An energy and water odyssey

Broderick Street talks about his family's journey to save even more water and energy in their sustainable home

Our previous story, in *ReNew 90*, talked about the passive solar and water efficient renovation of our Melbourne home. Since then we have focused on saving even more power, gas and water, with good results. Here's the details on how we've done it.

To make their house even more energy and water efficient Brod Street's family have not only bought the most efficient appliances suitable for their needs but have looked at ways of setting them up for maximum savings.

Fridge/freezer

We purchased a 350 litre Whirlpool fridge/freezer (model 6WMV35NW) which did not make it in the 'What to Buy' section of a popular national consumer guide. That guide ranked the Fisher & Paykel Elegance fridge/freezer higher when considering food cooling time and other factors. But if energy efficiency is your highest priority, then like us, you would seriously consider the Whirlpool fridge.

Our old fridge was a small 250 litre Kelvinator which used 400kWh per year. Using a Power-Mate meter to measure energy consumption, the Whirlpool electricity use is about 240kWh per year. I also tested the temperature to make sure the food section was below 4°C. The energy efficiency label on this model is 389kWh per year. The lower power use is in part due to us using the warmer setting on the freezer, which seems to work well for ice-cream.

For a family of three we are happy with the Whirlpool. It provides very good food preservation and has sufficient storage.

By teaming up with a friend (who also wanted an energy-efficient fridge) and by shopping around we got the Whirlpool for $750 as part of a package with an ASKO dishwasher. From our calculations it saves us 160kWh of energy compared to our old fridge. This is despite being 100 litres larger and a fraction of the cost of the legendary energy-efficient VestFrost fridge/freezer.

Dishwasher

Changing from washing dishes in the sink to using an ASKO D3630 dishwasher has saved us 30 litres of water per day on average (or about 11,000 litres per year) if we use the normal wash cycle. The downside of so little water use is that it draws on small amounts of hot water at a time, and the time between draws is long enough that the water cools in the hot water line. It is therefore energy inefficient compared to hand washing dishes.

We are striving to avoid electrically heating any water as we have a 1.35kW grid connected PV system and we also want to maximise hot water use from our solar (gas-boosted) system.

The major plumbing and technological factors causing double water heating when using the dishwasher are:

- There are two hot water steps with-

in the ASKO normal wash (45°C), these being main wash (3.5 litres) and final rinse (3.5 litres).

• There is a 24 minute gap between the main wash and the final rinse. This means that the water drawn by the ASKO from the hot water line is largely cooled standing water in the hot water branch line.

• The measured dead water (cold water coming from the hot water pipe) in winter from our Bosch tankless gas water heater to the kitchen sink is about 3.0 litres. However, not all this cold water is old water in the hot water line. About two litres is the result of the operating delay of the gas burner to provide hot water to the sink.

• The measured dead water in summer from 100% solar heated water is 3.7 litres, for a pipe length of 13 metres (19mm diameter) from tank to dishwasher.

• The hot water lines (plastic) within the house were not insulated when installed in September 2002.

Possible solution?

To try and solve the problem of dead water and double water heating we easily installed a Dux Readyhot water recirculation unit at the end point of our hot water plumbing, under the laundry sink. The Dux Readyhot is a demand-activated pump which turns off when it detects a temperature rise. The pump re-circulates cooled water in the hot water line back to the water heater via the cold line. We no longer waste water waiting for the cold water in the hot water line to warm up before a shower.

Our monitoring of the Dux Readyhot indicates that it uses only 14kWh of energy over a year: about 5kWh is used to re-circulate the water and 9kWh is standby energy use. The pump's annual standby energy use is low compared to our tankless Bosch instantaneous gas water heater which uses 53kWh in standby mode. And the gas water heater is consuming power when not used for about 60% of the year. If we switched off the gas water heater in summer this would reduce the parasitic power drain by 30kWh per year.

One downside of the Dux Readyhot is that it's not practical to manually activate the device to prime the hot water line twice during the ASKO normal cycle. There needs to be a commercial agreement between the manufacturers so that the Dux Readyhot works cooperatively with dishwashers.

Our final solution was to connect our dishwasher to the hot water line which has reduced the electricity used for water heating by the ASKO and reduced greenhouse gases by 100kg per year compared to the standard cold line connection.

Dishwashing method	Hot (or cold) water line kL/y	Electricity kWh/y	Gas[1] MJ/y	Greenhouse gas kg/y (Traditional energy sources)
Sinks (wash and rinse) No cold water added. Hot water source solar gas boosted to 60°C and tempered to 50°C	15.7	0	1080	69
Common approach ASKO D3630 connected to cold water line only	(4.7)	220	0	323
Our approach ASKO D3630 connected to hot water line, source solar gas boosted to 60°C and tempered to 50°C	4.7	138	300	221
Technically possible approach A demand-controlled hot water pump linked to dishwasher program functions. Source solar gas boosted to 60°C and tempered to 50°C	4.7	80	300	136

Comparison between new ASKO dishwasher and hand washing dishes.

Other options

One solution would be to connect the dishwasher to the solar gas boosted hot water. With the use of the Dux Readyhot recirculator and a continuous loop line running past the dishwasher it is possible to have less than a cup of dead water going into the dishwasher. Retrofitting the existing plumbing works, but if starting from a new plumbing layout consider viewing the California Energy Commission website to look at

If you could align a Dux Readyhot on demand pump (right) with the dishwasher (left) program Brod's household could save an extra 58kWh of energy by not double heating seven litres per wash of cooled water standing in the hot water line.

their research on smarter hot water distribution.

An alternative would have been for us to install the dishwasher as close to the external wall where the tankless gas water heater is located, avoiding some two metres of hot water pipe.

Savings on all fronts

By purchasing and installing the water- and energy-efficient appliances we have made the following savings:

Energy

Installing a new dishwasher and replacing a 20-year-old fridge/freezer means we are now saving 780MJ of gas per year. However, on balance the addition to the house of all three appliances means we have maintained the status quo for electricity use to around 2390kWh per year (75% of this is displaced by the solar power grid-connected system). In terms of gas use we are now in our second year of using about 12GJ per year.

If we could align our Dux Readyhot on demand pump with the dishwasher program we would save an extra 58kWh of power by not double heating seven litres per wash of cooled water standing in the hot water line.

Water

Water saving has been a major success since we installed the Dux Readyhot and the ASKO dishwasher. We have reduced our water use by 20kL per year. This is on top of the savings we get from our private supply of alternative water (rainwater tanks and greywater treatment).

We have only purchased 29kL of water from our water retailer from January to October 2006. We use on average 93 litres of mains water per day for three people during the worst drought in Melbourne's urban history.

Wastewater

The dishwasher and Dux Readyhot have helped reduce our volumetric disposal of wastewater to Melbourne Water's sewage treatment plant by 20kL per year, bringing an overall reduction in wastewater to sewer per year of 55kL (including our greywater reuse).

Space

We have a small property and to achieve an additional 20kL of water saving without needing to install any more rainwater tanks is a huge bonus. Adding another 2kL capacity rainwater tank would have taken up about 2m^2 of land area and not guarantee daily water savings. Using local real estate data, 2m^2 of land is worth $3000 even before you purchase the tank. It starts to make the 0.4m^2 of floor space for the dishwasher hidden under benches look like a far more attractive option.

Greenhouse gases

If all dishwashers were installed with both hot and cold water (cold rinse cycle) and used on normal wash cycle of 45°C linked to a device similar to a Dux Readyhot then the potential for greenhouse savings would be 190kg per year.

Back to the future

As homes get physically bigger and hot water lines longer, structured plumbing design (heater efficiency, proper tempering valve installation, pipe layout, such as avoiding 90° elbow joins and inclusion of re-circulation pump) should be mandatory for all new homes and major alterations. Also, our dishwashers should be designed to take up the potential energy savings of structured hot water plumbing and avoid electrical water heating.

All this knowledge is nothing new. In the Australian book *Your House and How to Build It* published in the 1950s, it states 'The efficiency of storage hot-water systems may be increased if pipe-runs are kept as short as possible. Eight feet of ¾ inch copper pipe holds one pint of water. Therefore, in a pipe of 32 ft long, half a gallon may cool off between operations of the tap it feeds. This not only wastes electricity, but lengthens the time before really hot water reaches the tap.'

California Energy Commission plumbing layouts go to www.energy.ca.gov