

Methods for calculations in “Switch and save: how gas is costing households”

Note on the methods used to calculate bill savings, emissions reductions, and details of other assumptions and interviews

The Switch and Save report analysis relies on established methods for assessing the cost of a range of appliances. That said, it is a desktop study. If the data that is publicly available on the efficiency of devices is incorrect, then this would flow through to our analysis. Stated cost savings are generally averages and are likely to vary between houses depending on the behaviour of the Australians living in those homes.

Built in assumptions

The analysis uses a number of assumptions, which may not apply to all homes. House sizes are Australian averages and heating loads are based on a Nationwide House Energy Rating Scheme (NatHERS) 6 Star rated home. Many homes in Australia are not rated this high and could have higher heating costs, which means savings could increase. Heating costs could also decrease based on smaller homes. Daily hot water use may also vary widely. Assumed cooking amounts are likely to be quite low compared to some homes, however, on a like for like basis between gas and electricity, the savings will increase linearly with cooking frequency increase. It is also important to note that when assessing the efficiency of gas appliances throughout the report, we take our figures from the efficiency of brand-new appliances, which have the greatest efficiency both because of technological change and ordinary wear and tear. We do include potential leakage rates from ducting, but older, less efficient appliances may mean bill savings increase and calculations will depend entirely on a home’s actual use of an appliance.

Electricity and gas costs

Prices for gas and electricity were averages for capital cities from Watter, ¹ which compares prices from 53 energy retailers. Prices were gathered following the release of the updated Default Market Offer on 31st July 2022, which did see average prices increase across the board. Future prices will have a major impact on the savings and payback periods that are calculated in the report. However, it is not possible to predict given the volatility in both electricity and gas markets.

Table 1. Average electricity and gas tariffs and supply charges in cents

	Sydney	Melbourne	Adelaide	Brisbane	Canberra	Perth	Hobart
Gas (Mj)	3.45	2.86	4.49	5.58	3.46	3.05	4.18
Gas supply charge (day)	57.27	76.62	74.41	72.31	68.85	21.29	57.00
Electricity (kWh)	24.99	20.93	32.18	22.91	24.98	22.91	24.20
Electricity supply charge (day)	86.54	106.08	99.46	103.35	88.28	103.35	90.48

¹ <https://watter.com.au/>

Note: Darwin has not been included because gas prices were not publicly available.

Total savings

Bill savings and payback periods have been calculated by combining heating, cooking, and hot water per year including daily connection fees for gas.

Electrification savings include the removal of the daily gas supply fees. While we have considered the increased electricity usage fees, we have not considered daily supply charges in the assessment as these would already be being paid for lighting and other appliances.

Table 2. Yearly bill savings based on total gas bill vs electricity bills with lower and higher priced appliances.

	Gas bill	Electricity bill (lower priced appliances)	Electricity bill (more expensive appliances)	Yearly bill savings low priced appliances	Yearly bill savings median priced appliances + solar hot water
Sydney	\$1,329	\$721	\$405	\$608	\$924
Melbourne	\$1,790	\$847	\$583	\$943	\$1,207
Adelaide	\$2,155	\$1,104	\$698	\$1,051	\$1,457
Brisbane	\$1,717	\$582	\$293	\$1,135	\$1,424
Canberra	\$2,927	\$1,366	\$1,051	\$1,561	\$1,876
Perth	\$1,254	\$740	\$451	\$514	\$803
Hobart	\$2,662	\$1,068	\$763	\$1,594	\$1,899

Hot water heating cost calculations

Hot water heating costs were calculated using a number of sources, based on using 160 litres per day. This assumes an average 3-person household having three five-minute showers a day, and additional minor hot water use in the kitchen and laundry.

Table 3. Annual electricity and gas usage and bills for hot water

Hot water system type	Grid electricity kWh/year	Gas usage MJ/yr	SYD	MEL	ADEL	BRIS	CAN	PER	HOB
Electric storage 160L, continuous tariff ²	3,407		851	713	1096	781	851	781	824
Gas storage 170L 5 or 6 Star ³		16,175	558	463	726	902	559	494	676
Gas instantaneous ²	69	14,960	533	443	694	850	534	473	642
Solar hot water, electric boost ²	510		127	107	164	117	127	117	123
Heat pump – state of the art 250L, continuous tariff ⁴	757		189	158	244	173	189	173	183
Heat pump – efficient mid-range, 170L, continuous tariff ³	1,771		443	371	570	406	442	406	429

Room heating cost calculations

Space heating is perhaps one of the most complex of the comparisons because of what is known as the Coefficient of Performance (COP) - the output energy of a heater divided by input energy. In many cases the COP of gas is below one meaning less than one unit of energy is gained from a single unit of gas. On the other hand, reverse cycle air conditioners, which can heat and cool, have COPs well over 1 and therefore produce more units of heat, or cool, for every unit of energy input - the average COP across all rated air conditioners in Australia is 3.65.⁵ COP information is not published for gas heaters; however, we calculated an average COP across the range of 'Rinnai' standing gas heaters of 0.97.⁶ Average COP for ducted gas is lower at 0.88.⁷

Heating loads are from the Nationwide House Energy Rating Scheme (NatHERS).⁸

² Author calculation based on Coefficient of Performance of 1

³ <https://harvesthotwater.com.au/how-much-your-hot-water-system-costs/>

⁴ Based on manufacturer COP assuming daily use of 160 litres, heating from 20-70 degrees Celsius

⁵ Greenhouse and Energy Minimum Standards Regulator 2022, Product – Air conditioners, [Online] Available at: https://reg.energyrating.gov.au/comparator/product_types/64/search/?expired_products=on.

⁶ <https://www.appliancesonline.com.au/manuals/151n/151n-2.pdf>

⁷ <https://www.plumheatcool.com.au/wp-content/uploads/2017/07/BRIVIS-Installation-Manual-Gas-Ducted-Heating-SP4-SP5-SP6-BX5-May-2016.pdf>.

⁸ <https://www.abcb.gov.au/sites/default/files/resources/2022/ABCB-Standard-NatHERS-heating-cooling-load-limits.pdf>

Table 4. NatHERS 6 Star heating load, average size Australian houses, and total heating load converted to kWh.

	Heating load (Mj/m ²)	Ave house size ⁹	Annual heating load (kWh)
Sydney	40.4	222.5	2493.85
Melbourne	96.0	238.8	6368.00
Adelaide	67.0	231.5	4308.47
Brisbane	24.0	201.8	1345.33
Canberra	154.0	259.3	11092.28
Perth	57.0	230	3641.67
Hobart	155.0	176.5	7599.31

Note: Sydney's heating load is an average between Mascot and Western Sydney representing the very high temperature range from east to west across the city.

Table 5. Annual bills for gas, plug-in electric and reverse cycle air conditioners in capital cities.

	Standing gas heater	Gas ducted	Plug in electric	Reverse-cycle air conditioner
Adelaide	709	1012	1387	417
Brisbane	275	383	308	93
Canberra	1,405	2,005	2,771	833
Hobart	1,165	1,647	1,839	553
Melbourne	668	955	1,333	401
Perth	408	583	834	251
Sydney	315	451	623	187

(Standing gas heater average input 18MJ/hour, 4.91kW output COP of 0.97; ducted avg input 105.56 MJ/hr, 482.5W fan, 25.78kW output, COP 0.88; Electric resistive 2.4 kW input and output, CoP of 1; RCAC average input 1.94kW, output 6.45kW CoP 3.19.)

⁹ CommSec 2021. Bigger apartments over the past year [Online] Available at: <https://www.commbank.com.au/articles/newsroom/2020/11/commsec-home-size-trends-report.html>.

Ducting heat loss

Ducting heat losses of 17 percent were presented in the main report. Below the higher losses for ducting without upgrade are presented. This could mean bills are even higher than expected.

Table 6. Ducted heating loss and bill increases (\$)

	Bill increase 35% leakage	Bill increase 58% leakage
Adelaide	\$441	\$1,130
Brisbane	\$169	\$432
Canberra	\$873	\$2,239
Hobart	\$719	\$1,844
Melbourne	\$415	\$1,066
Perth	\$254	\$650
Sydney	\$196	\$503

Cooking cost calculations

Calculations for cooking were based on a study¹⁰ that compared three induction stoves, ceramic and coil type electric stoves, and a gas burner. Gas and electric oven yearly energy use is not widely reported so a single source was used.¹¹ Heat up efficiency highlights the poor efficiency of gas compared to the other technologies.

Table 7. Electricity (kWh) and gas (MJ) use for different cooktops and uses.

Cooktop	Induction A (Frigidaire) kWh	Induction B (GE) kWh	Induction C (Samsung) kWh	Resistance Ceramic (Whirlpool) kWh	Resistance Coil (Frigidaire) kWh	Gas Burner (Samsung) MJ
Heat-Up Efficiency	85.20%	86.10%	83.00%	75.50%	79.30%	31.90%
Heat-Up Energy Per Day	0.563	0.561	0.581	0.641	0.606	5.43
Simmer Energy Per Day	0.238	0.228	0.25	0.227	0.244	1.77
Sauté Energy Per Day	0.169	0.207	0.182	0.182	0.238	1.4

¹⁰ <https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf>

¹¹ https://renew.org.au/wp-content/projects/CAP_Gas_Research_Final_Report_251114_v2.0.pdf

Table 8. Annual bills for various cooking technologies.

	Induction (3 model average)	Resistance Ceramic	Resistance Coil	Gas Burner	Electric oven	Gas oven	Saving
Sydney	\$90.60	\$95.78	\$99.25	\$108.30	\$27.74	\$27.60	\$17.58
Melbourne	\$75.80	\$80.20	\$83.11	\$89.89	\$23.23	\$22.91	\$13.72
Adelaide	\$116.60	\$123.34	\$127.80	\$140.98	\$35.72	\$35.93	\$24.54
Brisbane	\$83.00	\$87.81	\$90.99	\$175.03	\$25.43	\$44.61	\$111.16
Canberra	\$90.50	\$95.74	\$99.21	\$108.45	\$27.73	\$27.64	\$17.82
Perth	\$83.00	\$87.81	\$90.99	\$95.84	\$25.43	\$24.43	\$11.79
Hobart	\$86.20	\$91.59	\$90.00	\$131.21	\$26.86	\$33.44	\$51.59

Appliance and installation costs

Table 9. Appliance and installation cost of analysed appliances including Small-scale technology certificates for hot water systems.

Hot water system type	Purchase price \$	Discount for STCs	Installation cost	Total cost rounded \$
Electric storage, 250-315L (Rinnai Hotflo Electric Storage heaters)	\$810 (250L) \$960 (315L)	n/a	\$400	\$1200-1400
Gas storage, 170L, 5 star (Dux 170L 5 star Prodigy Water Heater)	\$1,500	n/a	\$350	1,850
Gas instantaneous, 26L, 6 star (Rheem Metro Max 26L Gas Continuous Flow)	\$870	n/a	\$350	1,200
Solar hot water, electric boost (Rheem 511271/2NPT - Loline 270L two collector)	\$5,010	\$880-1040	\$1,200	\$5200-5300
Heat pump, 150-220L, state of the art (Sanden GAUS-250FQS Eco Plus 250L)	\$4,600	\$1080-1200	\$600	\$4000-4100
Heat pump, 150-220L, efficient mid-range (Midea RSJ-15/190RDN3-C 170L)	\$2,110	\$1000-\$1080	\$600	\$1600-1700
Lowest price induction	\$300	n/a	\$200	\$500
Median induction	\$2199[1]	n/a	\$200	\$2,399
RCAC split low price (1 large, 2 small)	\$1618 [2]	n/a	\$1,000	\$2,618
RCAC median price	\$3236 [3]	n/a	\$1,000	\$4,236

[1] Calculated across entire range of Good Guys induction cooktops

[2] Appliances Online lowest cost 3.5kW (\$718) and 2 of the lowest cost RCAC (\$450)

[3] Double the price of lowest cost appliances

Emissions savings

Emissions savings were calculated over a 10-year period assuming decarbonisation of electricity at a rate in line with the AEMO 'Independent System Plan'¹² and Western Australia's 'Whole of System Plan'.¹³ Gas emissions were calculated using the 'National Greenhouse Accounts Factors'.¹⁴ Emissions were calculated for hot water, heating and cooking using the yearly megajoules of gas used or kilowatt hours of electricity.

Table 10. Average emissions intensity of grid delivered electricity to 2030.

Average emissions intensity to 2030
WA (Double Bubble): 376.127 kgCO ₂ e/MWh
NSW (Step Change): 309.526 kgCO ₂ e/MWh
QLD (Step Change): 380.095 kgCO ₂ e/MWh
SA (Step Change): 21.119 kgCO ₂ e/MWh
TAS (Step Change): 0.014 kgCO ₂ e/MWh
VIC (Step Change): 413.083 kgCO ₂ e/MWh

Note: The ACT is calculated as zero emissions from electricity due to their 100% renewable energy target having been met.

Table 11. Emission intensity of piped gas in Australian networks.

	kgCO ₂ e/Mj (Pipeline + Scope 3)
NSW + ACT	0.0757
Victoria	0.06615
Queensland	0.0705
South Australia	0.0728
Western Australia	0.0662
Tasmania	0.07027

Table 12. Yearly electricity (kWh) and gas (Mj) use of different heaters.

	SYD	MEL	ADEL	BRIS	CAN	PER	HOB
Gas heater (18MJ/hour, 4.91kW output)	9,142	23,345	15,795	4,932	40,664	13,350	27,859
Brivis ducted (avg input 105.56 MJ/hr, 482.5W fan, 25.78kW output)	10,211	26,075	17,642	5,509	45,419	14,911	31,116
Electric resistive 2.4 kW (CoP of 1)	2,494	6,368	4,308	1,345	11,092	3,642	7,599
RCAC (average input 1.94kW, output 6.45kW COP 3.19)	782	1,996	1,351	422	3,477	1,142	2,382

¹² <https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp>

¹³ <https://www.wa.gov.au/system/files/2019-08/Information-paper-Whole-of-System-Plan-Modelling-Scenarios.pdf>

¹⁴ <https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2021>

Table 13. Yearly electricity (kWh) and gas (MJ) of various cooking technologies.

Cooktop	Yearly use
Induction average 3 models kWh	362
Resistance Ceramic (Whirlpool) kWh	383
Resistance Coil (Frigidaire) kWh	397
Gas Burner (Samsung) MJ	3139
Gas oven MJ	800
Electric oven kWh	111

See Tables 3 and 4 above for yearly hot water and space heating use.

Solar saving calculation

Solar savings were calculated as an average across capital cities of daily solar output (26.4 kWh) from a 6.6kW solar system and the number of sunny days in each capital city. Cloudy days were not calculated and so the average is likely to be much more than \$800. Output also varies enormously depending on the city.

Details of responses to request of information for installation, electrical upgrade, and rectification costs

Table 14. Detail of responses from a survey of members of the Facebook Group 'My Efficient Electric Home'.

	Upgrades undertaken	Total cost	Gas disconnection	Electric upgrades	Breakdown of costs	House	More details
1	Reverse Cycle Air Conditioning (RCAC) (Planned: induction cooktop and Hot Water System (HWS))	\$15,325 (supplied by interviewee)	Not mentioned	Not mentioned	Not supplied	Double brick exterior. However, house is not leak proof, has thin glass windows and wooden frames from 70s/90s (planning to switch out).	On efficiency: "Found the RCAC heating much more consistent and less drying on us, can get away with our heating sitting at 19-20" On bills: last gas bill with heating (\$600), current one with no ducted heating for half the period (\$400)
2	HWS heat pump and induction cooktop	\$10,100+ (total of listed items)	N/A LPG	\$3,000+	\$3,000+ Plumber to install heat pump hot water and remove old gas box \$4,000 HWS heat pump \$2,100 new Westinghouse induction stove / oven \$1,000 electrician to install stove and oven	"Run down place" that they are in the process of doing up.	Upgrade process: Removed gas stove and most of the copper pipes themselves No cost for gas disconnection, all LPG.
3	HWS heat pump and RCAC	\$10,280 (total of listed items)	Not mentioned	None required	\$4,690 Sanden eco plus heat pump \$5,590 Daikin US7 RCAC No electrical upgrades, installation costs included in purchase price. Stove already electric.	Video on upgrade for Sustainable House day 2020: https://www.youtube.com/watch?v=MNio9ypx43l	
4	HWS heat pump, split systems air conditioning and induction cooking	~\$17,372 (total of listed items)	\$22 (\$120 to get the meter removed, hasn't undertaken yet)	\$400-500 for electrical installs for each appliance	\$400-500 for electrical installs for each (thicker cables, dual circuits, breaker switches, no upgrade to the meter box) \$22 cost of disconnecting gas for final reading (\$120 to get the gas meter removed, hasn't undertaken yet) \$5,000 HWS heat pump \$9,000 RCAC heat pumps \$1,000 electric radiators \$1,000 induction stovetop	Reinsulated roof cavity, installing double glazing and draft proofing.	Gas comparison: looking at \$3,500 for ducted heating boiler replacement, gas hot water was 15+ years old
5	HWS heat pump (Planned: induction cooktop)	Partial information	Cancelled account and turned off at meter (hasn't abolished due to stories)	Not mentioned	\$3,200 hot water heat pump	Double brick with suspended slabs (most common residential construction method in Perth) more difficult to run a separate circuit for an induction stove compared to a house with studs and plasterboard. Currently using two portable induction cooktops until kitchen is renovated.	Gas (dis)connection: only cancelled our account and turned it off at the meter, heard horror stories of high costs. On gas abolishment and switch to electric: "I hope that the gas companies will be forced to stop charging people fees for gas abolishment. Particularly given the environmental and health impacts of gas use are now well known, it seems

							unreasonable that people should be charged for doing the right thing."
6	HWS heat pump and ceramic stove	~\$10,000 on conversions (supplied by interviewee)	\$1,200	\$2300 for installing cables, timer, cable for stove	\$5361 Sanden 315L heat pump \$300 installing cables for the heat pump \$200 installing a timer on the fuse box (Sanden one not easily accessible) \$1,800 provide a 32 amp cable to the kitchen for the stove (from one end of the house to the other) Ceramic cooktop \$1,200 abolishment of gas meter by Jemena	Besser full brick two story house. Also have rooftop solar and a hybrid car.	On abolishment of the meter: "We haven't minded having to spend almost \$10k on the conversions, but find that the "correct" abolishment of the gas meter is nothing short of extortion by [our gas company] in NSW, to cost over \$1200. I would dearly love to be able to change this at the political level, perhaps with government subsidy for those of us trying to do the right thing.
7	Induction cooktop (Planned: HWS)	\$2,150 (total of items listed)	\$650 for electrical upgrades and gas capping		\$1,500 induction cooktop (display model) \$650 electrician install a 15amp socket for an Electric Vehicle and run a new line for the induction cooktop, plus gas tradesperson to cap gas (\$5,000-7,000 quotes for planned HWS heat pump)		
8	HWS heat pump	Partial information	Not mentioned	\$400	\$400 in upgrades (run another circuit from switchbox to new pump)		Already had a smart meter
9	RCAC and induction cooktop Upgrade on hot water and dryer (from resistive to heat pump)	Partial information	N/A LPG	Not mentioned	Not supplied	Renovated a 1990s house in [inner city Brisbane suburb]. Also have 6kW solar array, Tesla PowerWall 2 battery, house prewired for 30 amp EV charging. 90% of the time run on self-generated power.	
10	Resistive HWS, portable induction cooktop (Planned: induction cooktop)	Partial information	N/A LPG	Not mentioned	Not supplied	Off-grid home in regional QLD. 8kW PV array with 26.4 kWh of LiFePO4 batteries and a 9 kVA diesel generator. House double glazed, excellent insulation.	Since switching to resistive HWS, 90% of the time runs on electric hot water. Gas has also gone from 120kg LPG for first 12 months, to less than 40kg. No cost to remove gas (on bottle LPG), saving of \$220 per annum for the bottle supply charge from [energy supplier]. On affordability: "I realise that we are in the fortunate position of being able to afford energy efficient, electric appliances ... Our ethos has been to reduce gas usage as much as possible. Even living off grid, we have proven that it is possible".

Note: Three individuals chose to not have their responses included