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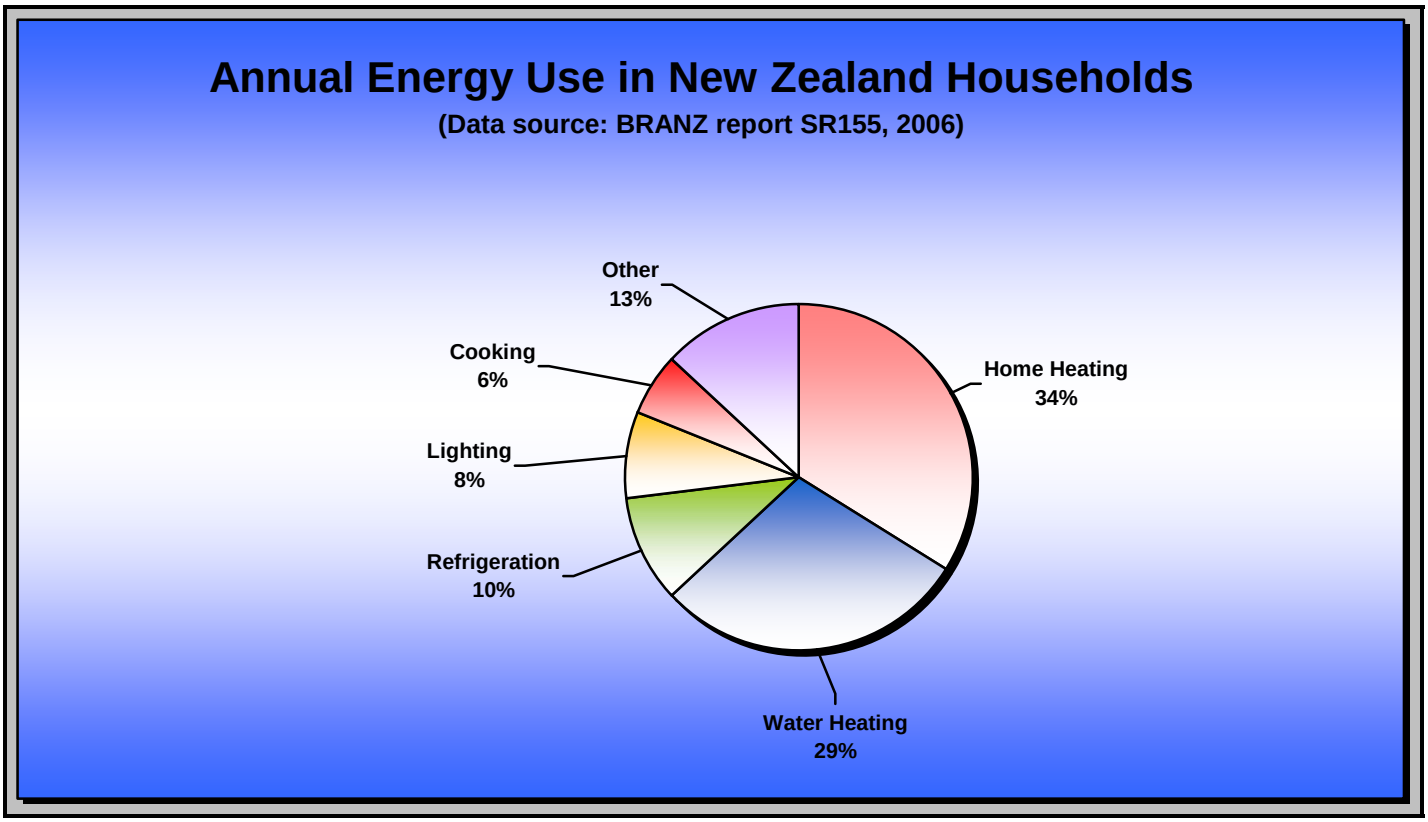
ENERGY EFFICIENCY v1.2

The average family household uses energy in the following ways (Source: BRANZ report SR155, 2006):



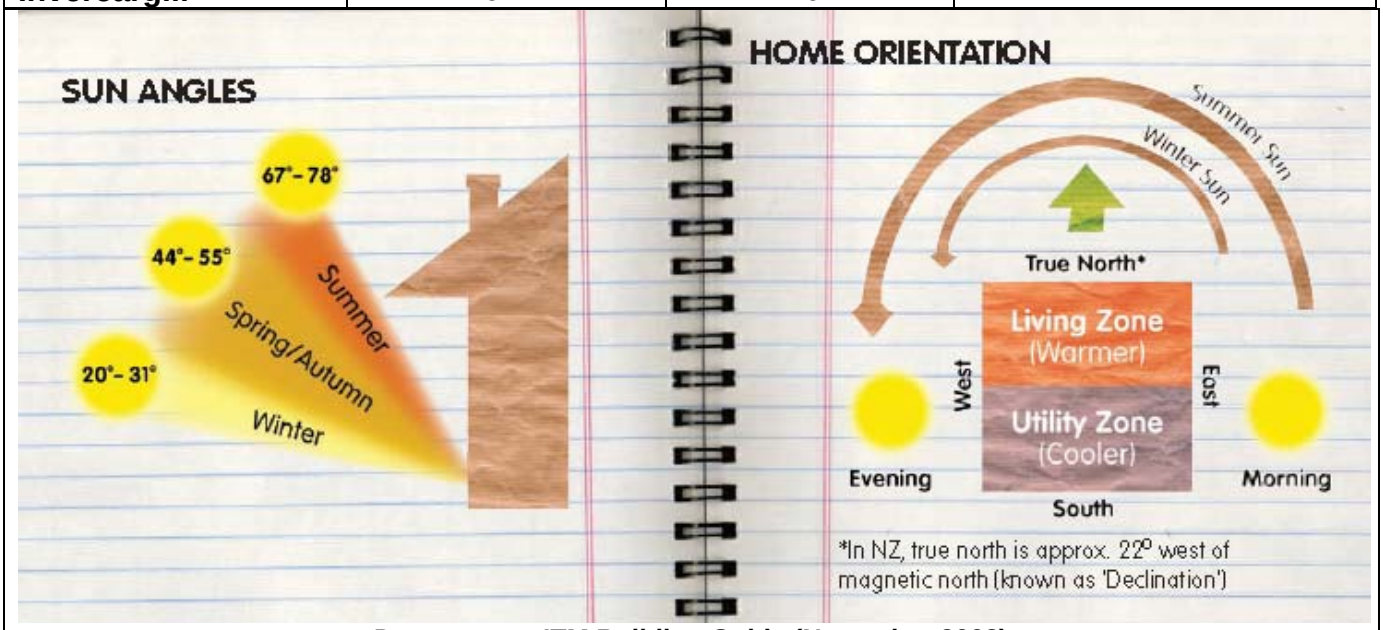
Energy Use	Kilowatt Hours	Running Costs (at 20c per kWh)
Home heating	3570	$710
Water heating	3045	$610
Refrigeration	1050	$210
Lighting	840	$170
Cooking	630	$130
Other	1365	$270
Total	**10 500**	**$2 100**

PASSIVE DESIGN – HEATING, COOLING, VENTILATION AND LIGHTING BENEFITS

Passive design uses natural resources (sun, shade, wind and site features) to gain heating, cooling, ventilation and lighting benefits. Because some passive design measures counter other benefits, carefully consider which is more important e.g. winter heating or summer cooling, natural light and views, privacy, access and living requirements.

- ☐ *Solar Design* – In most New Zealand climates you should design or orientate the building so the main living areas and outdoor spaces ideally face **true north** or within 20º of true north to maximise full day solar heat and light. Consider the sun's highest angle during summer (approx. 70-80 degrees) and lowest angle during winter (approx. 20-30 degrees). The east side gains heat from the morning sun, the west side from the afternoon sun and the south side will receive the least sun so is best for bedrooms and utility rooms i.e. laundry, storage or garage.

Sun Angles at Noon			
	Summer (December 22)	Winter (June 22)	March 21 & September 23
Whangarei	78º	31º	55º
Auckland	77º	30º	53º
Hamilton/BOP	76º	29º	53º
Wellington/Nelson	72º	25º	49º
Christchurch	70º	23º	47º
Dunedin	68º	21º	44º
Invercargill	67º	20º	44º



Data source: ITM Building Guide (November 2008)

- ☐ *Glazing* - To maximise solar heat and light during the day increase glazing, particularly on the North facing side of the home. South facing windows should be kept to a minimum and mainly used for ventilation or natural lighting purposes. To minimise solar heat gain during the day then use less glazing or tinted, reflective or low-e glass.

- ☐ *Thermal Mass* – High thermal mass such as exposed concrete or masonry walls will absorb and store heat from *direct* sunlight during the day and release it slowly at night as temperatures fall.

- ☐ *Colours* – Dark coloured exterior walls, roofing and internal surfaces in direct sunlight will absorb more solar heat. If overheating is a problem then light coloured exterior walls, roofing and internal surfaces in direct sunlight will help reflect light and absorb less solar heat.

- ☐ *Shading* – Overheating and glare can be managed using deep overhanging eaves, louvres, awnings, verandahs, window treatments or shade planting. Careful planning will allow shade from the high angle summer sun while allowing solar gain from the lower angle winter sun (refer to sun angles above).

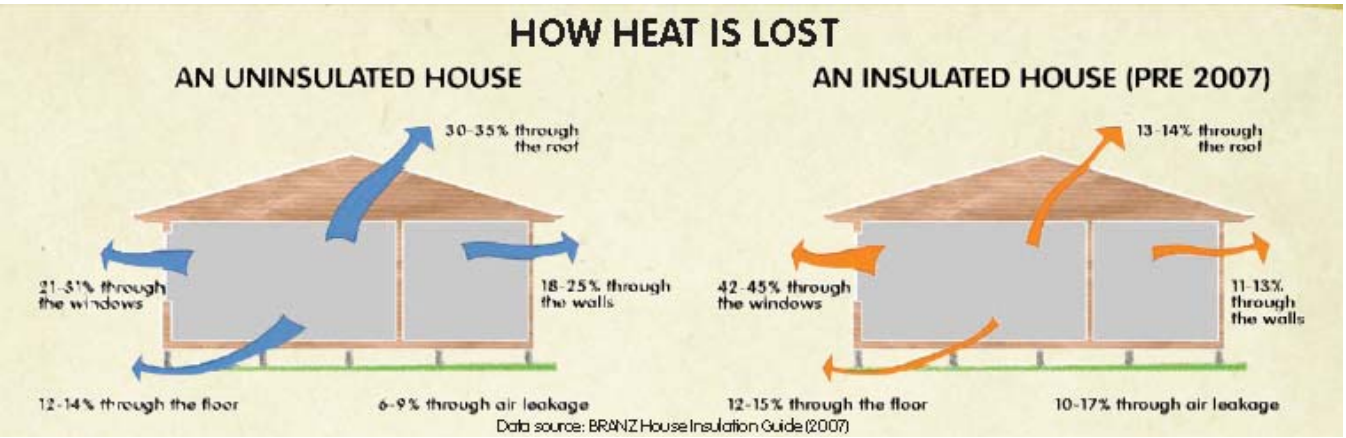
- ☐ *Natural Ventilation and Windflow* – Cross ventilation and air flow can be encouraged using window and door openings at opposite sides of a room or building. Use windows that capture prevailing winds. Higher window openings will vent rising hot air and encourage cool airflow. Allow windows to open or vent in high moisture areas such as kitchens, bathrooms, toilets, spa rooms and laundries. An open plan layout will encourage cooling air movement by minimising barriers to airflow. Fences, trees and/or earth mounds can significantly reduce prevailing winds (approx. halved for distances up to ten times their height).

- ☐ *Site Considerations* - Where site selection is possible consider; good solar access, prevailing winds, shading from trees, landforms and other buildings (actual and proposed). Locate buildings and yards outside of shaded areas and build towards the southern boundary to maximise full day sun.

- ☐ *Home Energy Rating Scheme (HERS)* – You can obtain an independent energy rating report developed by The Energy Efficiency and Conservation Authority (EECA). The report assesses a homes energy efficiency performance based on the homes design, construction and orientation, the home heating system and the water heating system. It also provides a comparative star rating and recommendations on how the rating can be improved. Visit www.energywise.org.nz for details.

INSULATION – MORE IS BETTER!

One of the most efficient and cost-effective ways to make a home warmer in winter and cooler in summer is to insulate well and the best and most cost effective time to do this is during construction.



- ☐ *Home Insulation* – Up to 35% of heat loss is through the ceiling so increased ceiling insulation is a worthwhile investment - the extra ceiling space also allows for thicker insulation materials. Also, look at increased insulation in the walls and floors. Insulation must be installed correctly – even small gaps can halve insulation performance.

- *Glazing and Doors* - Up to 45% of heat loss is through glazing and doors. Heat loss can be halved using double glazing so do this first. Then, consider other options to reduce heat loss by using Low-E glass and/or argon gas between the two panes of glass and/or timber, PVC or thermally broken aluminium frames. The window efficiency rating scheme (WERS) uses stars to compare the performance of window features (visit the Window Association of NZ's website www.wanz.org.nz to see the WERS star ratings). Curtains can also make a real difference if they are thermally lined and preferably floor length with few gaps. Use a solid and/or insulated exterior doors or an enclosed entrance lobby to help reduce heat loss.

- *Air Leaks* – Up to 17% of heat escapes through gaps around windows, under doors and where ducts, drains and water pipes enter rooms. Seal ducts and pipes with mastic tape and fillers, fit weather strips around doors and windows if necessary and draught-stoppers to the bottom of exterior doors.

- *Use CA-rated downlights* – CA or closed abutted downlights allow inslation to be placed up against the downlight enclosure. Older downlights require a minimum clearance of 150mm from insulation materials, which encourages heat loss through ceilings.

HOME HEATING – 34% OF HOUSEHOLD ENERGY USE

For health and comfort, inside temperatures should be between 18ºC and 24ºC. The World Health Organisation recommends a minimum indoor temperature for health of 18ºC, with up to 20-21ºC for more vulnerable groups, such as the elderly and young children. Temperatures below 16°C result in an increased risk of respiratory illness and premature mortality.
Data source: (World Health Organisation, 1987)

Efficiency of Home Heating Systems		
Average	**Above Average**	**Excellent**
Flued gas heaters (LPG/Natural gas)	Electric heater (fan/radiant/convection)	Passive solar design (see above)
Solid fuel burner	Hot water radiators (Electric/Condensing Gas/Electric boiler)	Heat pumps (Air to Air or Ground Source)
Central heating (LPG/Gas/Electric/Oil)	Electric cable (Underfloor)	Heat recovery ventilation systems
Hot water radiators (Gas/Underfloor)		Geothermal-sourced heating
Based on co-efficient of performance [heating output (kW) divided by heating power input (kW)] **Data source: BRANZ Level website www.level.org.nz (October, 2009)**		

- Heat Pumps – Heat pumps are among the most energy-efficient forms of heating available. They take heat from the air (or ground) outside and use it to warm the air inside providing both heat and ventilation. Reverse cycle heat pumps can also provide cooling in summer.

Tip: Inverter or variable speed models are up to 30% more efficient than fixed speed models. The heat output of a heat pump is often quoted based on an outside temperature of +7° Celsius (H1 performance standard). Request the H2 (+2ºC) or H3 (-7ºC) performance standard if you want to know the heat output with lower outside temperatures.

- *Heat Recovery Ventilation Systems* – Heat recovery ventilation systems use a heat exchanger attached to the ventilation system in the roof space to transfer heat extracted from the inside air to the incoming fresh outside air. In this way, most of the heat is recovered.

Tip: A true *heat recovery ventilation system* should 1) Extract stale inside air 2) Replace with fresh outside air 3) use an air-to-air heat exchanger to recover heat and 4) provide balanced indoor air pressure

- ☐ *Electric Radiant, Convection and Underfloor Heaters* – Radiant or convection heaters such as fan heaters, wall panel heaters, electric hot water radiators and electric underfloor cables have above average heating efficiency.

- ☐ *Gas Heaters* – Flued gas heaters provide easily adjustable, instant heat and because the flue on some models can be run down and out, horizontal or vertical they can be installed in most places in a home. They offer average heating efficiency.

Tip: *Condensing gas* systems using hot water radiators are more efficient than standard flued gas heating systems.

- ☐ *Woodburners and Pellet Burners* - Modern, enclosed woodburners are much more efficient than open fires. Pellet burners are a cleaner more efficient option again which burn compressed wood pellets made from sawmill waste.

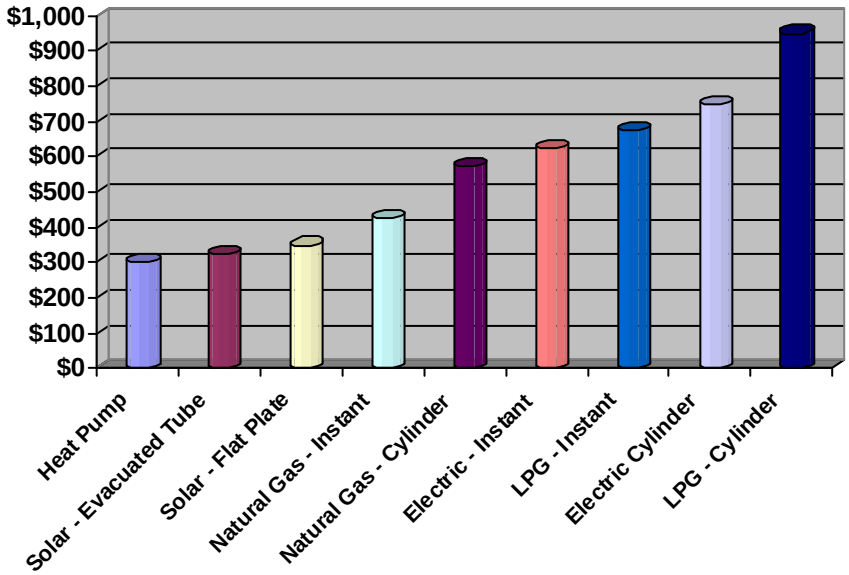
- ☐ *Thermostats and Timers* – A heating system with a thermostat or timer will help provide heating only when required.

Tip – Ensure your chosen heater can meet your space heating requirements e.g. Is the heat output sufficient for the space required? Do you need instant, adjustable and/or directional heating? Does the heater need to be portable?

WATER HEATING – 29% OF HOUSEHOLD ENERGY USE

There are two main types of water heating systems — storage and instant flow (tankless). Your hot water system should be able to supply about 40-60 litres of hot water a day per person (Data source: www.level.org.nz/energy/water-heating)

Hot water system annual running costs



Approximate running costs for a typical family of four.
Data source: www.energywise.govt.nz (February, 2008)

Tips for energy efficient hot water use…

- Install an energy efficient hot water heating system
- Use low flow showerheads and taps or install flow restrictors
- Install water-efficient household plumbing and appliances (visit www.waterrating.com.au to compare models)
- Reduce the hot water cylinder temperature, but not less than 60°C.
- Check and fix leaking taps or pipes
- Wrap at least the first metre of the hot water pipe attached to the cylinder
- Install showers instead of baths where possible
- Cluster rooms using hot water together to reduce pipework and heat loss
- Install a *drain water heat recovery unit* to recover heat from drainwater

Water Heating Options

Use the information in this section to help make the best water heating choices.

- ☐ *Heat Pump Water Heaters* - These cylinders are usually located on the outside of the house and work by taking heat from the outside air to heat the water inside the cylinder. Using heat pump technology makes them one of the most energy efficient options available.

- ☐ *Solar Water Heating* - These systems are very efficient and can be effective anywhere in New Zealand, providing up to 75% of a household's annual hot water needs. You'll require an unshaded section of roof approximately 4-6 square metres, ideally north facing. The optimum angle will depend on your latitude: in Auckland, panels should be angled about 37º and in Dunedin about 46º (i.e. 90º - Mar/Sep sun angle. Refer to 'Sun Angles' table earlier). Your installer can supply a frame to give the right tilt.

Tip: Customers may be eligible for government funding of $1000 to install one of their specified heat pump or solar water heating systems. Visit www.energywise.govt.nz for details.

- ☐ *Instant Flow Gas* – Water is heated as required, so you don't need a storage tank. Select a system with a flow rate suitable for the households needs.

- ☐ *Gas Hot Water Cylinders* - Gas hot water cylinders can use natural or LPG gas and can be situated inside or outside the house. Condensing systems are the most efficient type but have to be located outside. Gas systems reheat water more quickly than electric systems.

- ☐ *Electric Hot Water Cylinders* - The cheapest and most common water heaters but very inefficient to operate. Consider a 'heat pump or solar–ready' tank, which can have a solar panel, or heat pump, connected to it in the future.

- ☐ *Wetback Systems* - A hot water system can be boosted with a wetback fitted to a wood or pellet fire, range or burner system. A wetback uses a water pipe arrangement at the back of the heat source to help heat water.

Tip: For very efficient water heating systems consider a heat pump system or solar water heating system. They cost more upfront but will cost less than half the running costs of an electric hot water cylinder.

Data source: Hot water system annual running costs - www.energywise.govt.nz (February, 2008)

LIGHTING – 8% OF HOUSEHOLD ENERGY USE

Good lighting offers safety and comfort with the minimum use of energy.

- ☐ *Use Natural Light* – Reduce artificial lighting requirements by using natural light as much as possible from good solar design, home orientation, increased glazing, skylights and reflective light surfaces.

- ☐ *Use Lighting Controls* – Use multiple switches to control lighting in specific areas rather than a single switch to light the whole room. Place switches at convenient locations for rooms with multiple exits. Use *dimmers*, *timers* and *light sensors* to reduce lighting when not required.

- ☐ *Compact Fluorescent Lamps* – Medium price, long life (up to 10 000 hours) and high energy-efficiency (up to 80% less energy than incandescent bulbs). Recommended in most household situations, especially for extended use. Disadvantages include delayed full brightness and restricted use with dimmers and downlights.

- ☐ *Halogen Lamps* – Medium price, long life (approx. 2000 hours) and energy-efficient (up to 30% less energy than incandescent bulbs). They produce an instant, bright white light - excellent for task lighting. An excellent option in most household situations, particularly for concentrated task lighting. New energy saver halogen lamps are up to 40% more efficient than standard halogen bulbs.

- ☐ *LED Bulbs* – Expensive but very long life (up to 100 000 hours!) and very high energy-efficiency (up to 90% less energy than incandescent bulbs). Limited availability and use at present but will grow rapidly as LED technology develops. Very cost effective life cycle cost so recommended subject to availability.

- ☐ *Fluorescent Tube* – Expensive but long life (approx. 10 000 hours) and high energy-efficiency (up to 80% less energy than incandescent bulbs). Recommended in selected household situations requiring extended use and general lighting e.g. kitchens, bathrooms and workshop/garages.

- ☐ *Incandescent Bulbs* – Cheap but short life (approx. 1000 hours) and poor energy-efficiency (up to 95% of energy is wasted as heat). Not recommended due to their high running costs compared to the alternatives above.

Data source: Rightlight www.rightlight.govt.nz and BRANZ Level website www.level.org.nz (July, 2009)

OTHER APPLIANCES – 29% OF HOUSEHOLD ENERGY USE

- ☐ *Energy Rating Labels* – Energy Rating Labels use star ratings and display energy use (usually kilowatt hours per year) to make it easy to compare the energy efficiency of different models. Each extra star means an extra 10% or more savings in running costs. Visit www.energyrating.gov.au to compare appliances.

- ☐ *ENERGYSTAR® labels* – ENERGYSTAR® is the global mark of energy efficiency and is only awarded to the most energy efficient products in each class.

- ☐ *Correct Size* - Reduce unnecessary running costs by selecting appliances that are the sized for the household's needs.

- ☐ *Refrigerators & Freezers (10% of home energy costs!)* - Upright fridge-freezers with one door above the other are generally more efficient than units with side-by-side doors. Upright freezers with enclosed drawers (not baskets) are a good compromise. Avoid placing the fridge or freezer in direct sunlight or flush against the oven or cooktop.

- ☐ *Cooking Range (6% of home energy costs!)* – Induction cooktops are very efficient but relatively expensive. Gas cooktops are relatively efficient and relatively cheap. Ceramic glass and halogen are less efficient than gas and usually more expensive to purchase. Exposed coil and solid disk elements are the least efficient but relatively cheap.

- ☐ *Clothes Dryer (1-2% of home energy costs)* - Look for a model with an auto-sensing feature to save energy and prevent overdrying.

- ☐ *Dishwasher & Washing Machine (1% of home energy costs)* - Look for models with an eco cycle. Front loading (horizontal-axis) washing machines may cost more to normally use less energy and water than a top-loading machine. Look for washing machines with a cold wash cycle, auto load sensing or load size selection and high spin speed.

Tip: Most of the energy used for dishwashers and washing machines is for heating water. Search for water-efficient dishwashers and washing machines at www.waterrating.gov.au (click on `Finding a WELS product' on the left hand menu).

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Department of Building & Housing – www.dbh.govt.nz