CLIMATE COUNCIL

SWITCH AND SAVE: HOW GAS IS COSTING HOUSEHOLDS

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The Climate Council acknowledges the Traditional Custodians of the lands on which we live, meet and work. We wish to pay our respects to Elders past, present and emerging and recognise the continuous connection of Aboriginal and Torres Strait Islander people to Country.

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Key findings

1

Australian households are trapped in a vicious cycle of escalating gas bills, which are fuelling a cost-of-living crisis.

- Australian households meet their energy needs through a combination of different fuel sources with piped gas accounting for almost 40%.
- The wholesale price of gas has almost tripled since last year, with 80% of supplies shipped overseas and our prices tied to a volatile international market.
- Our analysis shows gas heaters, cooking appliances and hot water systems are almost always more expensive to run than the smart, electric alternatives now available. Households in Brisbane with gas water heating are paying $733 more on bills each year.
- Even if you choose not to use a single gas appliance, being connected to the gas network will still sting you hundreds of dollars per year in daily supply charges with the most expensive annual bill being $280 for Melbournians.

2

It would be cheaper for households in all Australian capital cities analysed to be fully electric with yearly bill savings ranging between $514 and $1,899.

- The biggest bill savings are to be found in Brisbane, where gas is significantly more expensive than other capital cities, and in Hobart and Canberra due to their colder climates.
- Households that switch to fully electric in Hobart can save up to $1,899 on their annual bills, in Canberra households can save up to $1,876, in Adelaide ($1,457), Brisbane ($1,424), Melbourne ($1,207), Sydney ($924) and Perth ($803).
- For Australians living in one of the more than three million homes with solar panels on the roof, switching to electric heaters, cooking appliances and hot water systems could save them roughly $800 more on bills every year.

3

The biggest barrier for households going fully electric is the upfront cost of replacing appliances, which governments could fix with low- or zero-interest loans.

- Once electric appliances are installed, households enjoy immediate savings of hundreds of dollars every year. However, the combined cost of buying a new stovetop, room heaters and hot water system is a barrier for many households that want to get off gas now.
- We calculated the fastest pay-back period as being in Hobart, where it would take an average of six years to pay off the purchase cost of replacing a gas stove, gas hot water system and gas room heater before they stopped working with electric alternatives based on bill savings.
- Victoria and the Australian Capital Territory already offer government incentives which reduce payback periods in these jurisdictions by up to two years.
- Government assistance with the up-front costs for households, such as zero-interest loans for buying new electric appliances, will help ensure all Australians – including low-income households – can immediately start enjoying the cost and health benefits of getting off gas.

4

Making the switch from gas to electric is a win for reducing our costs of living, as well for our health and climate, but going all electric requires coordinated government action.

- Getting off gas is the only way to shield households from high gas prices that are expected to continue into next year, and beyond.
- Utilities charge exorbitant fees to disconnect individual households from gas. Governments should investigate these costs and seek to minimise them, including by exploring disconnection to whole suburbs or regions.
- New homes should be built to be fully electric from the get-go, and whenever gas appliances break down they should be replaced with cheaper and cleaner electric alternatives.
- Investing in Australian manufacturing of heat pumps and other all-electric equipment will create many quality jobs and ensure Australians can always readily access electric products that will be in increasingly high, global demand.

1. Introduction

Australian households are trapped by escalating gas bills, which are fuelling a cost-of-living crisis. We shouldn't have to choose between heating or eating. Nor should we be forced to keep burning toxic gas in our homes, which carries well-established health risks to our families. Getting off gas - by switching to electric cooking, heating and hot water - will set us free from paying exorbitant gas bills, and create a safer home.

Gas appliances - including stovetops, heaters and hot water systems - are an outdated technology with no place in the modern home. They are more expensive to run, as well as polluting. Gas is also a fossil fuel that's worsening climate change, with major impacts like killer heatwaves and megafires occurring more frequently, or becoming more severe. While the costs of gas may be bad for you and me, it's big business to certain corporations. Australia's gas industry has spent 2022 trying to market itself as "renewable", lobbying governments to allow even more gas mining and scaring Australians who want to electrify their homes with absurdly inflated costs for the change. They want to keep households trapped - paying exorbitant energy bills and using fossil fuels they don't have to.

This report presents new analysis on exactly how expensive gas appliances are to run compared to the electrical alternatives, and how much households can save over the long term from switching. Despite the cost of energy varying between cities, we find that modern electric appliances are cheaper to run than gas alternatives in all the capital cities we analysed. Government assistance with the up-front purchase costs, such as zero-interest loans, will ensure that all Australian households – and, in particular, low-income households – can start immediately enjoying the benefits of getting off gas.

Gas market prices in Australia's eastern and southern states have more than tripled over the past decade (see Figure 1), driven in part by volatility in international gas markets and dramatic spikes in the wholesale price of gas. These prices feed through to home gas and electricity bills. A recent report has highlighted the major impacts that rising prices have had on Australian families. Australian Parents for Climate Action (2022) found some households were even going into debt to pay energy bills.

The gas industry keeps arguing that more gas will somehow lower prices. But Australia is already the biggest exporter of liquified gas in the world. The only way to shield Australian households from future price shocks is to help them get off gas.

In addition to its high cost, recent studies have revealed the alarming health implications of burning toxic gas in the home for cooking, heating and hot water. Cooking with gas is estimated to be responsible for up to 12 percent of the burden of childhood asthma in Australia. A child who lives in a home with gas cooking faces a comparable risk of asthma to a child living with household cigarette smoke (Climate Council, 2021).

The switch from gas to electricity can significantly improve a household's greenhouse gas emissions in most states. Emissions savings will increase as Australia continues to decarbonise its entire electricity system with more renewables, backed by storage.

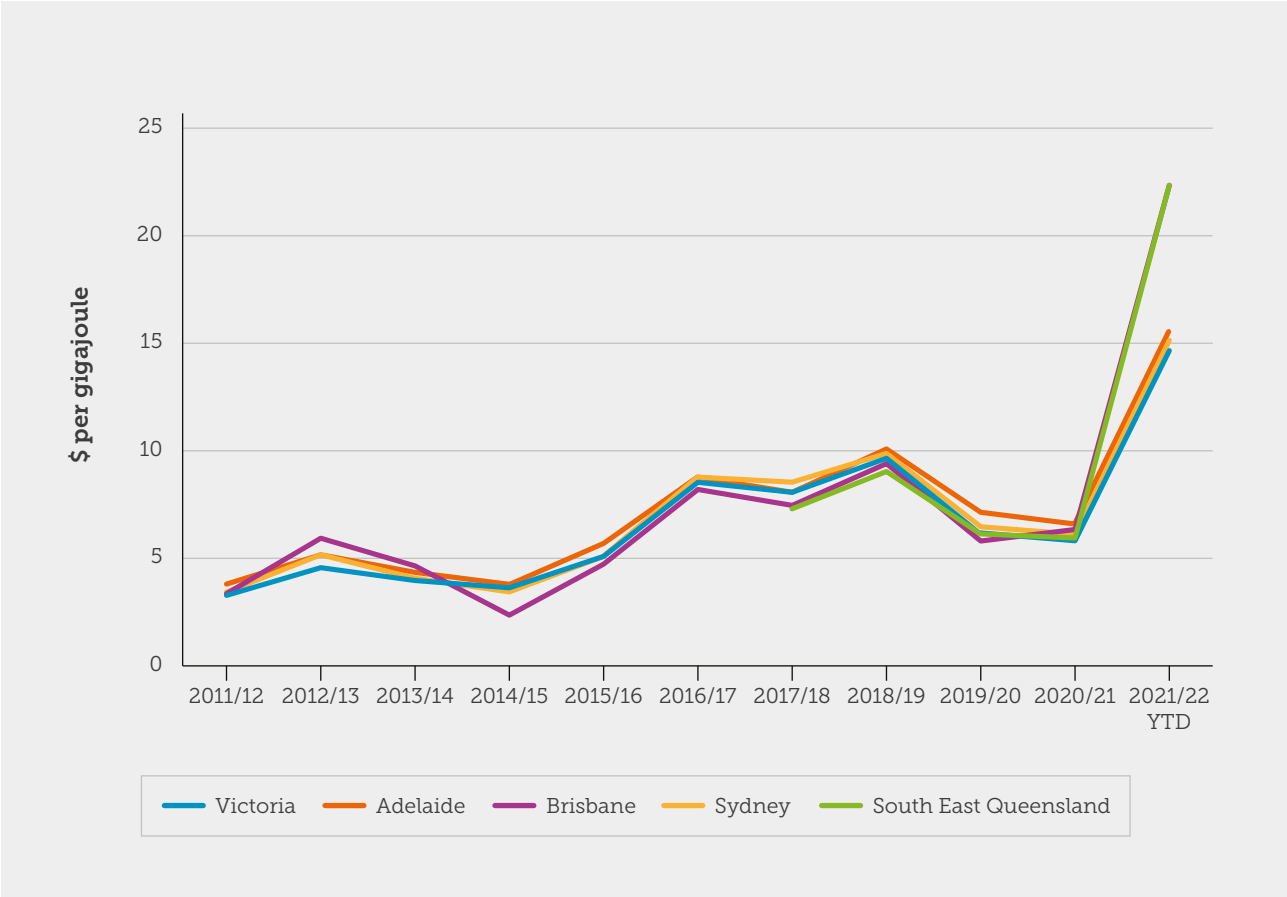


Figure 1: Gas market prices in Victoria, Adelaide, Brisbane, Sydney and South East Queensland, 2011/12 to 2021/22. (**Source:** Australian Energy Regulator, 2022.)

2. Key things to understand when comparing gas and electric appliances

A number of things need to be considered when comparing how much it costs to operate gas and electric appliances (specialist equipment for cooking, heating or hot water such as a stove top), as well as comparing how much they pollute.

THE ELECTRICITY GRID

Different forms of electricity produce different amounts of pollution - or greenhouse gas emissions - which worsen climate change. Depending on how electricity is produced in the grid an electrical appliance can be more, or less, polluting (known as its "emissions intensity"). Appliances that require electricity to operate will become less emissions intensive as our electricity grid is increasingly powered by renewables, like solar and wind. In contrast, gas appliances will always produce emissions while they are in use.

While emissions from electricity will decrease over time, gas emissions will remain the same.

HOW SMART IS YOUR APPLIANCE?

Modern electrical appliances are typically more energy efficient than gas appliances. This means they use less energy to do the same job; and this is particularly true for room heaters and water heating.

The "Coefficient of Performance" is an important concept to consider when comparing the efficiency of gas and electric appliances. This can be understood as the amount of energy an appliance uses to create a single unit of heat. Or, in other words, "energy used" by the appliance versus the "useful energy output" of the appliance.

For a gas appliances, the Coefficient of Performance is generally 1. That is, for every unit of energy in the gas used, only 1 unit of heat can be produced. As no appliance is perfectly efficient, in reality the Coefficient of Performance is somewhat less than 1, particularly for older, less efficient models.

In contrast, for an electric heat pump, the Coefficient of Performance can be anywhere between 3 and 6. This is because heat pumps - which are used in water heaters, reverse-cycle air conditioners and refrigerators - don't generate their own heat but effectively use heat energy from their surroundings (see below).

MAINS GAS AND BOTTLED GAS

The cost savings achieved by switching from gas to electricity will vary depending on whether a household is using bottled gas (LPG) or gas that's piped to the household via the local network. In all states and territories, the majority of gas is piped. This includes Victoria, where gas makes up a significant portion of overall household energy use due to the early exploitation of gas nearby in the Bass Strait. However, in Queensland - where gas only makes up a small portion of household energy use - a lot of the gas that's used is bottled gas. (See Table 1, in the following section.) The calculations in this report are all based on piped gas.

Figure 2: The Federal government provides financial incentives (through Small-scale Technology Certificates) for households to install small-scale renewable energy systems such as solar PV and solar and air source heat pump water heaters.

DIFFERENT TECHNOLOGIES

Heat pumps

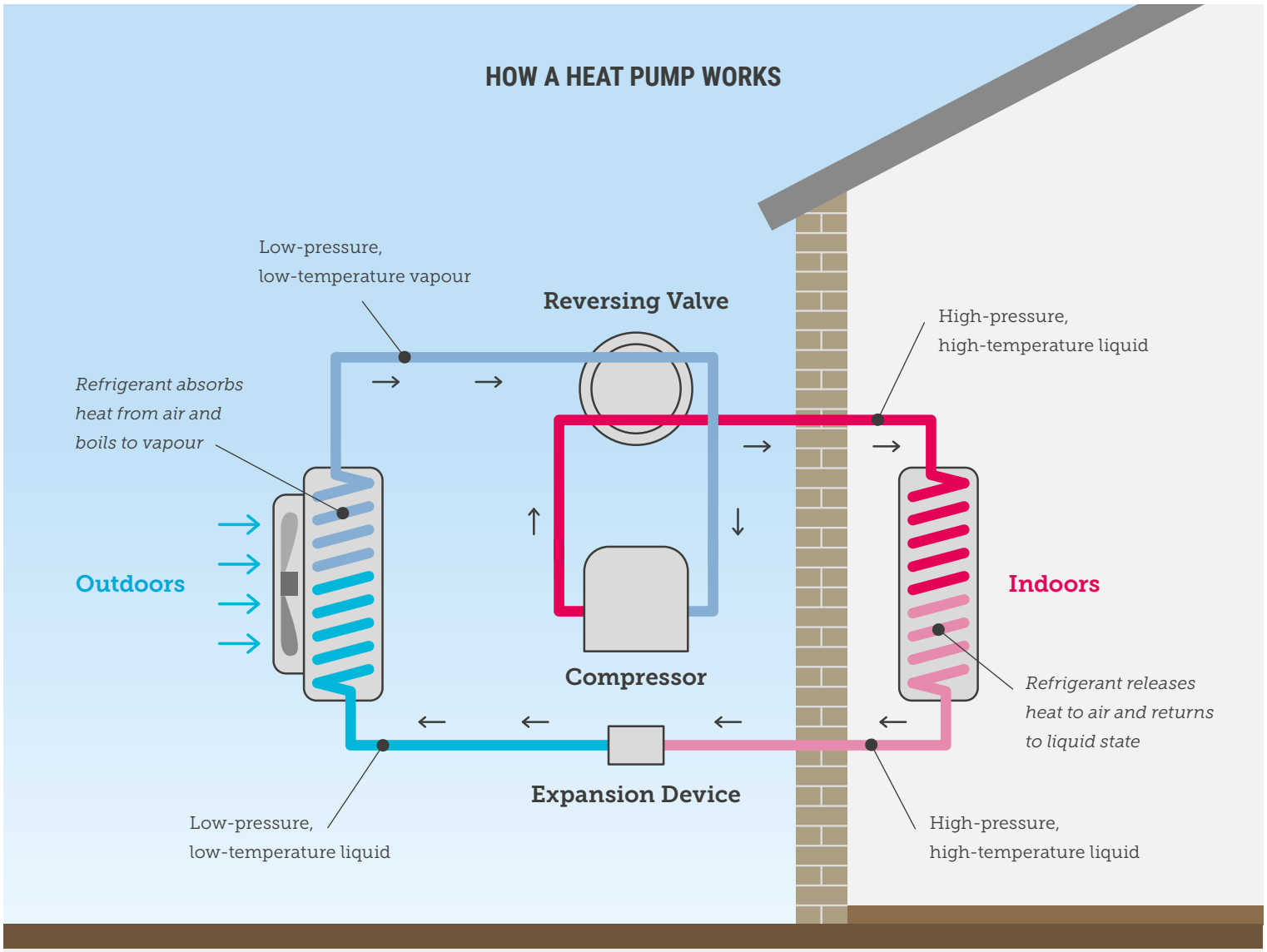
Heat pumps are an efficient means of providing heat or cooling for water, air or industrial purposes. Rather than burning a fuel or using electricity to heat a coil, heat pumps source energy from the immediate environment – from the air, the ground or nearby water.

Through physics and the laws of thermodynamics, an air-source heat pump can heat a home to a comfortable temperature using heat from the outside air even when that outdoor temperature is as low as -5°C. The only energy used by a heat pump is the electricity needed to transfer the energy through the system and to support other functions of the system. This includes, for example, the energy needed to power fans that blow heat from the pump into a room. Because heat energy is provided by the immediate environment, heat pumps provide heat far more efficiently and cheaply than a gas heater.

Reverse-cycle air conditioners use heat pumps, although they operate in opposite ways when heating and cooling (see Figure 4 below). An electric motor drives a compressor that concentrates the heat to a higher temperature, which is then expelled into the room. Or when cooling, the system works in reverse, blowing cold air into the room and dumping hot air outside. Heat pump hot water systems work in the same way but instead of hot air, the hot gas is used to heat water (Figure 4).

Figure 3: Air source heat pumps are the most common type of heat pump. The number installed in Australia has continued to increase over the years, from 7,822 in 2015 to 31,094 in 2020 (Statistica 2022).

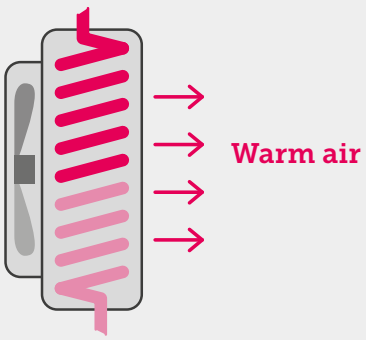
Figure 4: How a heat pump works to heat air and water.



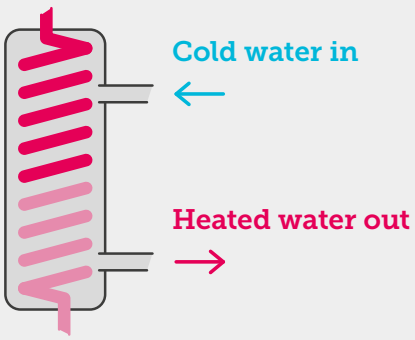
WHERE THE HEAT ENERGY IS USED

A heat pump works in the same way for reverse cycle air conditioners and hot water heaters. When the cycle is reversed for air condtioning, the inside unit blows cold air into the home and sends hot air outside of the house.

Indoors – Air conditioner



Outdoors – Water Heater



Induction cooking

Conventional electric stoves use electricity to heat either a metal coil or a ceramic plate, which then heats the pot or pan. Today, induction stoves are an increasingly popular, affordable and more efficient option.

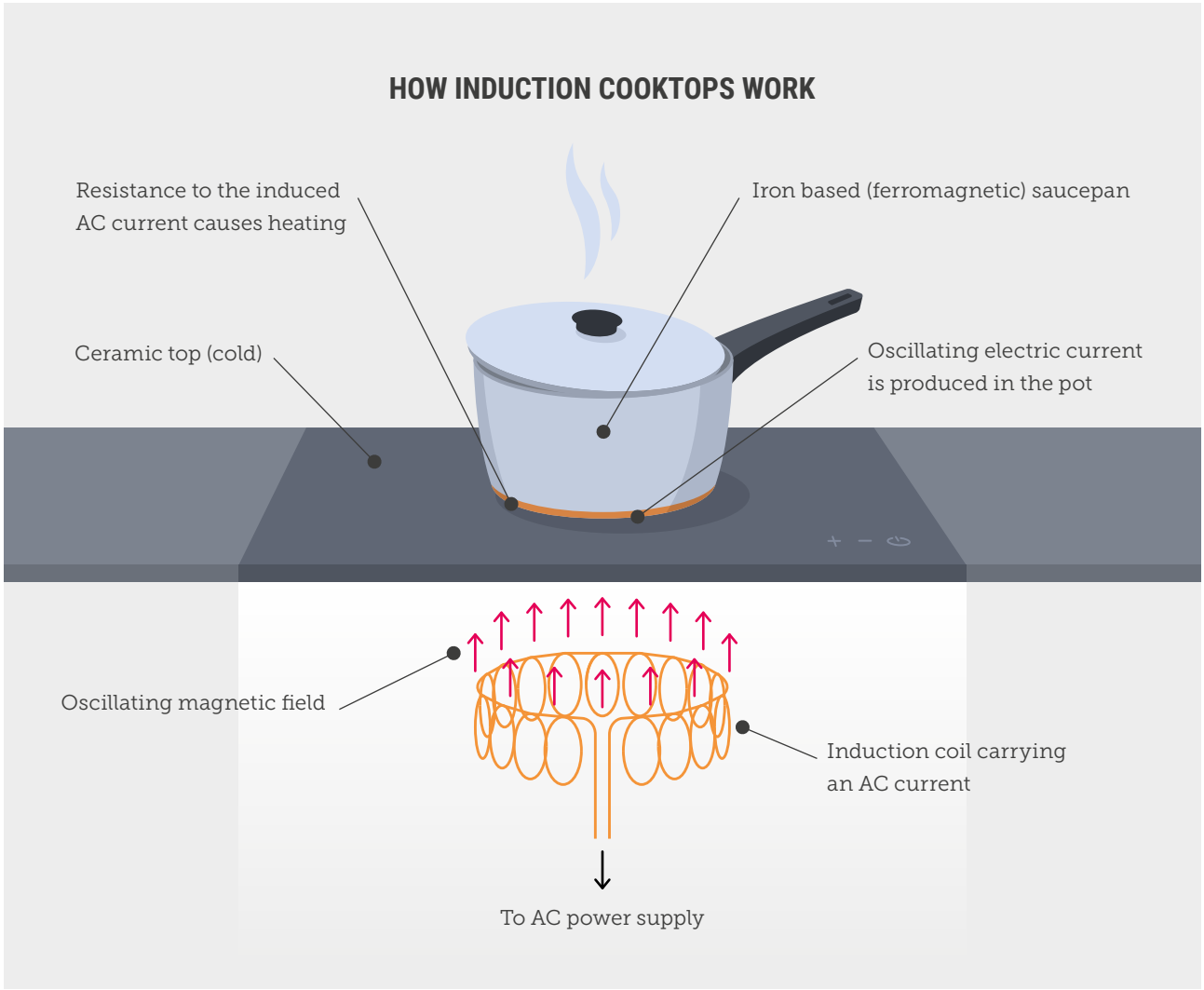
The process of induction uses magnetism to create a current through the pot or pan (Figure 6). The pot or pan effectively acts as the heating element itself, by resisting the current and producing heat. Because the heat comes from the pot or pan itself and is delivered straight to the food, an induction stove is more efficient than coil or ceramic stoves, and far more efficient than a gas stove - which wastes a lot more heat.

An induction stove also allows cooks to quickly and easily control the cooking temperature. When an induction stove is turned down, the only heat that remains is what is stored in the pot or pan. That's similar in levels of control to using a gas flame, but is significantly cheaper to run. When using an induction stove, the pot or pan needs to be made from ferrous material - that is, a magnet will stick to them. Fortunately, most pots are already made of magnetic metals.

When induction cooktops were first introduced in the 1970s, they were more expensive than other types of cooktops and some remain so. However, there is now an enormous range of options available with some induction cooktops costing as little as $300 - similar in price to the cheapest gas cooktop available online. There are also portable induction hobs available that cost well under $100. Induction also gets hotter than gas - on average, induction cooktops reach a maximum temperature of 352°C, compared to just 220°C for gas. While radiant electric cooktops can get hotter—394°C on average (Reviewed 2022).

Figure 5: An induction stove only heats the pot, not the stove surface. Even if the stove is accidentally turned on or someone has forgotten to turn it off, the surface still remains cool.

Figure 6: How induction cooktops work.



3. Comparing the pair: the costs and emissions of gas versus electric

For historical reasons, most Australian households meet their energy needs through a combination of different fuel sources - shared across electricity, piped or bottled gas, and wood burning.

Across the country a little over half of all residential energy is met by electricity, and a little less than 40% comes from piped gas, with the remainder from bottled gas and wood (EnergyConsult 2020). However, as shown in Table 1, there are big differences between different states and territories in the combination of fuel sources. In Tasmania and Queensland overall residential gas use is very low. Whereas in Victoria and the ACT more than half of all energy used in homes comes from piped gas.

Table 1: How homes are powered in different states or territories (**Data source:** EnergyConsult 2020).

	Electricity	Piped Gas	Bottled gas	Wood
National	53%	38%	3%	6%
NSW	69%	23%	3%	5%
VIC	29%	65%	1%	5%
QLD	84%	8%	6%	2%
WA	58%	31%	4%	8%
SA	60%	28%	3%	8%
TAS	63%	5%	2%	30%
ACT	41%	56%	1%	2%

Note: totals may not add to 100 percent due to rounding.

Using gas to power households costs families in many ways - and those costs are rapidly rising. Even if you choose not to use a single gas appliance, being connected to the gas network will still cost you hundreds of dollars per year in daily supply charges (Table 2). Houses connected to mains gas that go fully electric are able to avoid this ongoing cost by disconnecting from the gas supply network, but getting disconnected from gas also costs money.

Over 3.2 million Australian households already have rooftop solar installed (DCCEEW, 2022), and for these families much of the electricity being used in the home during the day is essentially free of charge.

Our calculations show that even for those relying solely on electricity from the grid, households in every Australian capital city[1] would save hundreds if not thousands of dollars per year on their bills by shifting from costly gas appliances to efficient electric alternatives. They would also be free of the significant health risks associated with burning toxic gas in their homes, and collectively help address the climate crisis by reducing household greenhouse gas emissions.

Table 2: Average annual gas supply charge (ongoing connection cost) for current retail gas and electricity plans in Australian capital cities.

	Average annual gas supply charge
Sydney	$209.18
Melbourne	$279.85
Adelaide	$271.78
Brisbane	$264.11
Canberra	$251.47
Perth	$77.76
Hobart	$208.19

Households in every Australian capital city would save hundreds if not thousands of dollars per year on their bills by shifting from costly gas appliances to efficient electric alternatives.

1 We have not included Darwin in our analysis because publicly available date on gas prices was not available.

HOUSEHOLD COST SAVINGS

Once electric appliances are in use, families can save significant amounts of money every year in bill savings - of between $514 and $1,899 as shown in Table 3 - compared to those stuck using gas appliances.

The total bill savings have been calculated by combining heating, cooking, and hot water bills for an example household using gas appliances per year, including daily connection fees for gas, compared to the combined bills for a household with electric appliances at the same level of use, including the removal of daily gas supply fees (see Methods for further details on calculations and assumptions).

Table 3: Yearly bill savings based on total gas bill vs electricity bills with lower and higher priced appliances.

	Yearly bill savings low priced appliances	Yearly bill savings higher priced appliances + solar hot water
Adelaide	$1,051	$1,457
Brisbane	$1,135	$1,424
Canberra	$1,561	$1,876
Hobart	$1,594	$1,899
Melbourne	$943	$1,207
Perth	$514	$803
Sydney	$608	$924

Appliance costs and payback times

There are, of course, costs associated with buying new appliances, potential upgrades to wiring and electrical infrastructure in homes, as well as removal costs of old gas appliances.

Most of the time, we buy things for use and not for investment. However, when we have a choice between two items that serve the same purpose we can end up being better or worse off in the long run when calculating not only the purchase cost but also the running costs. For example, a car may be more expensive to buy up front but have cheaper running costs because it is more fuel efficient. If you own the car for more than 10 years you may end up saving money over time by purchasing the more expensive but more efficient model. Some purchases, like rooftop solar, should be viewed as an investment rather than only a purchase, because by installing rooftop solar, families make such significant savings in power bills that the upfront purchase is effectively "paid back" over time through these bill savings. It is the same case with electric appliances.

It is challenging to calculate average payback times due to the enormous variety in the types of appliances that people already have in their homes, as well as those available to purchase. In short, there are now electric appliances available that suit a wide range of budgets.

In our calculations we present two payback scenarios. The first is based on someone buying lower-priced electric appliances ($7,818): a less efficient heat pump hot water system, three of the lowest cost reverse cycle air conditioners, and the least expensive induction stove. The second scenario is based on someone buying higher-priced appliances ($14,936): the most efficient hot water system (solar hot water with electric boost, which is also the most expensive option), three median-priced reverse-cycle air conditioners, and a median-priced induction cooktop. Savings are based on comparing these purchases with ducted gas heating, instantaneous gas hot water, and a gas stove and oven. Both scenarios include installation costs as well as a further $3,000 for electrical upgrades and other associated costs.

Table 4: Payback periods in years for low and higher priced appliances based on yearly bill savings when converting from gas to efficient electric appliances.

	Low priced appliances payback	Higher priced appliances payback
Adelaide	7	10
Brisbane	7	10
Canberra	5	8
Hobart	5	8
Melbourne	8	12
Perth	15	19
Sydney	13	16

As has recently been highlighted in analysis commissioned by the Gas Appliance Manufacturers Association of Australia (GAMAA), there are also differences in costs associated with rectification and potential need for electrical upgrades (Frontier Economics, 2022). This analysis focuses on Victoria - which has a heavy reliance on gas for home appliances - and uses three archetypes, standalone homes consisting of 2, 3 and 4 bedrooms respectively although the archetypes vary as to the type of appliances already installed (Table 5). There are a number of shortcomings with the analysis, which we outline below.

The report lumps the costs of purchasing electric appliances with upgrades and concludes that costs could range between $11,508 and $41,530 for 2-4 bedroom homes. That is misleading as many homes need to replace appliances (due to breakdown etc) anyway. If we compare the cost of replacement gas with new electric appliances from the analysis, the gap between them becomes $1,276 to $27,353. Considering the savings we have calculated, a home in Victoria that did face GAMAA's stated costs would pay them off within a reasonable timeframe.

There are many efficient electric appliances available, which are affordable and ready-to-be installed.

A second major shortcoming is that the report's conclusions rely on data from a survey of appliance installers of which only nine percent responded. We know that installers were identified through GAMAA's networks and so are likely to be sympathetic to the use of gas in homes. The report also does not state how many survey respondents nine percent equates to as that information has been withheld. From media reports it is clear there are major differences between the extent of electrical upgrades that different electricians consider necessary (see AFR (2022) "$299 to $2099: switching off gas at home is harder than it should be"). This data set is at odds with our findings (see Methods) from interviewing 13 individuals from the Facebook group 'My Efficient Electric Home' who were either *in the process* of replacing gas appliances with electric or had already completed this. Each of these home upgrades represented different challenges but not one of those surveyed were required to upgrade their electrics or have other home rectification carried out at anywhere near the costs cited as possible in the industry report.

The report also suggests that hydrogen will replace gas in grid networks sometime in the future, which is highly improbable. In saying this might occur the report rightly acknowledges that this change would require all homes to replace all of their appliances to accommodate such a major change of fuel source. Assuming hydrogen costs the same as gas does now, which is unlikely because all of the network, plumbing and other infrastructure that comes into contact with hydrogen will also need replacing, homes will not only face entire appliance replacement costs but will continue to pay much higher bills than if they had just switched to cheaper electric appliances.

The analysis also uses scenarios that assume all homes have ducted gas heating and evaporative coolers that will need to be replaced. However, in Victoria less than one in two homes (roughly 43 percent) have ducted gas and only 13 percent have evaporative cooling. On top of this there are roughly 43 percent of homes with reverse cycle air conditioners already installed in Victoria (Table 5). To assume all houses have the same appliances and apply the highest switching costs across the board is misleading. Some homes will face higher costs than others depending on what appliances they are replacing but this does not mean homes should therefore avoid switching. It underscores the need for governments to provide incentives and/or low-interest loans so more households can switch sooner and start reaping the significant health and economic benefits of getting rid of gas. There are many efficient electric appliances available, which are affordable and ready-to-be installed.

Table 5: Percentage of homes with different gas and electric appliances throughout Australia (**Data source:** EnergyConsult 2020).

	NSW	ACT	QLD	SA	TAS	VIC	WA
Heating and cooling							
AC ducted and AC non-ducted (split and window/wall)*	53%	46%	79%	58%	34%	43%	63%
LPG gas non-ducted	3%	3%	1%	1%	1%	0%	1%
Mains gas ducted	2%	39%	0%**	4%	0%	43%	2%
Mains gas non-ducted	15%	14%	0%	8%	4%	15%	22%
Evaporative (mostly central)	5%	13%	2%	15%	0%	13%	18%
Water heating							
Electric storage	53%	28%	68%	33%	83%	17%	17%
Gas instant (LPG)	2%	0%	8%	5%	3%	2%	5%
Gas instant (mains)	22%	36%	7%	30%	2%	40%	35%
Gas storage (LPG)	1%	0%	4%	3%	2%	1%	3%
Gas storage (mains)	6%	24%	4%	21%	1%	27%	24%
Heat pump	2%	3%	4%	3%	4%	3%	2%
Solar electric	5%	4%	8%	4%	2%	1%	11%

* Percentage of houses with reverse cycle, non ducted airconditioning have been calculated by assuming 2.5 split systems per household. This is likely to mean the number of houses with split system air conditioning is higher.

** Where a zero value is listed, the percentage of houses is below 0.5 percent

The advantage of rooftop solar

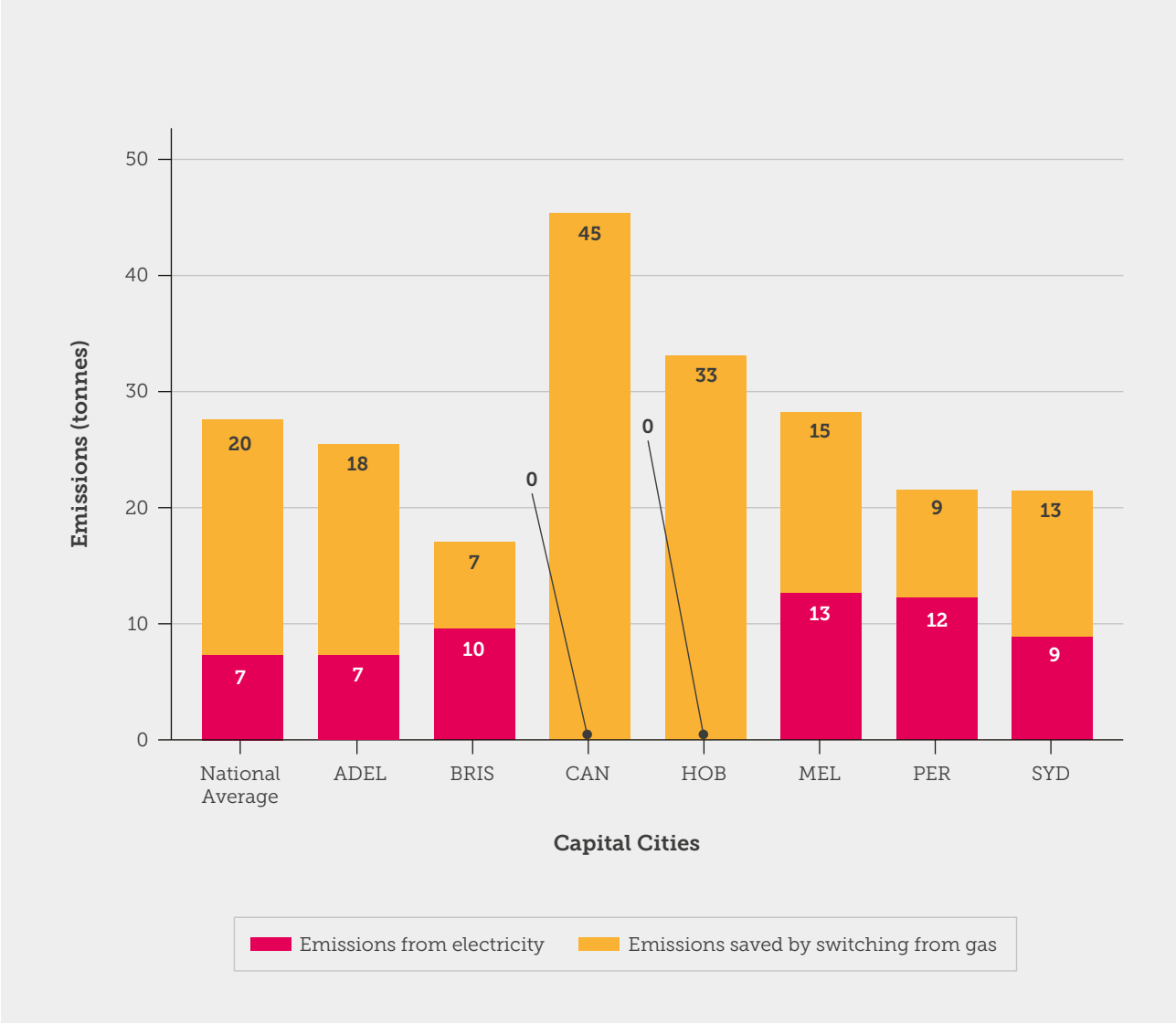
For Australians living in one of the more than three million homes with solar panels on the roof, switching to electric appliances is a no-brainer. While the full savings will depend on how effectively each household makes use of the solar energy collected on their own roof and virtually free, having electric appliances allows a household to take full advantage of the power it's already generating. In short, this saves a household even more money over the life of the solar system. For example, a Sydney home that electrifies with lower-cost appliances and generates half of their increased electricity use via their own rooftop solar would pay back the upfront costs of the conversion in as little as eight years - rather than 15. Once appliances were paid off, the household would save $800 per year on their energy bills at current rates.

CLEANER AND SAFER

In addition to substantially lowering household energy bills, getting off gas (a fossil fuel) also reduces greenhouse gas emissions. We have calculated total emissions saved based on average yearly use of heating, hot water and cooking per household over 10 years, factoring in the projected decarbonisation of electricity grids. Since Canberra already has 100 percent renewable energy, the savings calculated are the gas emissions avoided over that period. A similar situation occurs in Hobart, which relies mainly on hydroelectricity, which is close to zero emissions.

As Table 1 shows, 38 percent of homes in Australia use gas for some or all of their cooking, heating, and hot water needs. Assuming all of these homes switched all their gas appliances to electric ones, the maximum national, average emissions savings over the next 10 years would be just under 87 million tonnes of greenhouse gas emissions, or the equivalent of a sixth of Australia's total total annual emissions. That equates to 20 tonnes of emissions per home saved - equal to the yearly emissions from just over ten cars.

Figure 7: Total emissions savings between gas and grid-connected electric cooking, heating and hot water per house over 10 years.



Average emissions savings over the next 10 years could be the equivalent of a sixth of Australia's total annual emissions.

COMPARING THE PAIR: BY APPLIANCE TYPE

Hot water heating

Families can enjoy big savings if they rely on solar or electric heat pumps for their hot water. On average, across capital cities, the mid-range heat pump costs $158 less per year to run than gas instantaneous, a state-of-the-art heat pump would cost $408 less to run per year, and solar hot water costs $469 less. Electric storage hot water is by far the least efficient, and therefore most expensive, costing almost seven times the amount to run than solar hot water does.

We have compared a number of different water heater types based on 160 litres of hot water use per day. We have not calculated costs for off-peak tariffs, which some homes use. It would be much smarter for households to be heating hot water during the day when solar PV generation is high across the electricity grid, and this approach is being trialled by South Australian Power Networks (SAPN, 2022). If a home already has rooftop solar installed, up to 48 percent of the water heating load can be provided (Yildiz et al., 2021), meaning a household will save almost 50 percent more on their hot water bills compared to a household without solar. Below we have presented the increased bill costs homes using instantaneous gas hot water heating will experience compared to other efficient electric options.

Table 6: Additional bill costs using gas instantaneous rather than different electric hot water heaters.

	Gas instant vs solar	Gas instant vs high efficiency heat pump	Gas instant vs mid range heat pump
Adelaide	$530	$450	$124
Brisbane	$733	$677	$444
Canberra	$407	$345	$92
Hobart	$519	$459	$213
Melbourne	$336	$284	$72
Perth	$356	$299	$67
Sydney	$406	$344	$91

Room heating

It is important to highlight that efficency upgrades to the home, including insulation and draft sealing among others, are vital to reducing bills on top of appliance replacement.

On average, reverse-cycle air conditioners are much cheaper than other room heating options on the market. To be precise, on average they are $316 cheaper to run per year than a standing gas heater, $614 cheaper to run than ducted gas, and $908 cheaper than plug-in electric heaters.

Below we have calculated the total yearly cost for room heating in capital cities based on the requirements of an average-sized new home with a 6-Star energy rating using a variety of heater types. It is important to note that many existing homes are not rated at 6 Stars, and as a result are much more uncomfortable to live in and more expensive to run. The current standard for new homes is 6-Stars, but all States and Territories have committed to raising this standard to 7 Stars for all new homes under the National Construction Code. The total bill saving would remain the same though the bills themselves would increase if a household has a star rating lower than 6 (and is less energy efficient), and would decrease with a higher star rating (because it would be more efficient and therefore use less energy overall).

For ducted gas systems there is highly likely to be heat leakage from the ducting, which means they are not delivering 100 percent of the heat created. One Australian study found leakage from older ducting could be up to 58 percent (average of 35 percent) and - even when upgraded - ducted systems still lost an average of 17 percent of heat (Palmer 2008). The below calculations include leakage of 17 percent, which increases the ducted gas bill and, therefore, the potential bill savings from switching to reverse-cycle air conditioning.

In a 2016 study Sustainability Victoria found that if a household chose to upgrade their ducting they would save an average of $177 per year in lower energy costs with the cost of upgrading being $2,849. This would mean it would take such a household an average of around 16.1 years to pay back the costs of upgrading based on bill savings. Because you will continue to pay higher bills for ducted gas heating, households would be better off simply replacing the system and using the upgrade costs to fund reverse-cycle air conditioners. Further leakage calculations can be found in the Methods.

Table 7: Additional bill costs using gas or plug in electric heating rather than reverse-cycle air conditioners in capital cities.

	Standing gas vs reverse cycle	Gas ducted vs reverse cycle	Plug in electric vs reverse cycle
Adelaide	$292	$595	$970
Brisbane	$182	$290	$215
Canberra	$572	$1,172	$1,938
Hobart	$612	$1,094	$1,286
Melbourne	$481	$554	$932
Perth	$157	$332	$583
Sydney	$128	$264	$436

Cooking - stovetops and ovens

Electric cooktops of all varieties assessed came out cheaper to run than the gas options due to the relative efficiency of each energy source. In some cities electric ovens were found to be more expensive to run than gas but that still didn't outweigh the overall savings from switching to induction cooktops. This means that by replacing a gas cooktop and oven with an induction cooktop and electric oven, households can still save between $11.79 and $111.16 a year depending on where they live around Australia.

We calculated cooking costs using average capital city electricity and gas prices, and then measured energy use of different cooking methods: boiling water, simmering water for 15 minutes after boiling (such as for cooking pasta), and sauteeing a hamburger patty. Our energy use calculations assume a household would be boiling then simmering just under 7 litres of water once a day and sauteeing two dishes per day, for 260 days of the year. There are likely to be large differences in how people cook. However, the below calculations allow us to compare appliances on a precise "like for like" basis, with electric stoves clearly coming out on top. As cooking frequency increases, so too would the bill savings from switching to electric.

The running costs saved by switching a household's cooking appliances from gas to electric are lower than what you save when switching out gas room heating and hot water. However, a home that chose to electrify its heating and hot water but keep a gas stove and/or oven would still have to pay gas connection fees, which average $223 per year across capital cities (see Table 8). This means that even in those instances where a gas oven might be slightly cheaper to run, the total costs of having a gas oven is far higher than electric.

Table 8: Bill cost increase and decrease between gas cooktop and induction cooktop and gas oven versus electric oven.

	Gas burner vs induction	Gas vs electric oven	Total saving
Adelaide	$24.38	$0.21	**$24.54**
Brisbane	$92.03	$19.18	**$111.16**
Canberra	$17.95	-$0.09	**$17.82**
Hobart	$45.01	$6.58	**$51.59**
Melbourne	$14.09	-$0.32	**$13.72**
Perth	$12.84	-$1.00	**$11.79**
Sydney	$17.70	-$0.14	**$17.58**

4. Accessing the benefits of getting off gas

Making the switch from gas to electric is a win for reducing our costs of living as well as our climate. So how do we make it happen? We need coordinated action from the national level down to individual households, so we can convert millions of homes that already exist while also making it easier for households to go all-electric in the years ahead.

HELPING HOUSEHOLDS MAKE THE SWITCH

Getting off gas will save households hundreds of dollars a year in energy bills, but the upfront cost of replacing appliances can trap families into higher cost gas. For example, the cost of replacing gas water, room heating and cooking appliances with electric alternatives can range from roughly $7,800 to many tens of thousands of dollars depending on the brand and model chosen as well as installation costs. Government incentives can play an important role in removing this cost barrier. These can take the form of direct grants, or low- and zero-interest loans as households can quickly pay back the loan amount using annual bill savings.

Figure 8: In addition to cost savings and emissions reduction, switching from gas to electric has significant health benefits, especially for young children. Young children suffer high exposure to household air pollution from gas stoves and heaters as they spend a larger part of their day at home compared to older children and most adults, and also have higher vulnerability as they are growing and developing (Climate Council 2021).

CASE STUDY: HOW SMART INCENTIVES ARE CREATING A GAS-FREE CAPITAL

The Australian Capital Territory Government has committed to phase out gas entirely in the nation's capital by 2045. It is helping Canberra households prepare for this change with a number of incentive schemes that address the upfront costs of going all electric.

The Sustainable Household Scheme provides zero-interest loans of up to $15,000 for home upgrades that improve energy efficiency and reduce environmental impacts. Households can borrow money with zero interest to buy new electric appliances, as well as install solar panels and/or batteries. With up to 10 years to repay the loan and no upfront costs or fees, the scheme makes healthier and cheaper electric appliances much more accessible to households.

The ACT Solar for Low Income program also provides direct grants of up to $2,500 for concession card holders - including seniors and pensioners - to help with the cost of installing solar panels on the roof to generate renewable power.

Together, these incentives make it very affordable for eligible households to get off gas and immediately start enjoying the energy savings and health benefits.

Figure 9: The ACT Solar for Low Income program is the first stage of the ACT government's Home Energy Support Program. Overall $50million has been committed over four years to improve building efficiency and sustainability for social and public housing, low-income owner occupiers and low performing rental properties.

Recommendation:

1. Implement government incentives and/or strengthen their uptake to help households with the upfront cost of new electric appliances.

Low- and zero-interest loan schemes can be particularly helpful because they address the upfront purchase and installation costs for households and are more affordable for governments to provide at scale than direct grants. The Climate Council (2022) has prepared a dedicated guide for governments, How concessional financing can help reduce emissions.

Unfortunately, it isn't just the cost of buying electric appliances that can be a barrier for Australian households trapped on gas. Disconnecting your home from the gas network can also be expensive and time-consuming, as companies don't want to make it easy for customers to leave. One of Australia's largest domestic gas retailers cites fees between $798 and $1,300 to remove a household connection (ActewAGL 2022), a huge and unreasonable cost that locks many people into the gas network even if they'd prefer not to be.

Recommendation:

2. Investigate and seek to remove the fees and charges involved in ending gas connections to homes.

As a first step, governments should establish what it actually costs for utilities to undertake disconnections to determine whether they are over-charging people to discourage them from leaving their networks. Governments should then consider updating regulations to dictate reasonable costs that utilities are allowed to recover from customers, as well as subsidies for removals that are genuinely complex or expensive.

Recommendation:

3. Coordinate with utilities and communities to explore disconnecting gas and upgrading electricity supply to whole suburbs or regions in one go.

As more and more individual households disconnect from gas it doesn't make any sense for utility companies to do this work in a piecemeal or ad hoc fashion. That's why governments should coordinate with power providers to explore options for disconnecting entire streets, suburbs or regions from gas wherever the community wants this. Undertaking community-level pilots and collaborative planning involving different levels of government - including local councils - will give residents more control over their energy future. People-powered initiatives like Totally Renewable Yackandandah show what's possible when communities come together; and utility companies and governments can help get more projects like this get underway.

Figure 10: The financial and health burdens of household gas consumption fall disproportionately on low income and vulnerable households, who are also least able to afford the upfront costs of switching to electric. For a just transition, these groups must be given priority as Australia switches from gas to electric.

Recommendation:

4. Provide free electric home upgrades to people on very low incomes - including upgrading public and social housing as a priority.

Of course, there are some households that simply won't be able to afford to switch from gas to electric because they are living on very low incomes. No-one in our community should be forced to keep paying ever-higher prices in a volatile energy market or suffering the ongoing health impacts of using gas in the home. It is essential that governments deliver programs to upgrade the homes of the most vulnerable Australians to be all-electric, such as incentives available in Victoria, South Australia and Queensland.

Where these programs are already in place, they should be scaled up significantly to ensure that every one of Australia's 425,000 public, social and Indigenous community homes runs on clean, and cheap electricity.

STOP TRAPPING FUTURE HOUSEHOLDS INTO HIGHER BILLS

In early 2022 the price of gas spiked massively across Australia as international demand combined with local supply challenges put our market under pressure. This has flowed directly through to households. These higher prices are expected to continue into 2023 and beyond as the world searches for alternative sources to Russian gas and more dirty, unreliable coal-fired power stations start to break down more often as they reach the end of their working life.

The best way out of this energy mess is to get off gas for good. That's why it's important we stop locking households into paying higher bills in future, by continuing to connect new homes to gas. Instead, we should be building new homes to be all-electric and ensuring that as gas appliances reach the end of their working life, they can only be replaced with electric alternatives.

As we've seen, disconnecting from gas can be an expensive and unnecessary cost, on top of the price of new electric appliances. Last year, more than 177,000 new homes were built in Australia (ABS, 2022). Many have some kind of gas connection because in some states, including Victoria, gas connections are currently mandated and in others it's because housing developers imposed the connection on households (Renew Economy, 2019). Changes are occurring in a number of states to remove mandatory connections no matter who is imposing them (Renew Economy, 2022). Any new home built today with a gas connection will eventually have to be disconnected as Australia strives towards net zero emissions, so why not build them all-electric from the start?

A 2021 Renew study looking at the costs of building a new home in Western Australia found that regardless of where homes were built or the electricity tariffs applying in that region, it is more economic to build all-electric because of the improved efficiency of electric appliances and the avoided costs of gas connections and fees. The building industry is also starting to get onboard, with all-electric housing estates popping up in cities like Melbourne (CEFC, 2021) and Canberra (Ginninderry, 2022) demonstrating what's possible.

Recommendation:

5. Ban gas connections to new homes as soon as possible to avoid higher bills today and future disconnection costs for households.

Federal, State and Territory energy ministers should agree on a national approach and timeframe for banning gas connections to new homes including apartments, taking into account both new-build estates and brownfield projects. Coordinating this step nationally will help ensure that projected increases in electricity demand can be factored into planning for the broader transformation of Australia's energy networks that is now underway.

In addition to ending gas for new homes, we should seek to ensure that gas appliances in existing homes are replaced with cheaper, cleaner electric alternatives when they reach the end of their working life. Often when appliances break down, households need to replace them urgently. That means they will reach for whatever is most readily available. At the moment, retailers and installers usually suggest gas appliances because this might be what homeowners are familiar with or they may not be aware of how the different running costs compare. Requiring gas appliances to be replaced with electric ones is an important way to shift this dynamic - giving households better options by ensuring the retail industry provides up-to-date advice about the reliable, affordable and clean electric appliances available.

CASE STUDY: VICTORIA ON THE MOVE, AWAY FROM GAS

In 2022 the Victorian Government delivered a Gas Substitution Roadmap as part of the state's transformation to a net zero economy. Victorians currently use more gas in their homes and businesses than any other jurisdiction around Australia - with more than two million users (State Government of Victoria, 2022).

Under the Roadmap, new homes built in Victoria are no longer forced to be connected to the gas network. The Victorian Government is also phasing out all household incentives for the installation of gas appliances from 2023.

This is an important first step towards helping households get off gas, by ensuring that people building a new home have more choice and control over their energy future, cheaper running costs and healthier homes.

Recommendation:

6. Mandate the replacement of gas appliances with more efficient electric alternatives from 2025.

Individual states and territories could mandate replacement with electric appliances within their own jurisdictions, but there is also the opportunity to coordinate a national approach. Getting this mandate in place as soon as possible is important because household appliances can have a lifespan of more than a decade, so every gas cooktop or hot water service sold today will likely stay in service well into the 2030s.

Recommendation:

7. Coordinate with utilities, retailers and communities to explore the implementation of tariffs that take advantage of high solar generation during the day.

Rather than off-peak tariffs occurring at night, it would be much smarter for households to be heating hot water during the day when solar PV generation is high across the electricity grid, and this approach is being trialled by South Australian Power Networks (SAPN, 2022). This would help to overcome the duck curve - that is, periods of very low demand in between the morning and evening peaks. If hot water, and other shiftable loads such as air-conditioning pre-cooling of homes, were moved to the middle of the day, it would increase use of low-cost solar generation and reduce reliance on fossil fuel generation at night.

AUSSIE-MADE PRODUCTS

Helping households go all electric won't just save families money on power bills - this switch can also create a lot more great Australian jobs if we encourage local manufacturing of key products like heat pumps, solar panels and batteries. Upskilling construction workers, electricians and plumbers to work with the latest all-electric appliances will help grow the workforce Australia needs for our zero-emissions future, and ensure working Australians also benefit from the change.

Australia is rich in many of the raw materials for manufacturing the inputs of an all-electric home. For example, manufacturing heat pumps calls for large quantities of copper and aluminium - two minerals that Australia has more of than almost every other country in the world. Manufacturing home batteries needs inputs like lithium, cobalt and nickel; all minerals our wide brown land is also generously endowed with.

Rather than sending our minerals offshore as lower value raw materials, there is a huge opportunity to boost processing and advanced manufacturing with them here at home. One analysis forecasts global heat pump demand to hit 450 million units by 2030, more than doubling the number sold in 2022 (Rystad Energy, 2022). This could rise as high as 1.5 billion units by 2050, contributing to a new clean manufacturing jobs boom as the world decarbonises.

The COVID-19 pandemic provided a wake-up call about the vulnerability of global supply chains and the risks that come with being overly reliant on international markets. Given the speed and scale at which Australia needs to electrify, we should work to ensure the key products households need to make this switch are manufactured locally so they are widely available.

Recommendation:

8. Invest to grow Australian manufacturing of heat pumps and other critical all-electric equipment.

The Albanese Labor Government has committed $1 billion towards an Advanced Manufacturing Fund with the manufacturing of renewables and low emission technologies to be a key focus (ALP, 2022a). There are also other potential funding streams available through agencies like the Clean Energy Finance Corporation and Export Finance Australia, as well as state and territory government investment programs. Governments should coordinate this investment to ensure there is focused support for local manufacturing businesses to start up and scale up to meet Australia's - and the world's - demand for more electric household appliances.

As well as creating new jobs, the move to all-electric homes will mean many existing workers need upskilling on how to choose, install and work with new appliances. This will be important to ensure industry figures can be advocates for the uptake of new electric equipment, not barriers to it. This will also ensure that workers have the skills they need to meet rising customer demand and stay safe on the job.

Recommendation:

9. Partner with building industry peak bodies, unions and trades associations to educate retailers, tradespeople and installers about great all-electric alternatives to gas appliances.

There is an immediate opportunity to train more workers in the building, construction and electrical sectors to work with all-electric homes through the Australian Government's New Energy Apprenticeships initiative (ALP, 2022b). It will be essential that the criteria for this program includes training workers who can deliver Australia's shift away from gas. Shorter courses to upskill existing workers in these sectors should also be considered as a priority in the design of a new approach to micro-credentialing through the next National Skills Agreement.

THINK NATIONAL, ACT LOCAL

Governments have an important role to play in helping Australians start saving by getting off gas. With more than five million Australian homes connected to a gas network (Energy Networks Australia, 2021), it's a big task to convert them all to electric heating, cooking and cooling.

Households want to do their bit, but leaving it to individuals will mean a messy, disjointed and more expensive transition. This risks exacerbating challenges with coordinating an orderly shift to renewables across Australia's energy networks, if governments and utilities don't have visibility of how, when and where demand for different types of power will change.

Recommendation:

10. Federal, State and Territory energy ministers coordinate a national switch away from gas for Australian households.

It's exciting that energy ministers are already designing Australia's future energy system, with work underway to plan for, and deliver, the supply and transmission of more than 80% penetration of renewables into the grid by 2030. However, this work needs to be informed by a national, coordinated plan for getting households off gas so that regulators, investors and planners understand exactly how much clean energy supply we'll need.

A nationally-coordinated transition will be smoother and more predictable for everyone. As a step towards this, energy ministers should commission a detailed analysis of the costs and benefits of removing gas connections from all homes across Australia. This should particularly consider the benefits to households in avoided bill costs, as well as the emissions reduction benefits from the change.

Recommendation:

11. A detailed national analysis examining the costs and benefits - including emissions reductions - of getting rid of gas in all Australian homes.

The Regulatory Impact Analysis process laid out by the Office of Best Practice Regulation (2020) provides a clear and transparent method of assessing costs and benefits for major reforms. It requires in-depth consultation with experts, stakeholders and the community, to ensure governments hear from a wide range of voices as part of preparing the assessment. Commissioning a Regulatory Impact Analysis would provide a solid basis for governments, industry and the community to understand what the pathway to a future without gas in homes could look like.

SUMMARY OF RECOMMENDATIONS FOR DIFFERENT LEVELS OF GOVERNMENT

All Governments	Coordinate with utilities and communities to explore disconnecting gas and upgrading electricity supply to whole suburbs or regions in one go.	Recommendation 3
	Provide free electric upgrades to people on very low incomes - including upgrading public and social housing as a priority.	Recommendation 4
	Mandate the replacement of gas appliances with more efficient electric alternatives from 2025.	Recommendation 6
	Coordinate with utilities, retailers and communities to explore the implementation of tariffs that take advantage of high solar generation during the day.	Recommendation 7
	Federal, state and territory Energy Ministers lead national coordination of the transition away from gas for all Australian households	Recommendation 10
Federal Government	Invest to grow Australian manufacturing of heat pumps and other key all-electric equipment	Recommendation 8
	Partner with building industry peak bodies, unions and trades associations to educate retailers, tradespeople and installers about great all-electric alternatives to gas appliances	Recommendation 9
	Undertake a detailed national analysis examining the costs and benefits - including emissions reductions - of getting rid of gas in all homes across Australia.	Recommendation 11
State and Territory Governments	Implement government incentives and/or strengthen their uptake to help households with the upfront cost of new electric appliances.	Recommendation 1
	Investigate and seek to remove the fees and charges involved in ending gas connections to homes.	Recommendation 2
	Ban gas connections to new homes as soon as possible to avoid higher bills today and future disconnection costs for households. (Together with Local Governments.)	Recommendation 5
Local Governments	Ban gas connections to new homes as soon as possible to avoid higher bills today and future disconnection costs for households. (Together with State and Territory Governments.)	Recommendation 5

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