Attachment 6.3

Future of Gas - Expert Report on Inputs

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PUBLIC

Australian Gas Networks

SJT

CONSULTING

Electric and Gas Appliance Comparison

Key Findings

Heating Systems

The most significant cost differential occurs in space heating. Current market pricing shows:

- Ducted gas heating: $4,750 (with evaporative cooling added its $7,250)
- Wall furnace: $3,103
- Reverse cycle air conditioning heating cost: $0 (when cooling system already installed, $16,000 if there is already adequate cooling)

Given that reverse cycle air conditioning is typically installed for cooling requirements (ducted systems: $16,000, split systems: $2,920), the heating function can be obtained at no additional capital cost. This eliminates the traditional cost comparison between gas and electric heating systems.

However, if the occupants like evaporative cooling and the home already has evaporative cooling and ducted gas heating, replacing both with ducted reverse cycle air conditioning is costly.

Water Heating

Electric storage water heaters with solar integration now present the lowest total cost option:

- Gas instantaneous: $1,335 (3.95 GJ annual consumption)
- Heat pump: $2,900 (434 kWh annual consumption, 17% solar offset)
- Electric storage: $1,233 (1,495 kWh annual consumption)
- Electric storage with timer: 90% solar offset, reducing grid consumption to 149.5 kWh annually
- Electric storage with smart charging: 99% solar offset, reducing grid consumption to 14.95 kWh annually

When accounting for typical rooftop solar installations (6-10kW systems now standard), electric storage water heaters achieve near-complete energy self-sufficiency. Even when additional solar capacity is required (1.8kW for electric storage vs 0.6kW for heat pumps), the total system cost remains lower than heat pump alternatives.

Solar Integration Impact

Current rooftop solar trends show:

- Average system size has increased from 4kW (2014) to 8-10kW (2024)
- Feed-in tariffs have declined to approximately 2c/kWh in South Australia
- Excess generation capacity is typically available for daytime water heating

This excess capacity fundamentally alters the economic comparison, as electric water heating can utilise otherwise exported energy at minimal opportunity cost.

Conclusions

The convergence of three market factors has shifted the economic case for electric appliances:

1. Heating: Reverse cycle air conditioning adoption for cooling needs has reduced the marginal cost of electric heating to zero
2. Hot Water: Oversized solar installations enable near-zero operating costs for electric storage systems with appropriate controls
3. System Integration: Electric appliances can leverage existing solar infrastructure, while gas appliances cannot

For typical 3-bedroom homes in South Australia, total ownership costs now favour all-electric configurations. This represents a fundamental shift in residential energy economics, driven by technology convergence rather than efficiency improvements alone.

What is a typical household

The energy consumption of household appliances is primarily determined by the occupants' need for services such as heating, cooking, and hot water. To effectively analyse the cost of equipment and energy usage for gas versus electric appliances, it is essential to first define a typical household in terms of the number of occupants and their patterns of energy consumption.

Typical household

The most common type of home in South Australia is a three-bedroom detached house occupied by a working couple without children. Both individuals work full-time, with two days each week spent working from home.

Heating and cooling requirements for this household typically include use during mornings and evenings three days per week. For the remaining four days, heating and cooling will be needed throughout the workday as well as in the evening and morning. The water heater is generally sized for three to four occupants, though the actual energy usage corresponds to two people. Cooking needs are centred around two professionals, accommodating their in-office schedules alongside two work-from-home days per week.

Typical household data

The following links provide the data.

- 2021 South Australia, Census All persons QuickStats | Australian Bureau of Statistics
- Working arrangements, August 2024 | Australian Bureau of Statistics

On each aspect the following results were the most common.

-	Separate house	78%
-	3 Bedroom home	51.5%
-	Family house	68%
-	Couple without kids	41%
-	Professionals	21.5%
-	Working full time	54.1%
-	35-39 hours	22.6%
-	Working from home	60%
-	Work from home days	2 days

Hot Water

Hot Water Equipment Cost Analysis

Water Heater Cost Trends

Oxford Economics have been sampling the cost of water heaters in Australia over a decade. A relevant segment of the data is provided in the chart below.

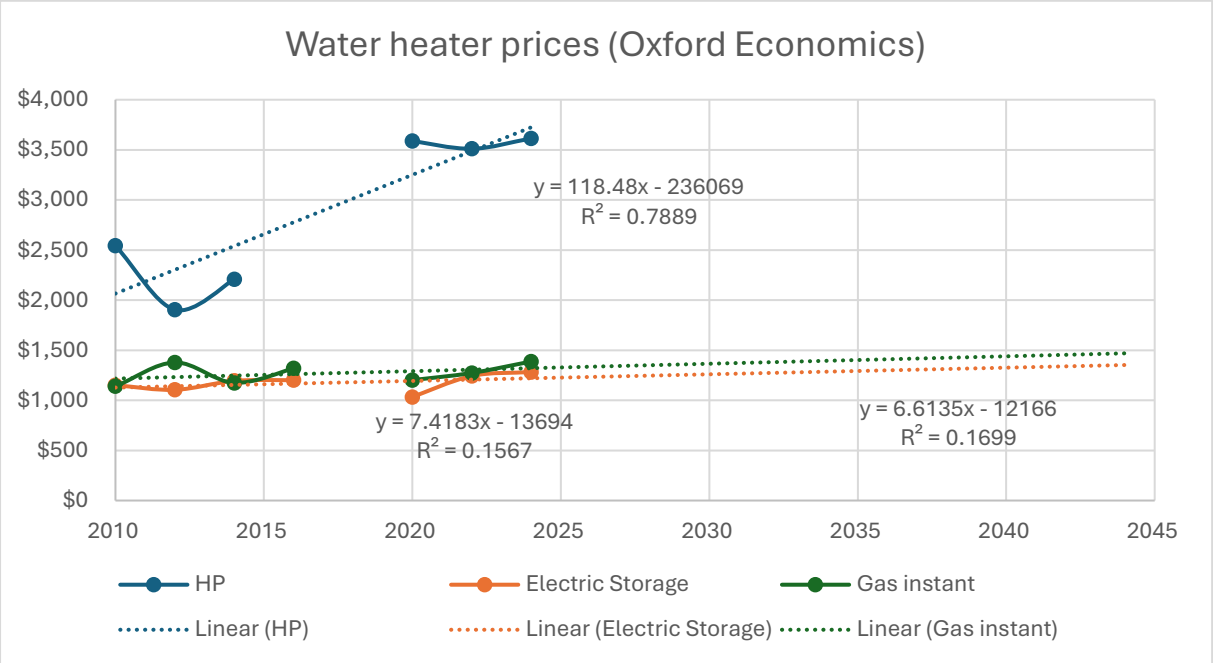

Figure 1 - Water heater cost trends

Both gas instantaneous and electric storage water heaters have been increasing in price, at about 0.5% per year, significantly below inflation. Heat pumps have been increasing in price by around 2% per year which is roughly in-line with inflation.

It is difficult to know if the cost inflation for heat pumps is due to actual inflation of the technology or a move from plumbers to installing high cost – more reliable heat pumps after customers have had poor experiences with lower cost units. There is some evidence that this is the case[1].

It is assumed the cost for gas instantaneous and electric storage water heaters follow the trends in Figure 1. For heat pumps, it is assumed the cost increases

[1] energyFit discussions with plumbers

year on year as the Small-Scale Renewable Energy Certificates awarded to heat pumps reduces to zero by 2031, in-line with the relevant legislation. Post 2031, it is assumed the technology increases in cost at a rate of 0.6%. The starting point for a heat pump that is relevant to a 3-bedroom home is $2,900[2].

Most Cost-Effective Electric Water Heating

Water heating needs to be considered in the context of roof top solar because water can be heated any time of the day ready to be used on demand. Water heaters are essentially thermal batteries, with a 400L water heater storing as much energy as two Tesla Power Walls.

Most modern roof top solar systems are large enough to power either a heat pump or an electric storage water heater. This means given electric storage water heaters are cheaper to buy compared to heat pumps, the electric storage water heater will be the preferred option. However, even if the cost of the additional solar PV is included in the cost of the water heater, electric storage with extra solar is cheaper. The typical home in South Australia needs an additional 0.6kW of solar to power a heat pump and 1.8 kW of additional solar to power an electric storage water heater. This adds about $500 to the cost of a heat pump and about $1,500 to the cost of electric storage, however heat pumps cost more than $1,000 more than an electric storage water heater so the extra solar with electric storage is the lower cost option, and under both scenarios, the energy cost is negative because the solar has been sized to power the water heater in winter when there is less sun and more demand for water heating, so the net effect over the year is the extra solar and the water heater actually produces more energy in summer than the system draws from the grid on cloudy days.

Figure 2 below shows that this has been the case in South Australia since about 2017.

[2] Quality Hot Water Heat Pumps ~ Adelaide SA

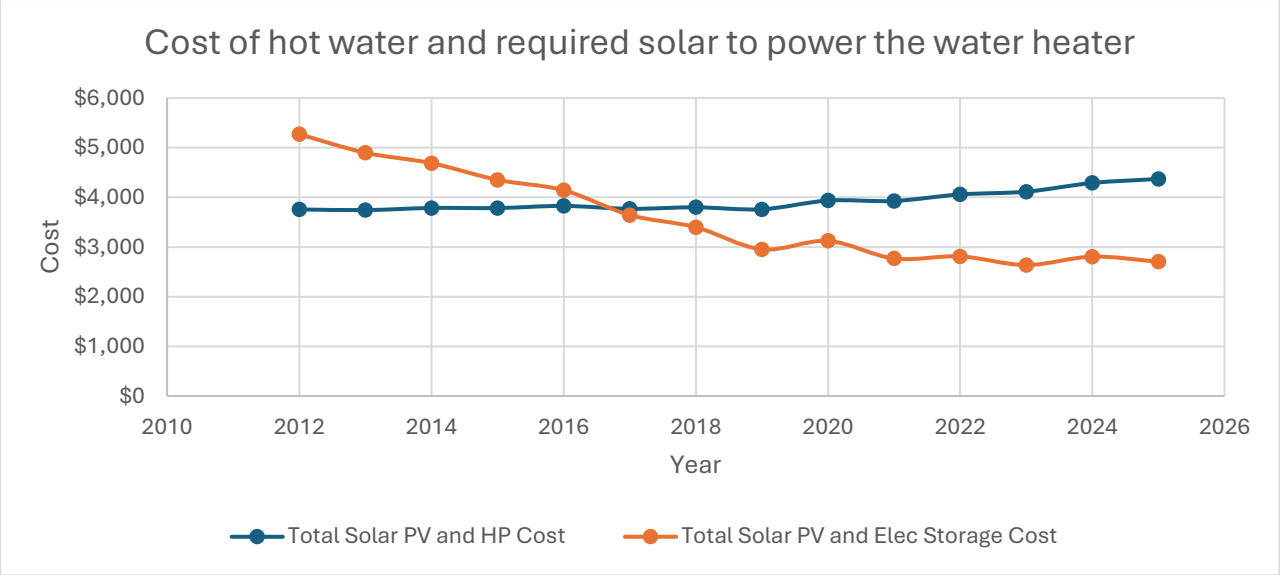

Figure 2 - Cost of electric water heating options with solar PV

Most commonly, households are not being this precise with their solar system installations and are just installing larger and larger sizes as the price comes down. This means that there is typically significant excess solar capacity which can be absorbed by an electric storage water heater at very little cost to the customer. In South Australia the solar feed-in tariff is approaching 2 cents per kWh.

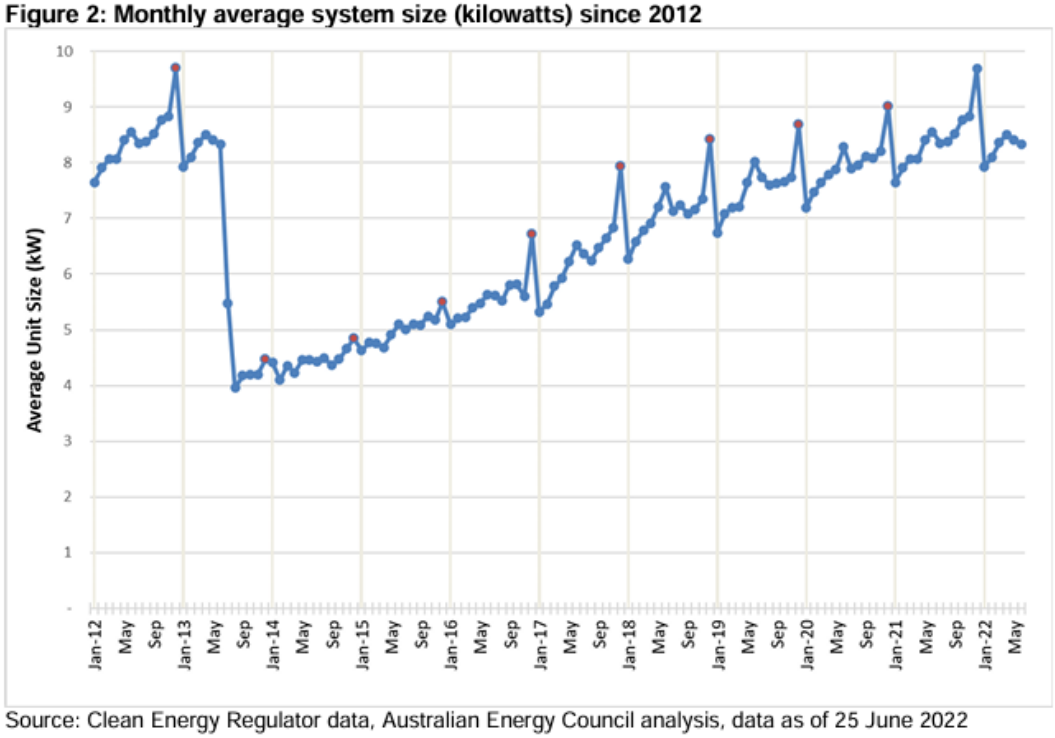

Figure 3 - Historical roof top solar sizes

Hot Water Equipment Energy Use

Typical hot water demand

energyFit is used to calculate the hot water demand for the typical 2-person household that showers for 8 minutes and washes clothes on warm. energyFit is a simulation tool that predicts household energy use with 96% accuracy on average.

For this typical 2-person household the energy use is:

- Gas instantaneous – 3,951 MJ
- Electric Storage – 1,495 kWh
- Heat Pump – 523 kWh

Grid level energy consumption

The grid level energy demand is a combination of the water heater technology and the ability of that technology to absorb roof top solar PV. The percentage of energy from solar are provided below for each technology type:

- Gas instantaneous – 0% solar
- Heat pump – 17% solar
- Large tank heat pump on a timer – 90%
- Electric storage water heater on a timer – 90%
- Electric storage water heater on a timer with smart charging – 99%

The grid level energy use for the most cost-effective electric water heater is therefore 14.95 kWh per year compared to 3.95 GJ for gas.

Heating and Cooling

Heating and Cooling Equipment Cost Analysis

Typical Heating and Cooling Need

The most common home is a 3-bedroom home built before the energy efficiency building standards that started in the 1990s.

The most common heating need is 5,763 kWh per year and the most common cooling need is 8,665 kWh per year for the typical home.

Equipment Cost

The cost of reverse cycle air conditioning is highly dependant on the regulatory environment. Air conditioners are subject to Minimum Energy Performance Standards (MEPS) and standards on the greenhouse gas potential of the refrigerant. All government regulation increases cost, and it is difficult to predict what regulations will be put in place in the future. If the industry is left to free market principals, the cost will come down over time. If government intervenes then costs will increase. Given prices could go up or down depending on government policy it is assumed costs will remain the same.

The cost for each heater or cooler is based on quotes received and are provided below[3]:

- Ducted Reverse Cycle Air Conditioning - $16,000
- Ducted Gas - $4,750
- Evaporative cooling - $2,500
- Split System - $2,920
- Wall furnace - $3,103

There is only an additional cost for heating if the air conditioner does not heat. This means if there is reverse cycle air conditioning installed for cooling, the cost of equipment for heating is zero.

[3] Quotes for similar sized systems under energyFit projects

Equipment Energy Use

Heating and Cooling Demand

The heating and cooling demand has been calculated based on the typical 3-bedroom house with 1993 building standards, using the USA Department of Energy energy Plus engine, built into the energyFit heating and cooling module. This system has proven to be 96% accurate on average and has been used by ARENA, ActewAGL, DCCEEW and others.

Energy Efficiency Trends

It is most likely that the energy efficiency of air conditioners will not increase over the next decade or more due to the government regulations requiring lower and lower global warming potential.

Figure 4 shows that the efficiency of air conditioners has been increasing over time. However, when the global warming potential limits came into effect in 2025 the efficiency dropped. Manufacturers will continue to aim to increase efficiency, while governments continue limiting the refrigerants that are available. This is likely to result in a balance where the efficiency remains constant over time, with ups and downs from year to year.

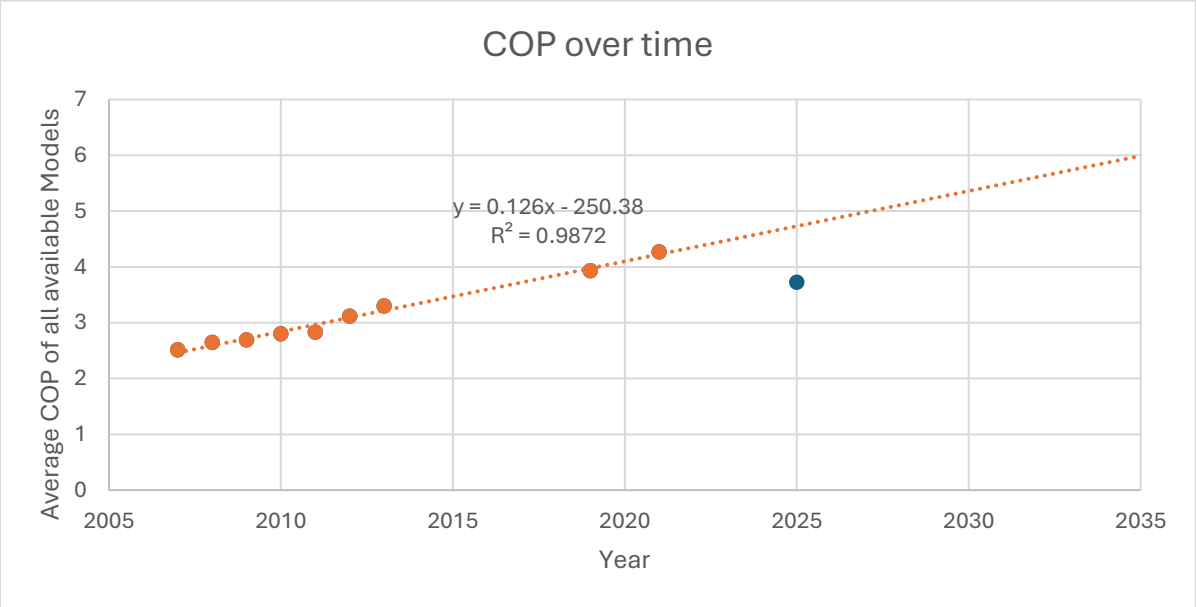

Figure 4 - Reverse Cycle Air Conditioning Efficiency Over Time

The worse case for gas is if the efficiency of reverse cycle air conditioning does continue to increase even with global warming potential limits. This has been modelled as an additional scenario.

Energy Use

The energy consumption for each technology is as follows:

- Ducted Reverse Cycle A/C
    - 5,200 kWh constantly for business as usual
    - 5,200 kWh reducing to 2,666 kWh by 2050 if manufacturing can overcome government regulation
- Ducted Gas – 31.81 GJ + 353 kWh
- Evaporative cooling – 557 kWh
- Split System Reverse Cycle A/C
    - 475 kWh constantly for business as usual
    - 475 kWh reducing to 270 kWh by 2050 if manufacturing can overcome government regulation
- Wall furnace – 9.13 GJ

Reverse Cycle Heating Capability

Reverse cycle air conditioners have become very good at heating, even in cold conditions. Since the Energy Rating Label changed to include cold, average and hot zones, the efficiency of air conditioners in cold climates has improved considerably. Households are also able to select a unit that is most suited to their climate, and most installers are now stocking units that are well suited to the local climate.