones – without costing the earth in electricity bills. Now the same principle can be used to heat your hot water. But how good are they? In one of the first tests anywhere, we tested six to find out.

Our results are for five models only because one of the tested models (the Hot Water Heat Pumps DHW150) is no longer being manufactured.

A space-heating heat pump extracts heat from the outside air and shifts it into your home. A heat-pump water heater (HPWH) extracts heat from the outside air and shifts it into your hot water. It's claimed it can do this much more cheaply than heating the water with a conventional electric element.

That's the hype. To see how efficient they were, we tested our HPWHs against a new standard A-grade electric hot-water cylinder. The results were revealing – particularly at lower "winter" temperatures. To get the hoped for savings, you need to choose your model carefully and for the appropriate climate zone.

Climate zone map



- Zone 1: Warmest
- Zone 2: Moderate
- Zone 3: Coldest

Two types

There are two types of HPWH: they work the same way but look different. We tested both types.

Integral models have the heat pump and the water tank combined into a single unit. The heat pump sits on the top of the tank and the whole unit is installed outdoors, preferably near the house's bathroom.

When you buy an integral model you replace your existing cylinder. (This also has the advantage of freeing up your hot-water-cupboard space in the house.)

The Stiebel Eltron WWK 300, the Quantum 270-11AC3-134 and the Rheem 55131007/05 were all integral models.

Less cost to you – and the country. Cut your water-heating bill by two-thirds with our recommended model.

Split models use an outdoor heat pump unit, which looks similar to a space-heating heat pump. A small pump then circulates water between the outdoor heat-pump unit and the hot-water cylinder. There are limits on the length of the piping from the heat pump to the water cylinder, but the shorter distance the better.

Split models can use your existing hot-water cylinder, although you might wish to replace it if it's an older model.

The Econergy HP4000 LT and the National RS 62P5A/T were split models.

Performance

There was a big difference in performance across the five models we tested. We expected them to become less efficient as the air temperature dropped – but some were much worse than others. At 15°C all were more efficient than the standard electric cylinder, but by the time the temperature had dropped to 2°C only the **Econergy**, **Quantum** and **Stiebel** were still significantly more efficient.

Integral models: The performances of the **Quantum** and the **Stiebel** were similar and both would give useful energy »

HEAT-PUMP WATER HEATERS HAVE THE POTENTIAL TO SAVE THE COUNTRY 320,000 TONNES OF CO_2 EMISSIONS EVERY YEAR.

THE ECONERGY BLITZED ITS COMPETITORS. AT ALL TEST TEMPERATURES IT WAS AT LEAST THREE TIMES MORE EFFICIENT THAN A STANDARD ELECTRIC CYLINDER

savings in all but the coldest climate zones. The **Rheem** performed well enough at 15°C but was poor below these temperatures. It would only be of benefit if installed in a warm climate zone.

Split models: The star of our test was the **Econergy**, which blitzed its competitors. At all test temperatures it was at least three times more efficient than a standard electric cylinder – an outstanding result for this locally designed and manufactured product. We recommend the Econergy for all but the coldest climate zones. Its manufacturer told us that in regions like central Otago (where winter temperatures are often sub-zero) an electric booster element could be required.

The **National** performed quite poorly. At 15°C it was 50 percent more efficient than a standard electric cylinder; at 7°C it was on par; at 2°C it was only half as efficient. The National's distributor said its poor performance was because of refrigerant leaking from the heat exchanger during testing. It now has a new design of heat exchanger that should solve the problem.

Noise

These units make a sound similar to a fridge – but louder. They're not particularly loud, but could become annoying at night when background noise levels are low. You probably wouldn't want to locate any of the units outside a bedroom window.

The noise levels we measured ranged from just under 58dBA to 62dBA. The Stiebel was the noisiest initially at over 69dBA; but the distributor then supplied us with an add-on noise hood that dropped the level to just under 62dBA. As a comparison, normal conversation levels are around 60 to 65dBA.

Ripple control

Most electric hot-water cylinders are connected by ripple control, which gives lines companies the ability to switch off water heating at times of high load. For this controlled supply, you generally pay less than the normal electricity rate.

If you use ripple-control electricity for your hot-water system (to find out check your electricity bills or ask your electrician), make sure you look at HPWHs that work with it. Don't worry if you don't have ripple control, you'll still make the same percentage savings on your water-heating bill by changing to a HPWH.

The **National** was the only model that couldn't be connected to a ripple supply: it lost settings when the power dropped off.

Payback

A good HPWH would reduce your hot-water bill by two-thirds. The amount you pay for hot water is most often itemised on your power bill as controlled supply. If it's not, divide what you pay each year for power by a third. You then take two-thirds off that to find your likely savings each year.

We estimate it'd cost you on average about $5000 to get a *split model* HPWH retrofitted in your home. If you borrow this money over 10 years at current interest rates (7.6 percent in early April), the monthly repayments would be just on $60.

The average household uses $54 worth of electrically heated hot water a month. A HPWH is not economic if you're making loan repayments of $60 a month.

However, if you usually pay $100 per month for your water-heating electricity, a good split model HPWH will reduce this to $33 a month. That $33 plus the $60 loan repayment comes to a monthly total of $93. So you're slightly ahead: you pay $90 instead of $100.

Hot-water temperatures

The building code requires that the water in your hot-water cylinder is kept at *not less* than 60°C – and delivered to your hot-water taps at *not more* than 55°C. A special tempering valve that mixes in cold water does the cooling to 55°C. These tempering valves have a reputation for being unreliable and are often removed – which then significantly increases the risk (especially for children) of being scalded by hot water.

Water is stored at 60°C to eliminate the risk of legionella contamination.

All HPWHs become less efficient as the water temperature rises, so there have been calls from the industry for the building code to be amended to allow hot-water storage at 55°C or even 50°C. This would make heat pumps even more efficient, eliminate the need for unreliable tempering valves, and reduce standing heat losses from the cylinder. And – more importantly – it would reduce the number of scalding accidents.

We think this is worth the government investigating provided there's no increased risk of legionella contamination.

A HPWH is more likely to be cost effective for a household of four or more people than it is for a two-person household. The more hot water your household uses, the greater the savings and the shorter the payback time.

We think there's a strong case for a permanent government subsidy instead of the current temporary grant (see "EECA grant"). If the government put in $1000, you would have to borrow only $4000 and the repayments would be just under $48 per month. The monthly cost of your HPWH would then drop to just over $81.

As electricity gets more expensive, the breakeven point would get lower (although rising interest rates may also affect the breakeven point if you borrow to pay for the HPWH).

That's the private benefit to you. But we think the country may benefit even more.

Everybody wins

A household uses on average around 8300 units of electricity a year: 2800 of these are for hot-water heating. If there are one million houses with electric hot-water heating, the annual consumption for hot-water heating is one million times 2800 kWh per year. That's 2800 gigawatt hours (GWh).

If those one million houses were fitted with a HPWH as good as our recommended model, the country could save two-thirds of the electricity now used to heat hot water. That's equivalent to the electricity use of 225,000 homes.

It also saves the equivalent of 320,000 tonnes of CO_2 emissions a year. Substantial savings all round.

Equipping one million homes with a HPWH would cost around $5 billion – probably less with genuine mass production. On the other side of the ledger, we would save the cost of additional power generation and distribution infrastructure. Perhaps installing HPWHs on a large scale would help solve Auckland's electricity problem? And quite a large proportion of that $5 billion would go back into the local economy – manufacturers, distributors, installers and the like.

Solar or heat pump?

Which is the better option for water heating probably depends on your house and where it's located.

In the sunnier parts of the country the energy savings from a good solar installation are likely to be similar to those from a good heat-pump installation. In the south we think a heat pump is likely to give you bigger savings.

It's personal preference whether a heat-pump unit outside is less intrusive than a solar panel on the roof. But the heat-pump noise (for you or your neighbours) is something to consider. »

Can you help?

The results from several of our test models gave us cause for concern that some poorly performing units may have been installed.

If you have a HPWH installed – any make, any model – we would like to hear about your experience with the installation, running costs and manufacturer or distributor back-up for the unit.

Email editor@consumer.org.nz or contact us at Consumer NZ, Private Bag 6996, Marion Square, Wellington 6141. Telephone 04 384 7963.

EECA grant

EECA wants to gather HPWH performance data from real installations. It's offering $1000 in two instalments to homes and businesses that install a qualifying HPWH. EECA will supply special water and power meters that must be installed with the heater; and the readings from these meters must be forwarded to EECA for three successive months. The scheme runs until September this year. Contact EECA for details: www.energywise.govt.nz.

How do HPWHs work?

A HPWH has a "radiator" similar to a car, but instead of hot water there's a refrigerant much colder than the outside air. When outside air is pushed through the fins of the "radiator", it warms the cold refrigerant inside.

This warmed refrigerant is then compressed (which increases its temperature further) and fed though pipes that are in contact with the hot water. This warms the hot water and cools the refrigerant – and when this is returned to the "radiator" it expands and cools further.

Circulating refrigerant around like this shifts heat from the outside air into the hot water. A well-designed HPWH will use much less electricity than if you directly heated the water with an electric element.

MODELS	$	%	RELATIVE PERFORMANCE			TECHNICAL BITS				FEATURES	
	PRICE	OVERALL SCORE	AT 15°C	AT 7°C	AT 2°C	NOISE (dBA)	TANK CAPACITY (L)	DIMENSIONS H X W X D (MM)	INSTALLATION LOCATION(S)	ADJUSTABLE TEMPERATURE	RIPPLE-CONTROL COMPATIBLE
SPLIT MODELS											
✔ **Econergy HP4000 LT**	4345	88	370	330	300	61	n/a	470 x 490 x 550	O, I, R		●
National RS 62P5A/T	3349	26	150	100	50	62	n/a	1020 x 740 x 340	O	●	
INTEGRATED MODELS								H X D (MM)			
★ **Stiebel Eltron WWK 300**	6825	57	260	220	180	62	303	1875 x 660	O, I		●
★ **Quantum 270-11AC3-134**	4998	56	260	210	170	59	250	1900 x 650	O, I	●	●
Rheem 55131007/05	4824	37	220	100	110	58	310	1870 x 643	O		●
STANDARD "A" GRADE ELECTRIC CYLINDER											
Rheem 31230015	1371	26	100	100	100	n/a	300	1825 x 580	I	●	●

GUIDE TO THE TABLE **OUR TEST** was conducted by an independent laboratory in New Zealand. **PRICE** is based on a survey in March 2009 and doesn't include installation costs. **RELATIVE PERFORMANCE** gives each HPWH's energy performance relative to that of a standard electric hot-water cylinder, at each of the three "ambient" test temperatures. **TECHNICAL BITS** **Noise** is the average of three readings taken 1m from the side, 1m behind, and 1m in front of the operating unit. **Installation locations** = **O** outside; **I** indoors; **R** roof cavity.