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Getting off gas

Why, how, and who should pay?

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This report was written by Tony Wood, Alison Reeve, and Esther Suckling.

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Overview

Australia will not hit its 2050 net-zero emissions target unless it gets off natural gas. Getting off gas will be complex for governments and difficult for many people – but delaying action will only make it more so.

Governments should start by ensuring all Australian homes become all-electric. All-electric homes are cheaper to run and better for people's health. Alternative technologies such as hydrogen or biomethane are too costly and too far off for widespread use in homes and small businesses.

It's a big task. About five million households in Australia are on the gas network. Victoria, the state that relies most on gas, will need to take 200 homes off gas every day until 2045 to achieve net zero. Governments need to start now.

There are many barriers, and all must be addressed. They include the initial cost of upgrading houses, apartments, and rental properties from gas to all-electric, the different interests of renters and landlords, and a myriad of space, wiring, and logistical problems.

Governments should embark on a six-pronged strategy.

First, state and territory governments should provide certainty about direction and timing by setting dates for the end of gas.

Second, they should prepare and roll out long-term, consistent, targeted communications campaigns on why households should switch to all-electric, and how best to do it.

Third, they should ban new gas connections to homes, shops, and small businesses.

Fourth, they should eliminate regulatory barriers to all-electric homes.

Fifth, they need to lower the cost hurdles, because electric cook-tops, home heaters, and water heaters often cost more to buy than the gas equivalents. Governments should pay for upgrades to social, community, and Indigenous housing, and provide low-interest loans or similar financing agreements for homeowners, and tax incentives for landlords.

And lastly, at a future date, governments should phase out the sale of natural gas appliances, so that the last remaining gas appliances are replaced with electric ones.

These activities must be supported by plans to safely decommission the gas network, and upgrade the electricity grid so it can cope with the extra demand.

Governments will also need to solve the problem of industries that cannot get off gas at present. Solutions may include local industry clusters using biomethane or hydrogen. Finding these solutions will require collecting gas usage data from numerous sites across Australia.

Finally, the current approach to regulating the energy sector is simply not up to supporting this transition. It risks sending the gas network businesses into bankruptcy, or stranding some customers on a redundant, unsafe, expensive gas network – or both.

Governments will need to engage with industry and households to develop solutions that are fair to consumers, provide certainty to businesses, and ensure the network is safe to use.

To achieve net zero and get off gas requires setting targets, developing policies and plans to meet them, and solving the associated challenges. This report shows how we can do it.

Recommendations

State governments

- Set state-specific dates for elimination of emissions from using gas.
- Develop detailed policy roadmaps for reaching these goals, including decisions on who should pay and when.
- Ban new residential and small commercial gas connections.
- Fund long-term, targeted communications campaigns about the benefits and timetable for upgrading to all-electric.
- Pay for the upgrading of public housing to all-electric.
- Include ceiling insulation and all-electric appliances in minimum rental standards.
- Implement a previously agreed requirement for disclosure of building performance standards at the point of sale or lease.
- Amend the curriculum for plumbing and gas-fitting qualifications to include a restricted electrical licence.

Federal government

- Extend, for a limited time, financial support via the Clean Energy Finance Corporation for households to manage the upgrade.
- Only make funds available for home electrification in states that have:
  - set dates for elimination of emissions from gas and banning new residential and commercial connections.
  - set minimum rental standards that include ceiling insulation and all-electric appliances.
  - set appropriate safety regulations for gas network decommissioning.
- Direct Housing Australia to avoid investing in housing that uses gas.
- Pay for the upgrading of Indigenous housing to all-electric.
- Provide an instant asset write-off for landlords for the cost of new electric appliances replacing gas ones.
- Create loans to reskill mature-age plumbers and gas-fitters.

All governments

- Develop policies to build green gas supply chains for the industrial sector.
- Set minimum performance standards for cooktops, water heaters, and home heating systems, not discriminating by fuel type, that tighten over time.
- Co-fund the upgrading of community housing to all-electric.
- Require gas network businesses to include plans for the efficient and safe decommissioning of the networks in the five-year reviews with the Australian Energy Regulator.
- Move towards a single, consumer-centred regulatory framework for energy that efficiently and fairly allocates costs over time.

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1 Australia needs to get off gas

All Australian governments are committed to meeting net-zero emissions goals as part of their response to climate change. This means an end in the next few decades to using fossil fuels.

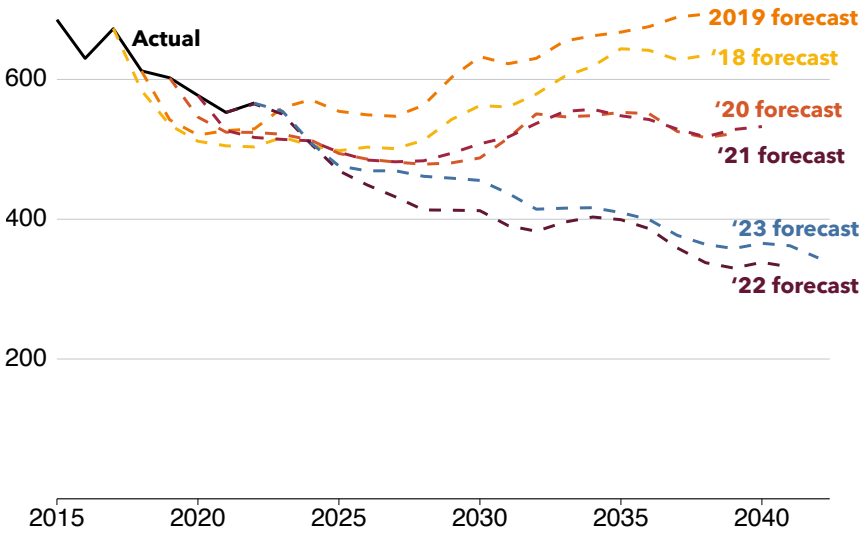
It is true that the economy will use fossil gas for a while, but the role of gas is unlikely to get larger – and ultimately it must shrink to zero to meet net-zero targets. Gas consumption forecasts are continually being revised downwards (Figure 1.1), but this decline isn't sufficient to meet net-zero emissions goals without extensive offsetting.

How we use gas in Australia varies from state to state. These different patterns mean different pathways away from gas, across different timeframes.

Gas use is associated with physical assets – from cook-tops in people's homes to furnaces in steel mills. Changing physical assets to low- or zero-emissions alternatives is a slow process. If it doesn't start today, there will be no hope of reaching Australia's net-zero emissions targets.

Getting off gas means finding substitute fuels that are net zero-emissions. For many parts of the economy, this will mean using electricity – for things like cooking and water heating, for instance. For other uses of gas, particularly industrial high-temperature heat, hydrogen or biomethane is a better substitute.

Figure 1.1: The writing is on the wall for gas in Australia
Domestic gas consumption (PJ)



Notes: Excludes gas consumed by the LNG industry. Each line represents the most likely scenario in consecutive Gas Statement of Opportunities reports: 2018 Neutral scenario, 2019, 2020, and 2021 Central scenarios, 2022 Step-change scenario, 2023 Orchestrated step-change (1.8 degrees celsius) scenario.

Source: AEMO (2018-2023).

1.1 Gas is a residual fuel

For many years, gas was considered the 'transition fuel' which would provide a bridge between fuelling economic activity with coal and oil to using renewable energy.

Increasingly this view is becoming redundant. Coal-fired electricity generators are not being replaced by gas when they are retired.

They are being replaced by renewable energy and storage, with gas providing residual capacity and balancing generation for the last 10 per cent or so.[1]

The picture is similar for industry: because of the long lifespan of industrial assets, there is no time to switch from coal to gas and then from gas to renewable hydrogen for high-temperature heat. Instead, companies are waiting for zero-emissions alternatives to become cheaper, so they can jump straight to using those.

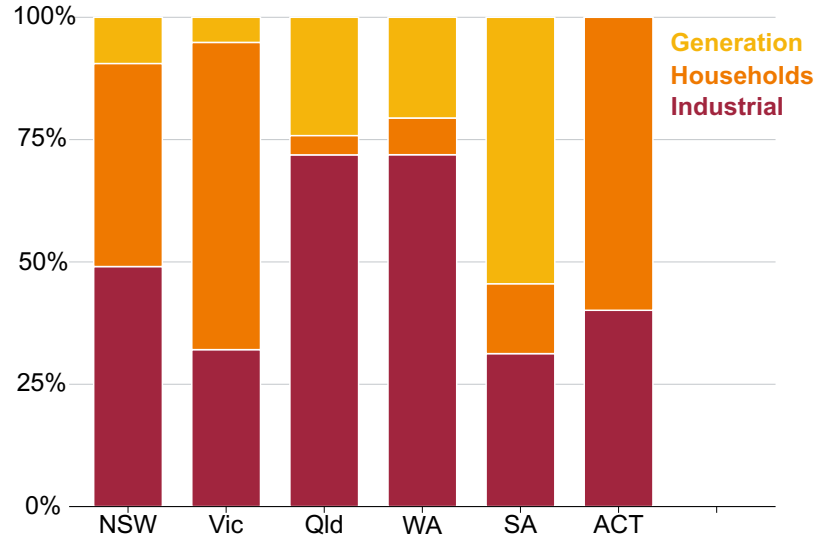
1.2 How Australia uses gas today

'Natural gas' is a naturally occurring mixture of gaseous hydrocarbons, primarily methane. It is a fossil fuel, found in underground geological formations. Once extracted and processed, it can be sent to households and businesses in pipelines, or it can be liquefied and exported as liquefied natural gas (LNG). Natural gas is burned as a fuel, or used as a feedstock for chemicals, plastics, and fertilisers. In 2020-21, Australia consumed 1,568.2 petajoules (PJ) of natural gas.[2]

'LPG' or liquefied petroleum gas is a by-product of processing natural gas or from oil refining. It is a mixture of propane and butane. It is transported to households and businesses in tanks as a liquid, and stored in these tanks or in bottles until used. It can be burned as a fuel, but different appliances are used than for natural gas. In 2020-21, Australia consumed 34.5 PJ of LPG.[3]

States use gas very differently (Figure 1.2). In Victoria and the ACT, the major users of gas are households and small businesses. In Western

Figure 1.2: States use gas differently
Proportion of gas use in 2021



Notes: Excluding LPG. No comparable data are available for NT use. 'Industrial' includes mining and mineral processing. 'Households' includes small businesses.

Sources: AER (2022a), AEMO (2022a), ACT Government (2022a).

1. Wood and Ha (2021).
2. DISR (2022), Table K.
3. DISR (ibid), Table J.

Australia and Queensland, the industrial sector is the dominant user of gas.[4] In South Australia, most gas is used for electricity generation.

Tasmania uses almost no gas, and the Northern Territory's gas consumption is almost entirely related to electricity generation and gas exports. For these reasons, this report excludes Tasmania and the NT from consideration.

In this report, unless otherwise stated, when we say 'gas' we mean natural gas delivered through a pipeline.

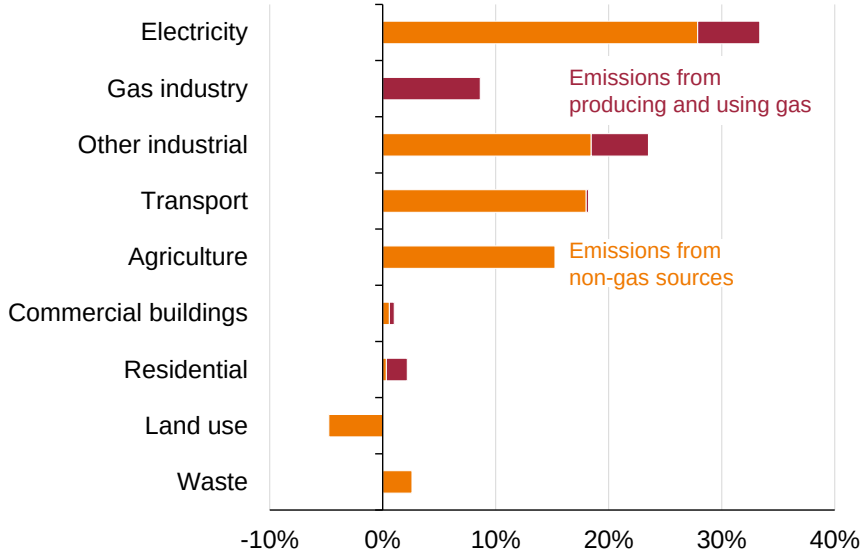
1.3 Why gas emissions matter today

Carbon emissions from producing and using gas account for 22 per cent of Australia's overall emissions (Figure 1.3). The share varies widely between states. About 7 per cent of NSW emissions come from producing and using gas. In Victoria, it is 18 per cent, and in Queensland, 15 per cent. Western Australia and South Australia are more gas-reliant: 56 per cent and 36 per cent (respectively) of their emissions come from producing and using gas.[5]

Gas emissions come from a few large sources and many, many small sources.

The large sources are generating electricity, large industrial manufacturers, and the production and processing of gas itself. The large manufacturing and gas production facilities are now covered by the revised Safeguard Mechanism, that will require them to reduce their emissions over time. The small sources are associated with residential and commercial buildings – gas for heating water, heating spaces, and cooking – and small industrial users. These sources of emissions

Figure 1.3: About 22 per cent of Australia's emissions come from producing and burning gas
% of national emissions in 2020



Note: Gas production and use includes LPG.

Source: Grattan analysis, using DCCEEW (2022a) and DISR (2022).

4. This does not include the gas consumed by the LNG export industries in these states.
5. Grattan analysis, using DCCEEW (2022a) and DISR (2022). Includes emissions from LPG. NSW totals include ACT.

are numerous and widely scattered. There are 4.5 million gas water heaters in Australian homes, 5 million gas stoves or cook-tops, and 2.7 million home heating systems using mains gas.[6]

In all sectors, emissions patterns change very slowly. Assets that use gas tend to be replaced only when they reach the end of their useful life. A gas water-heater installed today will still be burning gas in 2035. An industrial furnace installed today could still be burning gas in 2063.

To reach net zero, governments need to start changing asset replacement patterns now. Victoria and the ACT in particular are dominated by numerous small sources of emissions, and have net-zero goal dates of 2045, five years earlier than the national target date. There are currently no state or federal policies to constrain these emissions.

1.4 How to get off gas

For most uses of gas in Australia today, there are two possible substitutes: electricity, and 'green' (zero-emissions) gas. The best option depends on what the gas is being used for.

Electricity is the best solution for low-temperature heat (such as water heating, space heating, cooking, and drying). Efficient electric technology is able to deliver the same service with fewer units of energy (see Box 1).

For high-temperature heat, industrial feedstock, and power generation in some circumstances, electrification may not be the solution. Electricity can be used in some industrial processes – using an electric arc furnace to melt steel, for example. But for others, it is either physically impossible or uneconomic to substitute electricity for gas. This is particularly the case where gas is used for its chemical

6. Energy Consult (2021). Assumes every house with a gas connection has a gas stove. Excludes LPG appliances.

Box 1: How to compare gas and electricity

Comparing the merits of gas and electricity for heat requires considering their conversion efficiency: how much useful heat is produced for every unit of energy consumed.

Gas appliances are less efficient because when gas is burnt, some of the heat is lost to the surroundings rather than being transferred to whatever is being heated. Electric appliances are more efficient because heat is transferred directly to whatever is being heated, resulting in fewer losses.

For example, when water is boiled in a kettle on a gas stove, the gas flame sends heat into the air as well as the water. In an electric kettle, all the heat from the electricity goes into the water inside the kettle.

Heat pumps are a special type of electric appliance that are even more efficient that conventional electric appliances. Heat pumps contain a fluid that absorbs heat from the air. When the fluid is pumped through an expansion valve, it sheds the heat, which is then transferred into whatever is being heated. Because the heat is absorbed from the air, the only electricity used is to run the pump. Heat-pump water-heaters, reverse-cycle air-conditioners, and fridges all work this way.

Water heaters are a good example of conversion efficiency differences. Providing sufficient hot water for a family of four for a year requires about 30,000 MJ of gas used in an instantaneous gas water heater. Providing the same amount of hot water using an electric storage water heater requires about 6,500 kWh of electricity, equivalent to 23,400 MJ. Using a heat-pump water-heater requires about 3,300 kWh, or 11,900 MJ.[a]

a. Calculations using Ausgrid (2023)

molecules rather than its energy content. Making ammonia, for example, uses gas for both heat and as a source of hydrogen molecules.

1.4.1 The role of 'green' gas

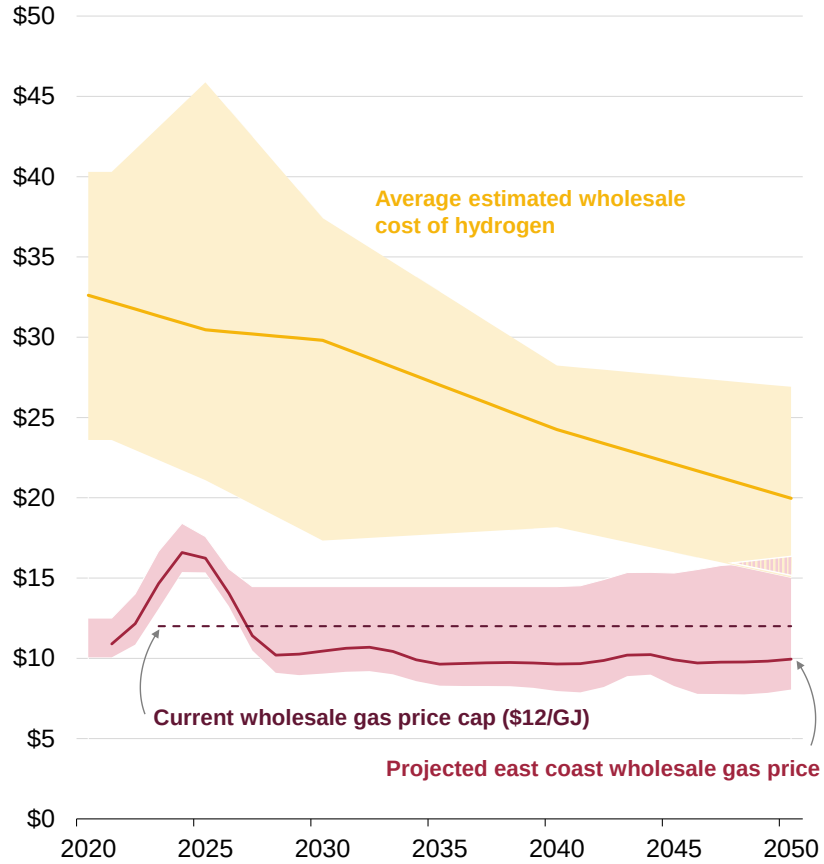
'Green gas' can refer to biomethane or 'green' hydrogen. Biomethane is chemically identical to natural gas, but is derived from biological materials such as food waste, sewage, and agricultural waste.[7] Biomethane can be transported by pipeline, and used in the same appliances as natural gas.

Green hydrogen is made by using electricity to split water into hydrogen and oxygen. Currently in Australia it is transported in gas cylinders, but there may be scope to transport it in pipelines in future.

Neither green hydrogen nor biomethane is produced or consumed in large quantities in Australia at present. Proponents of green gases argue that, if or when they are available in large amounts at reasonable prices, we could continue using existing pipelines, and current gas users – from households to factories – could keep using their gas appliances.

However, it is not as simple as switching one gas for another. There are economic, technical, and logistical reasons why widespread substitution of green gas for natural gas won't work.

Figure 1.4: Hydrogen can't match gas on price
Wholesale price of natural gas and hydrogen ($/GJ)



Note: Methodology and sources outlined in Appendix A.

7. Biomethane is released when natural materials decompose. Ordinarily it would escape to the atmosphere, break down into carbon dioxide, and then be re-absorbed by plants material. Capturing the biomethane and burning it releases carbon dioxide to the atmosphere, which is then absorbed by plants. Theoretically this results in no net increase in atmospheric carbon dioxide, which is why biomethane is considered 'green'.

Where hydrogen could have a role

Hydrogen is an excellent fuel for producing high-temperature heat, and it is a useful source of molecules for industrial processes such as ammonia. At present, it costs much more than natural gas, and the range of possible future costs is wide (Figure 1.4 on the previous page). Costs will fall with time, as production increases and technology costs fall. But even the most ambitious forecasts only see hydrogen matching gas on price in 2048.[8]

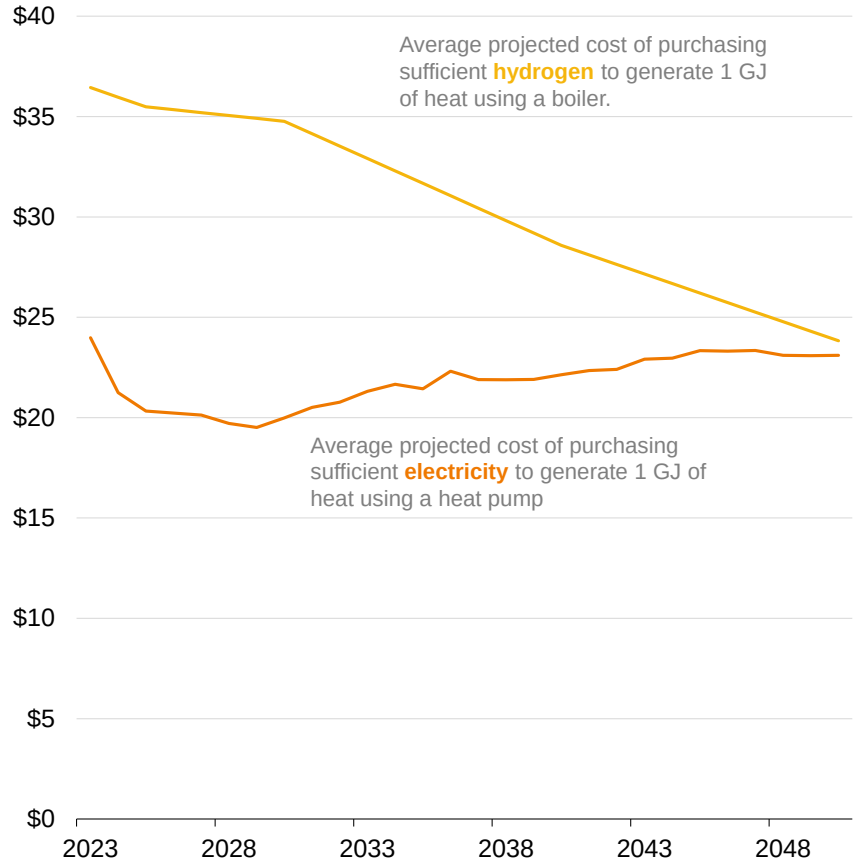
For many current uses of natural gas, hydrogen is unlikely to be competitive with using electricity as a substitute. About 75 per cent of the cost of making hydrogen comes from the cost of electricity consumed in the process. Cheap hydrogen requires cheap electricity, and cheap electricity opens up more options for using electricity than are economic today, further undermining the economic case for hydrogen in many applications that currently use gas.

Just as burning gas is less efficient than using electricity for the same task (see Box 1 on page 9), so too is burning hydrogen. As a rule of thumb, you need to burn three energy units of hydrogen to achieve the same outcome as from one unit of electricity. This makes the *effective* cost of hydrogen three times higher. Or, it means delivered hydrogen costs need to be one third of the cost of electricity to achieve the same service at the same price (Figure 1.5).

There is significant international research indicating that where electrification is viable, it is usually a better option than hydrogen. This is particularly the case for homes and commercial buildings.

An international meta-analysis of 32 studies found that hydrogen for space heating and water heating in homes is associated with both

Figure 1.5: Electricity is cheaper than hydrogen to do the same job



Note: Methodology and sources outlined in Appendix A.

8. One way to close this gap would be to subject consumption of natural gas to a carbon price. To close the gap between natural gas and hydrogen in 2050 shown in Figure 1.4 would require a carbon price of $194 per tonne.

higher energy system costs and higher costs for individual consumers.[9] The International Energy Agency estimates that burning green hydrogen in boilers would require three-to-five times more renewable energy than highly efficient heat pumps to deliver the same amount of heat in a home.[10]

Switching to hydrogen also requires upgrading parts of the current gas network, and changing all gas appliances to make them hydrogen-compatible. Current gas appliances can tolerate only a maximum of 13 per cent of hydrogen blended with natural gas. Domestic appliances that can use 100 per cent hydrogen (which exist only as prototypes at present) are likely to cost 20-to-30 per cent more than gas appliances do now.[11]

This does not mean there is no role for hydrogen in substituting for natural gas. Despite the limitations above, at the moment hydrogen looks like the best bet for many industrial uses.

Where biomethane will have a role

Unlike hydrogen, 100 per cent biomethane can be directly substituted into gas pipelines, requiring no appliance or network upgrades. Biomethane's challenges are economic and logistical rather than technical.

Like hydrogen, biomethane is expensive. The average global price is A$29 per GJ.[12] In France, the price ranges between A$34 per GJ and A$40 per GJ, depending on the feed-stock.[13] In its investigation of biomethane in the Australian context, the Future Fuels Cooperative Research Centre estimated a long-run cost of A$15-to-A$25 per GJ.[14] This is more expensive than the projected long-term gas price, which averages around A$12 per GJ.

On the logistical side, it is unlikely Australia will be able to produce enough biomethane to replace all its current gas use. Australia could produce up to 371 PJ of biomethane per year, about one-third of current total consumption.[15]

However, the feedstock to make biomethane is unevenly distributed. Victoria could make an estimated 48 PJ per year from local feedstock, while annual gas demand in homes and small businesses is 124 PJ.[16] Biomethane feed-stock can be transported, but this increases the cost, especially in a big country such as Australia.

Given the above, biomethane is likely to be much more valuable for gas users where electrification is not a technical possibility and hydrogen is not an economic option.

1.5 Should we keep our gas options open?

Some advocates of green gas suggest that it is too soon to rule out any uses of green gas.[17] They advocate continuing to use natural gas as we do now, potentially blending in small amounts of green gas until hydrogen or biomethane costs have fallen further. Then a decision could be made about whether to move away from gas or use green gas.

There are practical and policy risks to keeping gas options open.

First, Australian-produced biomethane can only substitute for one-third of total current Australian consumption. The other two-thirds and

9. Rosenow (2022).
10. IEA (2022).
11. Frazer-Nash Consultancy (2018, pp. 40–41) and Frontier Economics (2022, p. 9).
12. IEA (2020a).
13. Co-digestion (A$34), agricultural waste (A$40): Bioenergy Australia (2019, p. 38).
14. Future Fuels CRC (2022).
15. Deloitte Access Economics (2017).
16. Ibid.
17. Ausnet (2022, p. 7).

any new growth will require a different substitute – either hydrogen or electricity. For hydrogen to be this substitute, it must be cost competitive with electricity. But cheap hydrogen requires very cheap electricity, which undermines the case for using hydrogen.

Second, for hydrogen to be a realistic widespread option, multiple things need to go right in the next few decades. The costs of producing, storing, and transporting hydrogen needs to fall by orders of magnitude. Entire supply chains for appliances need to be built. And there will be much less time available for the logistical challenge of switching over millions of appliances in homes and commercial buildings.[18]

Third, keeping gas options open isn't cost-free. It means foregoing the opportunity to make a dent in our national emissions, and emissions may even grow in the meantime if more people start using gas. And, as we will show in the next chapter, households in particular can save money by upgrading from gas to electricity. Keeping options open will mean foregoing these savings. Households will also forgo health benefits. As we will describe in Section 2.1.3 on page 16, using gas in homes can be bad for people's health. This harm is potentially worse if hydrogen is used instead of natural gas.[19]

If things don't go right, and hydrogen and biomethane turn out to be bad bets, governments and householders will be left scrambling to replace multiple gas appliances with electric ones on a shorter time-frame. This will increase the cost and the inconvenience for everyone.

There are parts of the economy where hydrogen and biomethane will play a key role in getting to net zero. Governments and the gas industry need to focus on developing the green gas supply chains these sectors will need. Pumping green gases into applications where it isn't the best solution to eliminating gas emissions is a time-consuming and costly distraction.

Box 2: The history of gas use in Australia

Reticulated gas supply began in Sydney in 1841, using town gas – a mixture of hydrogen and carbon monoxide made from coal – to supply gas for street lighting.

Melbourne followed in 1856, Adelaide and Brisbane in 1865, and Perth in 1886. Street lighting remained the dominant use of gas in the 19th Century, but gas cookers, gas water heaters, and gas fires gradually grew more popular, and as they did so, the gas network expanded to serve more households.

Exploration for and production of natural gas began in the 1960s. Brisbane and Melbourne were the first Australian cities to switch from town gas to natural gas, in 1969. Other major centres followed in the 1970s and 1980s.

Because natural gas was cheaper, cleaner, and easier to produce than town gas, a wider range of activities became dependent on gas, particularly in electricity generation and industrial heat. These larger gas loads led to further expansion of the gas network, including into regional areas of south-eastern Australia, south-west Western Australia, and central and south-east Queensland.

18. The solution to this dilemma is not to install dual-fuel appliances in the meantime. UK analysis estimates dual-fuel appliances will cost 20 per cent more than hydrogen-only appliances – that is, 44 per cent more than conventional gas appliances. Plus, each one will require a visit from a tradesperson to switch it over safely: Frazer-Nash Consultancy (2018, pp. 31, 40).
19. Douglas et al (2022).

2 Start by electrifying homes

It makes sense to start the journey away from using natural gas in the home. All-electric homes are cheaper to run and better for people's health. And the technology is already available and in widespread use: more than 30 per cent of Australian households already use electric heating, cooking, and water heating.[20]

We could get all homes off the gas network by 2050 if every household upgraded its gas appliances to electric ones at the end of the appliances' lives. But there are physical, financial, and other barriers to households making this change. And there are new homes being added to the gas network every day. Governments need to step in and generate greater momentum towards an all-electric residential sector. The first step is to set a gas phaseout date and to ban new gas connections to homes.

The use of natural gas in commercial businesses will need to be phased out alongside its use in homes. The bulk of this report is focused on homes because they are so numerous and government support is most necessary. Government plans for electrification will need to include commercial applications, as discussed in Chapter 8.

2.1 Why electric homes?

2.1.1 Electric homes are cheaper to run

While it currently costs more to buy electric appliances than gas equivalents, they are significantly cheaper to run. This is because electric appliances are more efficient than gas equivalents, converting the same unit of energy into more units of heat. An efficient gas heater can convert one unit of energy into a maximum of one unit of heat,

Figure 2.1: What is the basic all-electric home?

The three appliances above are the foundations of an efficient electric home. There are other electric appliance options, such as electric storage hot-water systems and electric panel space heaters. But these appliances are less efficient and more costly to run.

Some households may want to add electric vehicles, batteries, and solar panels. These decisions are not related to the areas covered in this report.

Source: Picture adapted from Victorian Government (2021).

20. Grattan calculation based on Energy Networks Australia (2021) and Gas Energy Australia (2023).

while electric heat pumps produce three-to-five units of heat for the same energy input.[21]

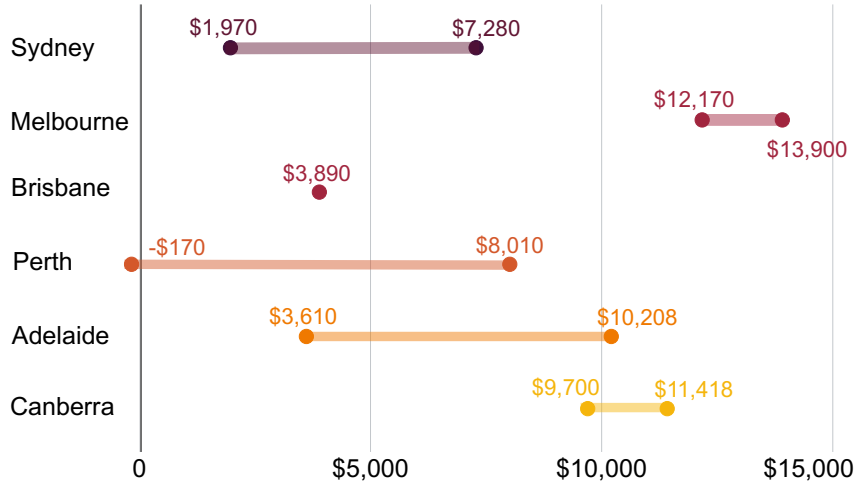
The lower running costs of efficient electric appliances allow households to recover the upfront cost, and more, over the life-span of the appliance, leaving the household significantly better off than if they'd stuck with gas (Figure 2.2). Savings are highest where a house switches three gas appliances to electric – heating, water heating, and cooking.

In 2022, the Victorian government found annual savings of $740-to-$1,020 for homes with no solar, and $1,070-to-$1,250 for homes with solar.[22] A 2022 study by the Climate Council found savings across all states.[23] And a 2020 study for the ACT government found savings of up to $593 for homes in Canberra with no solar, and between $307 and $985 for homes with solar.[24] Since these studies, electricity and gas tariffs have increased significantly, which has further increased savings.

It is true that not every household would save if they switched to all-electric today. Some West Australian homes may pay more in an all-electric home – since gas is so cheap in that state.[25] Households that buy cheap, inefficient appliances will also miss out on savings.[26] But for most households, switching now or soon will save them in the future, even after accounting for the upfront cost of electric appliances. And global adoption of electric appliances such as induction cook-tops and heat pumps would push down their prices.

Figure 2.2: Most households will save money by upgrading to electric appliances

Household savings over 10 years



Notes: Includes the upfront cost in savings calculations. See Appendix B for further detail.

Sources: Grattan analysis of Energy Consult (2021) and retail data.

21. IEA (2022).
22. Victorian Government (2021).
23. The Climate Council (2022a).
24. ACIL Allen (2020).
25. Western Australia has a domestic gas reserve which makes 15 per cent of exports available to West Australians.
26. ACIL Allen (2020).

2.1.2 Electrifying homes reduces emissions

The 5 million Australian homes connected to the gas network account for 17 per cent of total gas consumed in Australia.[27] Tackling these emissions is an essential step to reaching Australia's climate targets, as explained in Chapter 1 on page 6.

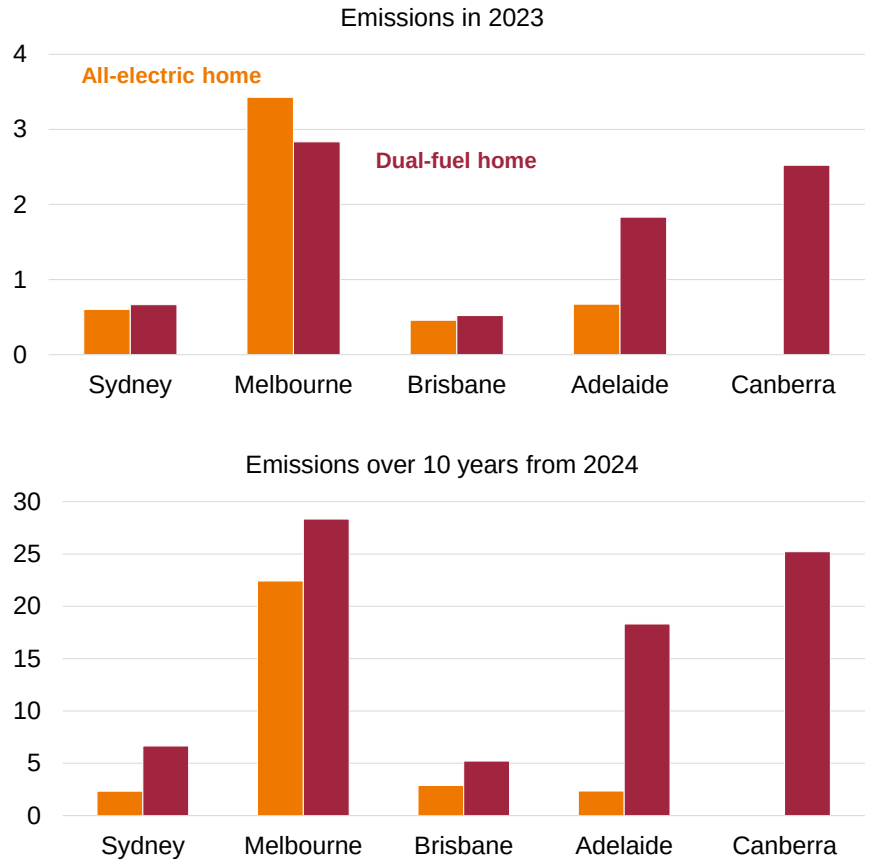
Proponents of green gases for homes often highlight that all-electric homes are more emissions-intensive than dual-fuel homes, due to the share of fossil fuel generators creating the electricity supply.[28] This is currently the case for some households. But when assessed over 10 years, the reverse is true for all (Figure 2.3).

Emissions savings are biggest in Canberra, because Canberra residents pay for 100 per cent renewable electricity. Elsewhere, as coal-fired generators continue to be retired, and the amount of renewable energy rises, the emissions savings from all-electric homes will increase. South Australia and Victoria aim to be 100 per cent and 95 per cent renewable, respectively, by 2030.

2.1.3 Electric homes are better for our health

Going electric is also good for people's health. Gas stoves release nitrogen dioxide (NO_2) and tiny particles called PM2.5. These particles irritate the lungs, particularly in children, whose lungs are still developing. These pollutants are reported to leak even when the stove is off.[29] A recent paper in the Australian Journal of General Practice concluded that electrifying everything 'on climate grounds will have substantial health benefits if it leads to the reduction in gas use in people's homes'.[30]

Figure 2.3: Greenhouse gas emissions from heating, cooking, and hot water are higher in dual-fuel homes than all-electric homes
Greenhouse gas emissions (tCO2-e)



Notes: tCO2-e = tonnes of carbon-dioxide equivalent. Dual-fuel homes have gas water heaters and cook-tops. All-electric homes have heat-pump water heaters and induction cooking. Sydney homes assumed to have no heating. Melbourne and Canberra dual-fuel homes assumed to have ducted gas heating, all-electric homes to use reverse-cycle air-conditioning for heating. Adelaide dual-fuel homes have gas furnace heating, electric homes have reverse-cycle air-conditioning.

Source: Grattan calculations using DCCEEW (2022b) and DCCEEW (2023).

27. The Climate Council (2022b).
28. Australian Gas Networks (2023).
29. Lebel et al (2022).
30. Ewald et al (2022).

NO_2 and PM2.5 have been repeatedly linked to higher incidences of childhood asthma. A study in Victoria's La Trobe Valley measured NO_2 levels in 80 houses. The researchers conducted quarterly tests on the children living in these homes who were between 7 and 14 years old. They found 'significant adverse effects of gas stove exposure', noting that gas stoves correspond to a 27 per cent increased risk of asthma.[31] Another international meta-study put this figure higher, at 42 per cent.[32]

The adverse impacts of gas cooking can be reduced by adequate ventilation, including the consistent use of range-hoods that are vented to outside the building.[33] But such ventilation is not consistently used.

The causal link between cooking with gas and the adverse health impacts has been challenged. For example, a study referenced by the industry 'detected no evidence of an association between the use of gas as a cooking fuel and either asthma symptoms or asthma diagnosis'.[34]

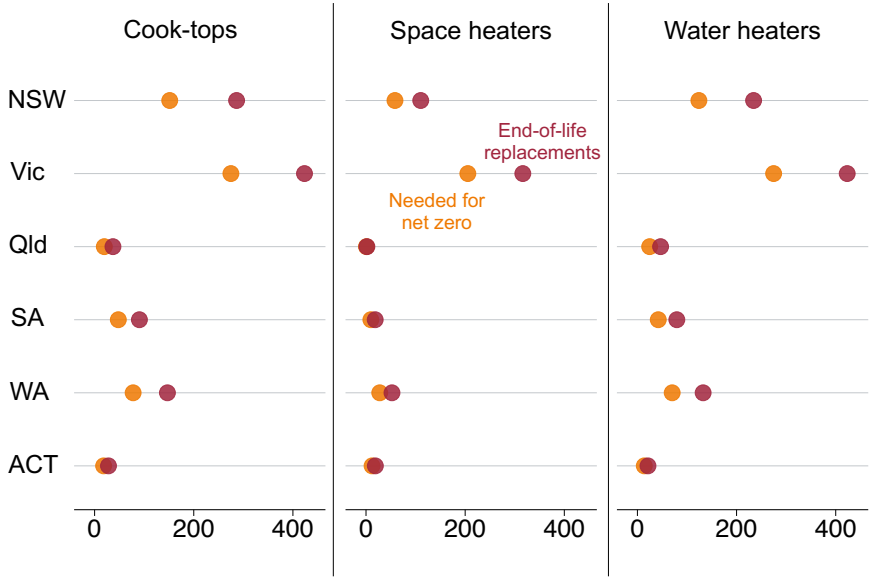
The absence of a definitive causal link probably explains why Australian health authorities have not acted more strongly against indoor gas use. However, health regulators in the US are considering banning gas stoves in homes, despite political objections.[35]

On balance, the health concerns would seem real enough to add to the climate and financial benefits of getting off gas.

These health impacts are greater when hydrogen is substituted for natural gas. Burning hydrogen or hydrogen blended with natural gas produces more NO_X emissions than burning natural gas alone.[36] This

Figure 2.4: Australia could get to zero gas homes on appliance replacement cycles alone

Number of gas appliances being retired per day



Notes: 'Needed for net zero' is the number of gas appliances which need to be switched to electric every day to retire all gas appliances by each states' net-zero date. Assuming all households with gas connections have a gas stove. Assuming 15-year lifespan for all three appliances.

Sources: Grattan analysis of Energy Consult (2021).

31. Garrett et al (1998).
32. Lin et al (2013).
33. Knibbs et al (2018).
34. Wong et al (2013).
35. Roush (2023).
36. NO_X is the combination of nitrogen dioxide and nitric oxide.

is another reason that hydrogen is not a good substitute for natural gas in homes.[37]

2.2 Why start now?

Converting five million homes to all-electric is a major logistical challenge. There are 11 million gas appliances in Australian households – all with average lifespans of 12-to-15 years.[38] In Victoria alone, 200 households per day will need to stop using gas to reach zero homes on the gas network by 2050.[39]

By starting today, Australia could have all homes being all-electric by the net-zero goal dates on natural replacement cycles alone.[40]

There are more gas appliances being retired every day because they have reached the end of their lifespans, than the rate of change required to reach zero gas homes (Figure 2.4 on the preceding page). In Victoria alone, 423 water heaters reach the end of their lifespan each day; Victoria needs to replace 274 per day to achieve zero gas homes by 2045.[41]

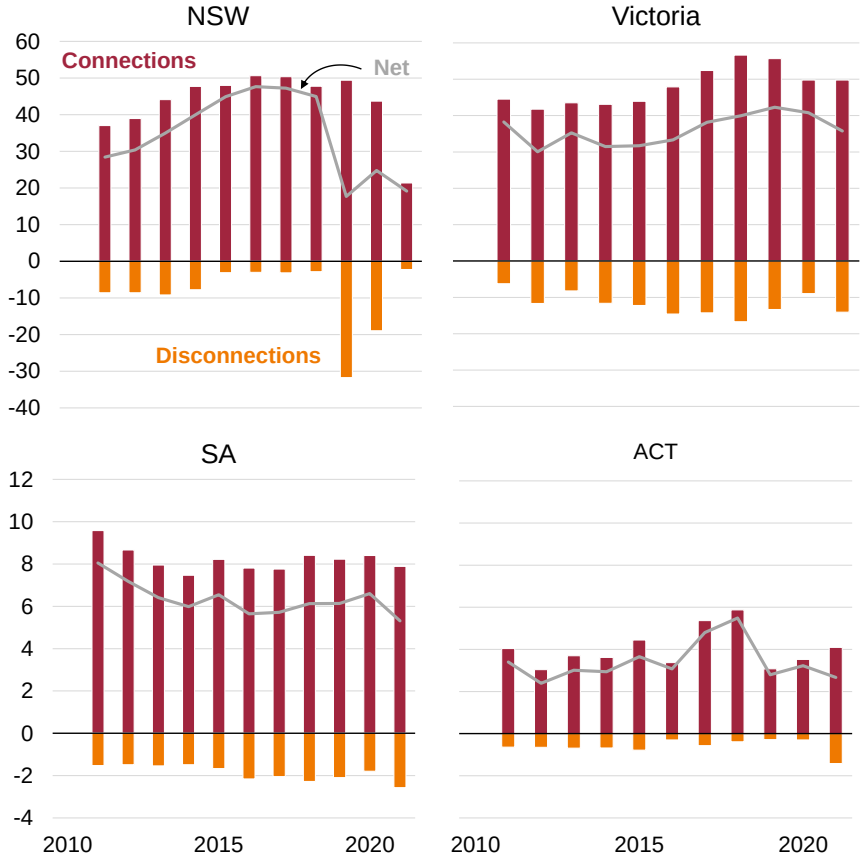
But the longer governments leave it, the higher the risk that households will have to change appliances prematurely as we approach deadlines for an end to gas.

2.3 Government action is needed to create momentum

It is tempting to believe that households could quickly move to electric homes on their own, by switching every gas appliance to electric at the end of life. But this is optimistic, for two reasons. First, the number of

Figure 2.5: More households are joining the gas network each year than leaving it

Gas connections ('000)



Notes: Connections in Albury NSW are included in the Victorian totals. Methodology used to collect data in NSW changed in 2019.

Source: AER (2022b).

37. Forbes (2022).
38. Energy Networks Australia (2021).
39. Grattan calculation based on Energy Networks Australia (ibid).
40. 2045 in Victoria and ACT; 2050 in all other states.
41. Grattan analysis of Energy Consult (2021).

households using gas is growing, not shrinking. Second, there are many obstacles preventing households that already have gas from making the switch.

2.3.1 Trends in home gas use are heading in the wrong direction

Since 2010, the number of residential gas customers in NSW and the ACT has grown by 37 per cent; in Victoria by 22 per cent; and in South Australia 18 per cent (Figure 2.5 on the previous page).[42] Victoria was the only state where the number of residential gas customers grew more slowly than the total number of households.[43] In 2021, 68,494 households joined the gas network across NSW, Victoria, South Australia, and the ACT.[44]

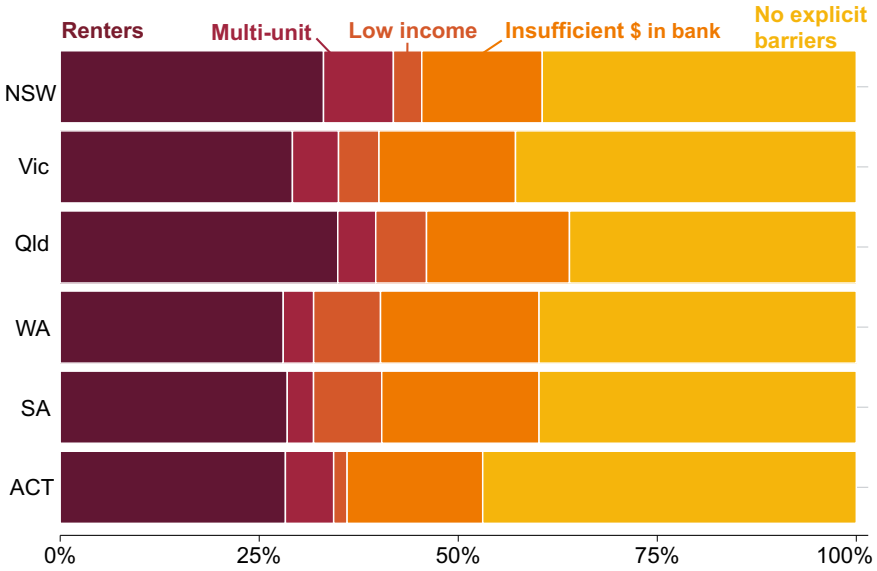
Every house added to the gas network is one which will later need to be taken off it. There is little point trying to encourage homes to upgrade to all-electric if new connections to the gas network continue to grow – it's like pouring water into a bucket with a hole.

Before they start encouraging homes to get off gas, state governments should do two things.

First, they should set a date by which residential network gas use in their state will end. This may be the same as its net-zero target date. It may have limited exceptions where eliminating gas use looks unusually difficult – some of these are explored in following chapters. But setting a clear date creates certainty for homeowners, tenants, building managers, and gas network businesses.

Second, state governments should stop adding to the problem. Governments should set a date after which new gas network

Figure 2.6: Many Australians face barriers to electrifying
Proportion of households by main barrier to electrification



Notes: This assumes households with gas follow a similar distribution by characteristic as all households. There is no publicly available data on the profile of households connected to the gas network. 'Insufficient money in bank' is defined as less than $15,000 in savings and offset accounts combined. Low income here is defined as people who are simultaneously in the lowest 40 per cent of both equivalised disposable household income (including private imputed rent) and equivalised household net worth: ABS (2019-20).

Source: ABS (ibid).

42. AER (2022b).
43. The number of households in NSW grew by 16 per cent from 2011 to 2021. In Victoria it grew by 22 per cent, in South Australia by 10 per cent, and in the ACT, 25 per cent: ABS (2019).
44. AER (2022b).

connections will not be allowed. The ACT Government has done this, banning new gas connections for homes and small businesses from November 2023.[45] All other states and territories – most pressingly Victoria – should follow the ACT's lead.

The federal government should make federal funds available for home electrification only in states that have a gas phase-out date and a ban on new connections.

About 750,000 Australian homes use LPG for water heating or cooking, and many more use it for outdoor cooking, such as barbeques. Governments will also need to eliminate the emissions from LPG to reach their net-zero targets. Getting off LPG will require a different set of solutions, not explored in this report. And moving away from using natural gas in homes need not affect the great Australian barbeque (see Box 3).

2.3.2 Getting off gas is not always easy

Upgrading to all-electric may be easy for fewer than half of Australian households – the rest face one or more barriers (Figure 2.6 on the previous page).

About 30 per cent of homes are rented, so the appliances are not chosen by the occupants. Then there are multi-unit buildings, which can be tricky to electrify due to communal water or space heating, which requires the consent of all unit owners to change over. The cost of upgrading will be a barrier for other low-income or low-savings households. And then there are people facing other, less tangible, hurdles. These might be cultural, or about personal preferences.

Governments will need to help households clear these hurdles. Different tools will be needed for different households. These are explored in following chapters.

45. ACT Government (2022b).

Box 3: The great Australian barbeque is safe

Ending the widespread use of natural gas in pipelines need not mean an end to the great Australian barbeque.

Most outdoor cooking is powered by LPG, which has the advantage of being portable.

Continuing to use LPG for barbeques will have minimal impact on Australia's carbon emissions. Using a barbeque for three hours emits 13.4kg of greenhouse gases. To generate a million tonnes annually would require every household in Australia to hold eight barbeques every year.[a]

LPG could continue to be used in barbeques until a non-fossil substitute such as hydrogen or synthetic bioLPG is developed. Governments should support LPG companies to develop these substitutes.

Where natural gas from pipelines is used, it should be possible for equipment suppliers to develop and sell conversion kits to change these items to burn LPG.

a. Grattan calculations based on gas consumption estimates from Elgas (2023).

3 Overcoming the upfront cost hurdle for homeowners

Though electric homes eventually save occupants money, there is still a purchase cost gap between gas and electric appliances. As a result, many low-income and low-savings homeowners will struggle to upgrade from gas to electric when their appliances break down.

Governments in Australia and abroad are meeting this challenge by providing loans and subsidies for key appliances. In Australia, the federal government's $1 billion electrification package in the 2023 Budget is one example. The ACT and Victorian governments have loan and rebate schemes to help homeowners go all-electric.

To ensure they get the most bang for their buck from these loans, governments should work with banks, and establish an 'eligible technology list' of electric appliances for financial institutions to use.

Government support for financing should continue until at least 10 per cent of current gas homes have upgraded to electric. At this point, and provided other hurdles have been removed, the price of all-electric alternatives should be comparable to gas appliances.[46] Governments should then phase out the sale of gas appliances.

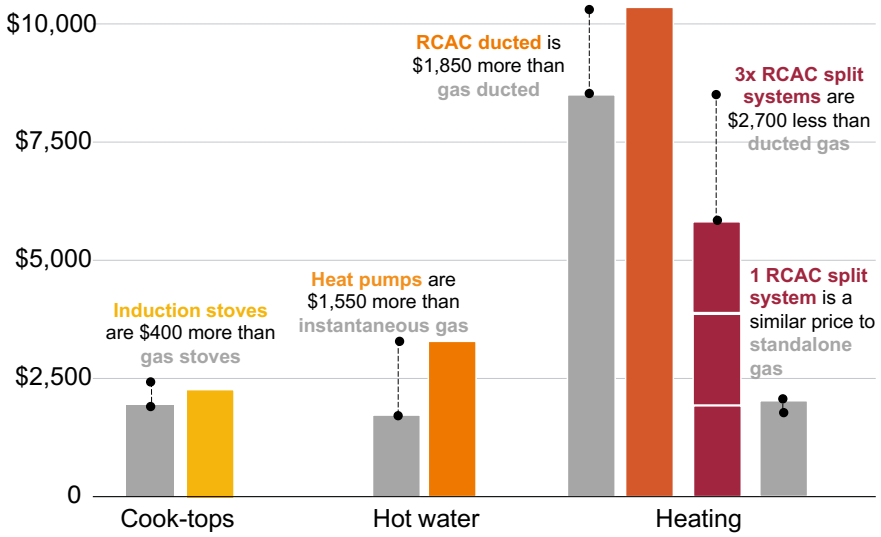
3.1 The cost gap has three components

Three things make choosing an all-electric home more expensive upfront than sticking with gas: the cost of the appliances, the cost of leaving the gas network, and – for some households – the cost of accommodating the new appliances, such as upgrading electrical wiring.

There is a cost gap between most efficient electric appliances and gas ones (Figure 3.1). Induction cook-tops cost, on average, an extra $400

Figure 3.1: Efficient electric appliances cost more to buy than gas appliances

Cost including installation



Note: RCAC is a reverse-cycle air-conditioner.

Sources: Grattan analysis of retail data, ACIL Allen (2020).

46. Benham (2023).

to buy and install. Heat pump water heaters cost about $1,500 more than instantaneous gas.

Space heating is not so straightforward. The cost gap depends on the switch. It is more expensive to replace gas ducted heating with reverse-cycle air-conditioning (RCAC) ducted heating. But switching from gas ducted heating to three RCAC split systems saves $2,740. Switching from a standalone gas heater to a single RCAC unit is also cheaper. Many Australian households already have RCAC systems, but currently use them only for cooling.[47]

The second component of the cost gap is the fee to disconnect or get rid of a gas connection. These costs, which vary by state, are explained in detail In Chapter 7.

Third, households that use a lot of power may need to pay to upgrade to three-phase power due to the increased electricity load. This costs between $4,500 and $6,000.[48] Most homes are likely to be fine on single-phase power.

Beyond these three components, some households may need to re-wire or create space for electric appliances. Heat pumps, for example, take up more space than gas instant water heaters.

3.2 Low-income households cannot afford the upfront cost

Low-income households on average spend 6.4 per cent of their income on energy bills, compared to wealthy Australians who spend 1.5 per cent.[49]

47. 43 per cent of homes in Victoria and 53 per cent in NSW. Note that some of these systems will be cooling only: The Climate Council (2022a).
48. A three-phase connection has four wires, compared to two wires for a single-phase home. A three-phase connection can supply triple the amount of power.
49. ACOSS and Brotherhood of St Laurence (2018), p. 4.

And low-income households are less likely to have rooftop solar. The average house with solar panels saves $117 a year on electricity. About 37 per cent of Australians earning more than $90,000 a year have solar, compared to 20 per cent of people in financial stress.[50]

Low-income households are likely to struggle to find the money to replace a broken gas appliance, let alone the extra cash required to upgrade it to an efficient electric alternative.

3.3 Other households don't have enough in the bank

Then there are households that are not low-income, but don't have enough liquid savings in the bank to go all-electric.[51] This may include households with a large mortgage, other forms of debt, or significant ongoing costs such as health bills.

About four million homes across NSW and Victoria – the states with most residential gas connections – have less than $15,000 in liquid assets.[52]

3.4 What governments are already doing

3.4.1 Rebates

Some governments are paying for the cost gap outright through subsidies. Many European governments are subsidising heat pumps, particularly for heating in cold climates.[53] These subsidies have

50. Melbourne Institute and Roy Morgan (2023).
51. We have defined low-savings households as those with less than $15,000 in savings and offset accounts. This is the upper limit of how much electrifying a home may cost for most homes.
52. ABS (2019-20).
53. In most countries, 'heat pump' refers broadly to water heaters and reverse-cycle air-conditioners. Both of these technologies convert energy stored in the air, water, or beneath the ground into heating energy. Australia has different names for air-to-air heat pumps (reverse-cycle air-conditioners) and air-to-water heat pumps.

corresponded with significant increases in uptake of electric technology. In France, for example, the share of homes with heat pumps jumped from 43 per cent in 2021 to 56 per cent in 2022. In Japan, where subsidies for heat pumps ran from 2001 to 2010, 90 per cent of homes now own heat-pumps.[54]

The ACT government offers rebates of up to $5,000 for a range of electric appliances. The Victorian government provides a $1,000 rebate for installing a heat pump for hot water. From May 2023 it added rebates for reverse-cycle air-conditioning units under the Victorian Energy Upgrades program.[55] This is a welcome change of direction; until this year, the Victorian government was still subsidising new gas appliances through the Victorian Energy Upgrades scheme.[56]

However, rebates can be very costly to the government. Subsidising $5,000 per household with gas would cost $25 billion. Subsidies also often require households to have money up-front. A rebate that requires the recipient to spend the money installing an electric appliance to replace a gas one, and then wait for their rebate claim to be assessed and paid, is of no use to someone who doesn't have the money in the first place.[57]

Another policy lever governments can pull is financing. Financial products such as low-interest loans provide the option to spread the upfront cost over time – to better align with savings (Section 2.1.1 on page 14). Some Australian households are already able to spread the costs over time. They may have a mortgage offset account, for example, in which case they can borrow the money to pay for an upgrade at the same interest rate as their home loan, and pay it back over the period of their mortgage. Aged pensioners may be able to use the Home Equity Access Scheme to borrow against their home at low interest rates.

Other households do not have these options, and may want a range of financing products – such as loans or product finance. This is where governments should play a role.

3.4.2 Financing

The ACT government has a 'sustainable household scheme' providing up to $15,000 in zero-interest loans.

The Federal government's recently announced $1 billion household energy upgrades fund will support 110,000 households through low-interest loans.[58] The remit includes upgrading to electric appliances, and other home efficiency improvements such as adding ceiling insulation.

The remainder of this chapter outlines how this funding, and any subsequent 'top-ups', should be structured.

3.5 How governments can get the most bang for buck

To achieve a large-scale switch from gas to electric requires a range of easily accessible and attractive financing options. The best institutions to provide these are the ones that already do so for all sorts of other home purchases and upgrades: banks, credit unions, and product finance providers.

54. Monschauer et al (2023).
55. Victorian Government (2021).
56. NSW, Queensland, Western Australia, and South Australia do not currently provide direct incentives to upgrade appliances to electric. NSW and South Australia (as well as Victoria) have 'white certificate' schemes, which encourage customers to choose efficient appliances. They do not directly support the uptake of any specific technology.
57. If governments do create rebates, a better design is as a point-of-sale discount. Or a voucher issued to low-income groups, which can be redeemed for a discount.
58. Federal Government (2023).

Federal and state governments have an important role to play in increasing the availability of financing options. Currently, there are one or two 'green home upgrade' or 'green mortgage' products available in Australia, but they aren't common. Financial institutions won't develop these products if there is no perceived demand for them. And because the financial benefit to the homeowner is in the form of an avoided cost rather than extra income, it's harder for banks to assess whether the savings from upgrading to all-electric will cover the loan or financial package.

Setting dates for an end to gas (see Chapter 2 on page 14) would provide more certainty to financial institutions about potential demand. This demand could be as high as 2,000 homes needing to replace a gas appliance each day.[59]

But some risk would remain. To increase the number and variety of financial products available for home electrification, the federal government should step in.

In the 2023 Budget, the federal government announced an additional $1 billion allocation to the Clean Energy Finance Corporation (CEFC) to 'turbocharge financing options for household energy upgrades'.[60] To maximise the number and variety of financial products available for households wanting to upgrade to all-electric, this money should be used to de-risk development of these products by financial institutions.[61] This way, the government would not have to assess individual loan risk. And people could get finance from a financial institution with whom they already have a relationship. Ideally the result should be creation of diverse – and tailored – financing options for people facing the upfront cost hurdle.

59. Grattan analysis based on Energy Consult (2021).
60. Bowen and McAllister (2023).
61. The CEFC has already partnered with Bank Australia, committing $60 million to de-risk establishing green home loans: CEFC (2022).

An 'eligible technology list' for banks

The easier it is for banks to establish home electrification financial products, the more widespread and accessible they will become.

The federal government can help in this process by creating an 'eligible technology list', identifying which electric appliances should be eligible for financing. The list should include efficient appliances only – reverse-cycle air-conditioning units, heat pumps for hot water, and induction cook-tops, for example – where the savings over time will far out-weigh the upfront extra cost. The list should not include cheap, low-performing appliances such as electric storage water heaters and electric panel heaters.

3.6 Regulation can keep the price manageable for governments

Using the CEFC to leverage financial products minimises the costs to government, although there will still be a short-term cost of interest on borrowings.

But, government intervention is intended to make efficient electric technologies mainstream, not to prop up these markets indefinitely.

Governments can put limits on their support by creating a long-term plan to phase out gas appliances. France banned the sale of gas boilers from 1 July 2022, and Germany will ban them from 2024.[62] The Netherlands announced that all residential buildings will be off gas by 2050. This sets a clear end-date for government support.

62. Bloomberg (2023).

3.6.1 Australia should build towards an end-date for the sale of gas appliances

Australia's governments should agree to a national end date for the sale of gas appliances. Different dates could be set for different appliances, reflecting their different lifespans and ease of replacement.

Setting an end date would enable households to plan ahead for when their gas appliances break. It would push landlords to consider upgrading their rental properties (discussed in Chapter 4 on the next page). And it would send a signal to appliance manufacturers and importers to supply more efficient electric technologies, such as heat pumps and induction cook-tops.

The best way to do this is to bring gas and electric water heaters, cook-tops, and heating systems into the Greenhouse and Energy Minimum Standards (GEMS) framework. Governments could then set stringent minimum performance standards that put gas and electric appliances on an equal footing with respect to their emissions and their energy efficiency.[63]

Doing it this way, rather than just banning gas appliances, would mean that if a homeowner or landlord couldn't upgrade a broken gas appliance to an electric one for some reason, the new gas appliance would use less gas and save the user money. It would also give appliance manufacturers and importers time to adjust.[64]

Eventually, the performance standard should exclude gas appliances. As noted in Section 2.1.1 on page 14, even the most efficient gas appliances cannot outperform efficient electric equivalents.

Finally, bringing heat pumps, induction cook-tops, and electric heaters into the GEMS framework would keep poorly-performing electric appliances, that offer an inferior user experience or cost more to run, out of the market.

63. The GEMS framework applies minimum energy performance criteria to fridges, washing machines, air-conditioners, and some other appliances. The standard requires performance to improve over time.
64. This approach was successfully used to phase out the sale of incandescent light-globes. A strict minimum standard was set in 2007 that was met by most compact fluorescent light-globes, but was not possible to meet with incandescent technology. The standard was further tightened in 2020, to phase out inefficient halogen globes: IEA (2020b).

4 It will be hard for renters and apartment owners

Renters, and people who live in multi-unit dwellings, have constrained choice about their appliances and the fuel they use.

For the 31 per cent of households that live in a rental property, choices about their cooking, heating, and water heating appliances are controlled by their landlords. But landlords do not benefit financially from the savings from upgrading to all-electric, nor do they get the health benefits.

The federal government should make a tax break available for private landlords who upgrade rental properties to all-electric. This would provide a financial benefit to landlords, and tenants would benefit from the savings. The tax break should be available for a limited time, before minimum rental standards are introduced that require rental properties to be all-electric. These standards should include ceiling insulation, to maximise savings.

State and federal governments are the landlords of social housing properties. They should upgrade these from gas to electric as appliances break, so that Australia's most vulnerable can save money and benefit from healthier indoor air quality.

State governments should sponsor upgrading trials for various typical multi-unit buildings, and share the lessons learnt widely. State governments should also immediately ban new gas connections for multi-unit buildings.

4.1 Renters don't control their appliances

About 31 per cent of Australian households live in rental properties.[65] In rental properties, the person making decisions about fixed appliances in the house (the landlord) is not the one who benefits or suffers from the consequences of operating the appliances (the tenant). So while switching from a gas to an induction cook-top may benefit a tenant through lower energy bills and better health, there is no benefit to the landlord.

When landlords are asked why they do not carry out energy retrofits, the most common factor cited is financial constraints. These can include lack of access to capital, but also the landlords' expectations of net profits from their rental properties, and their perceptions of retrofit costs.[66]

A survey of more than 900 landlords testing reasons for not investing in rooftop solar for rental properties found the biggest hurdles were the lack of return on the investment (including not believing that tenants would pay more rent for the property and that the resale value would not be higher), not wanting to make existing tight margins tighter, and that the savings accrue to the tenant.[67]

Landlords report a desire to improve comfort and running costs; but also a lack of demand from tenants for retrofits.[68]

There is also an information gap: a survey of Australian rental properties found a rent premium of between 5 per cent and 8 per cent for properties with solar PV, yet landlords report not believing they can charge higher rent for such properties.[69]

65. ABS (2021).

66. Lang et al (2021, p. 11).
67. Hammerle et al (2022, p. 17).
68. Lang et al (2021). A perceived lack of tenant demand is more likely to reflect the power imbalance between landlords and tenants
69. Hammerle et al (2022, p. 17).

Retrofit decisions by landlords tend to be prompted by appliance breakdowns, tenant requests, and government subsidies.[70] Breakdowns to water heating, stoves, and heating systems are generally considered 'urgent repairs' under Australian tenancy laws.[71] Landlords must act on these repairs immediately. This provides a strong incentive to replace like-for-like. If the property has an inefficient gas appliance which breaks, it is likely to be replaced with another inefficient gas appliance.

4.1.1 Landlords for social housing

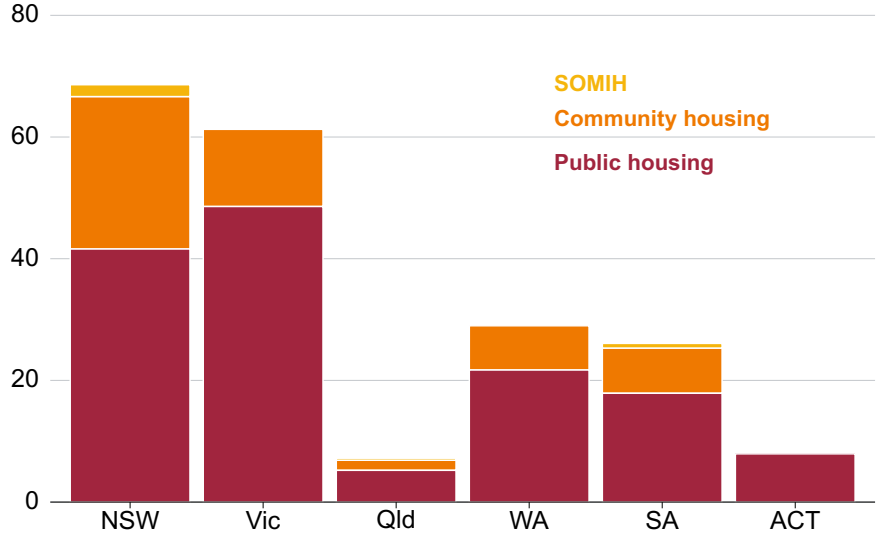
Another group of households rent from social housing providers. Social housing encompasses community housing, public housing, and Indigenous housing. It is long-term housing, rented to vulnerable or low-income people. Community housing is owned and managed by not-for-profit organisations; public housing is owned and managed by state governments. Some Indigenous housing is a subset of public housing specifically available to Indigenous people. Some is owned and managed by Indigenous Corporations. And some is owned by the Federal Government and managed by state governments or Indigenous Corporations.

Social housing runs the gamut from multi-unit towers in inner capital cities, to townhouses and free-standing houses. Each state has a different mix of public and social housing. To get to a near-100 per cent electric residential sector, around 60,000 social homes in NSW and Victoria, respectively, will need to be upgraded (Figure 4.1).

People living in these homes are among the most vulnerable in the country. Governments must ensure they are not trapped with increasing gas bills, and worse health outcomes.

Figure 4.1: There are thousands of social housing units using gas across Australia

Estimated social housing properties using gas ('000s)



Notes: SOMIH = state owned and managed Indigenous housing. These numbers are estimated using the assumption that social housing units on gas follows the broader proportion of homes on gas in the state. Northern Territory has significant amounts of Indigenous housing but is not included because almost no housing is connected to a gas network. Indigenous community housing is included in community housing.

Source: AIHW (2022).

70. Lang et al (2022).
71. See for example Consumer Affairs Victoria (2023) and NSW Fair Trading (2023).

4.2 What to do about rental properties

Governments should design policies with the aim of making all-electric rental properties the norm, because every home that is currently using gas must be upgraded to all-electric to reach net zero.

4.2.1 An instant asset write-off would provide incentives to replace gas appliances

The simplest way to provide private landlords with a financial incentive to move to all-electric appliances is to provide an instant asset write-off for new electric appliances that replace gas ones. An instant asset write-off allows a landlord to claim a tax deduction for the full cost of a new appliance, rather than claiming a proportion of the cost each year over its lifetime as it depreciates. It is simple for the federal government to implement: all that is required is to change the effective life years of heat pump water heaters and induction cook-tops from 12 years to zero years in the ATO's depreciation schedule.

Grattan Institute modelling shows that an instant asset write-off for heat pump water heaters and induction stoves would close the cost gap between these and the gas alternatives. Depending on the landlord's taxable income, an instant asset write-off would meet between 23 and 55 per cent of the cost gap for water heaters, and 39 per cent to 93 per cent of the cost gap for cook-tops (see Figure 4.2).

An instant asset write-off should be a short-term measure, ahead of a minimum rental standard and an end to sales of gas appliances (see Section 3.6 on page 24 and Section 4.2.3 on page 30).

If made available for five years (2025 to 2030), it would cover replacement of up to one third of the gas water heaters and cook-tops in existing rental properties. The cost to the budget would be a

Figure 4.2: Instant asset write-offs would close the cost gap on cook-tops and water heaters

Value of instant asset write-off by tax bracket, compared to electric premium

Notes: Based on current tax brackets. Under current policy settings, from 2024-25, the 37% tax bracket will be removed and the 33% tax bracket will drop to 30%.

Source: Grattan analysis of retail data, ACIL Allen (2020), and ATO (2022).

maximum of $384 million over the five years.[72] To maximise take-up, the asset write-off should be promoted to property managers and tax accountants.

We do not recommend making a write-off available for heating systems. Split-system reverse-cycle air-conditioning is already cheaper than free-standing and ducted gas heating. While there is a cost gap between ducted gas and ducted electric systems, the more economical solution is to replace ducted gas heating with split-system reverse-cycle air-conditioning. Providing a write-off for these replacements would mean landlords would be receiving free money.

Direct government subsidies for energy improvements tend to have much lower take-up rates among landlords compared to owner-occupiers.[73] This may be because subsidies are not promoted especially to landlords; or because they are not promoted to property managers and tax accountants, who help landlords make decisions about their property.

4.2.2 Governments should cover the cost gap for social housing

State governments are the landlords for public housing, so upgrading those homes to all-electric is their responsibility.

To minimise disruption to people living in these dwellings, replacements should be done in line with refurbishment cycles, when tenants are not in the house. And, like households, state governments should take the opportunity to replace gas appliances with electric at the end of their useful lives. This also applies to Indigenous housing, where the federal government owns the housing.[74]

Governments should also cover the cost gap for community housing and Indigenous housing that it does not own. These houses are owned by not-for-profit organisations, and every dollar those organisations spend on upgrading from gas to electricity is one they can't spend on new housing for vulnerable people who need it.

As with public housing, timing should be aligned with refurbishment cycles and appliance end-of-life, to minimise disruption to tenants and costs.

The Victorian government is spending $112 million through its Social Housing Energy Efficiency Program to upgrade 35,000 social housing units by June 2024.[75] The federal government allocated $300 million in the 2023 Budget to improve energy efficiency for 60,000 social housing properties.[76] While welcome, these policies fall a long way short of electrifying all social housing. The federal government's policy, for example, affects 15 per cent of social housing stock, excluding 380,000 households.

The federal government should direct Housing Australia to avoid investing in homes that use gas.[77] State governments should also ensure that new public housing does not use gas.

72. Cost estimate assumes 100 per cent uptake and includes avoided depreciation costs using the declining value methodology for existing replacements. 15 per cent of landlords do not pay tax and would not benefit from the write-off. Figure does not account for growth in the absolute number of rental properties. Extending the broad-based instant asset write-off for 12 months in the 2021 Budget was estimated to cost the budget $20 billion: Treasury (2022, p. 29)
73. Lang et al (2022).
74. The federal government has committed to using a portion of the investment returns from the Housing Australia Future Fund to fund Indigenous housing upgrades: National Indigenous Australians Agency (2023)
75. Victorian government correspondence.
76. Federal Government (2023).
77. Housing Australia will be established by the passage of the *Housing Australia Future Fund Bill 2023*, and will administer the returns from the Housing Australia Future Fund.

4.2.3 Use regulation to influence choice

Setting a date for all rental properties to be all-electric would do four things. It would encourage private landlords to make the choice to upgrade to electric. It would encourage purchasers of investment properties to prefer all-electric properties. It would encourage appliance suppliers to increase the supply of electric appliances. And, because investment properties can later become owner-occupied, it would increase the overall stock of all-electric homes.

A date could be set using minimum rental standards, which are currently controlled by state governments.[78]

Minimum rental standards could be phased in at different rates for different appliances. Water heaters and cook-tops and stoves have shorter lives (12 years) than heating systems (15 years).[79] Cook-tops are less likely to be subject to space constraints, and require less planning to replace than water heaters or heating systems. Minimum standards should reflect this.

Most Australian homes are poorly insulated. Minimum rental standards should include a requirement for ceiling insulation before requiring electric heating.

Phase-out dates for the sale of gas appliances (see Chapter 3) should be co-ordinated with minimum rental standards, and will assist in making an end-of-life upgrade to electric the norm for landlords.

78. Only two jurisdictions currently include energy in their minimum rental standards: the ACT government requires rental properties to have ceiling insulation (from 1 April 2023); the Victorian government requires an energy efficient heater to be installed.
79. Appliance lifetime based on ATO depreciation schedule for residential investment properties: ATO (2022).

4.2.4 Provide better information for landlords and tenants

Private landlords generally do not believe that energy upgrades attract tenants. And tenants have no information about the energy performance of a home when they are signing a lease.

Disclosure of energy performance at the point of sale or lease was agreed to by energy ministers in 2004.[80] Twenty years later, only the ACT has implemented it. It is well beyond time for other states to catch up, and to modernise the commitment to reflect the task of getting to net zero. Financial institutions are now demanding disclosure to better enable them to offer ‘green’ mortgages and home electrification financing.[81]

The federal government could motivate states by making access to funding for home electrification conditional on the states implementing mandatory disclosure. To complement this, the federal government could fund skills development and rating tools for property managers, to help them rate properties more easily and quickly.

4.3 What to do about multi-unit buildings

About 1.6 million Australian households own and occupy apartments, units, or flats. These households face additional hurdles to upgrading to all-electric, as do the landlords of rented properties in multi-unit buildings.

Some gas appliances in multi-unit buildings are the responsibility of the dwelling owner (for example, cook-tops), and some are managed centrally by the body corporate. The mix varies from building to building. In small, older blocks of flats there may be individual gas meters for each dwelling. In larger, multi-unit buildings such as apartment towers, water heating is often managed centrally, and in

80. MCE (2004).
81. Eyres (2023).

some cases heating as well. In these buildings, occupants do not have their own gas meter and do not receive a gas bill. Instead, gas use is rolled into their body corporate fees. Many multi-unit buildings also have common areas that use gas for things such as pool heating and BBQs, again paid for by body corporate fees.

This complicates the savings from upgrading to all-electric. Where an apartment-dweller in a building with central gas provision upgrades from a gas to an induction cook-top, they will not get a saving unless their body corporate agrees to reduce their fees. And, they must pay for the electricity used by the cook-top.

Upgrading centrally provided appliances requires the agreement of all owners, and has a high capital cost. And some buildings will have space constraints that limit capacity to upgrade. For example, centralised gas water heaters take up less space than centralised heat pumps.

In all cases, the gas cannot be turned off to the building until all dwellings have been electrified.

Governments should accept that it will take longer to upgrade all multi-unit dwellings to all-electric. Gas phase-out plans should reflect this.

State governments should sponsor trials of retrofitting various typical multi-unit buildings, and share the lessons nationally. One of these examples should be multi-unit public housing, which state governments will need to upgrade anyway.

Some councils have moved to prevent construction of multi-unit buildings using gas.[82] Governments should ban new gas connections for multi-unit buildings immediately.

82. For example, Melbourne City Council: Waters (2023); and Canterbury-Bankstown Council: Pike (2021).

5 All-electric has to be the preferred choice for all households

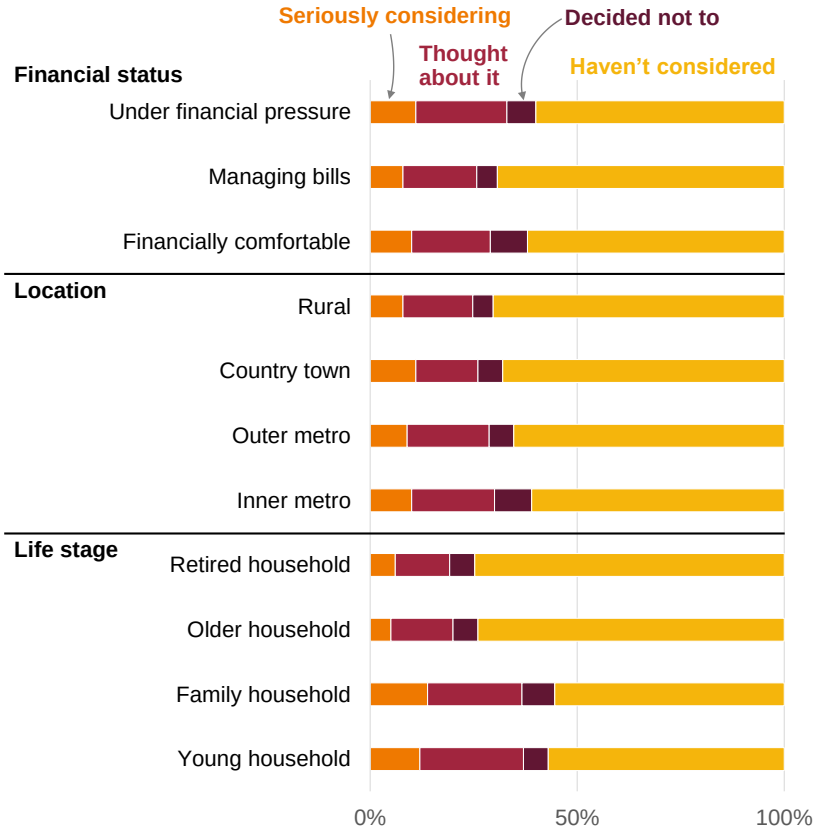
For the transition to an all-electric residential sector to be successful, all-electric has to be the preferred choice for all households. Yet, most households with gas haven't given it much thought.

About 40 per cent of households in each state are in a position to upgrade their home to all-electric: they live in a free-standing home, they are in a higher income bracket, they have more than $15,000 available to spend, and they aren't renting. But households vary widely. They include inner-city and regional households, young families and empty-nesters, big houses and small houses, Victorian-era houses and modern houses, blended multi-generation families and single-parent families, working people, retired people, and stay-at-home parents. Everyone's pathway to all-electric will be different.

Once governments have created certainty about the timeline and pathway to eliminating gas use in the residential sector, they should do three things to influence the choices people make about when and how they upgrade to all-electric homes.

First, governments should prepare long-term, consistent, targeted communications campaigns. Then, they should eliminate any regulatory barriers to all-electric homes. Third, they should make all-electric the superior choice, and eliminate encouragement in the other direction. All these actions set the stage for phasing out the sale of natural gas appliances, so that the last remaining gas appliances are replaced with electric ones by default at the end of their lives.

Figure 5.1: Most households with gas haven't considered upgrading
% of respondents



Notes: Survey of 1,212 households with mains gas in October 2021, asked 'Some Australian households have recently been cancelling their gas supply and converting their home to running on electricity only. Which of the following best describes you?'

Source: ECA (2021).

5.1 What Australians prefer now

About 65 per cent of Australian homes have at least one gas appliance.[83] In 2021, less than half of households (except in the ACT)

83. Energy Networks Australia (2021). This includes homes using LNG.

had given any thought to running their home on electricity only, with only 9 per cent saying they were seriously considering it (Figure 5.1 on the previous page).

5.1.1 Water heating

The percentage of households using gas for water heating has been growing in every state (Figure 5.2). This reflects two factors: state governments have encouraged households to install gas water heaters to reduce residential greenhouse gas emissions and save money.[84] And, the popularity of instantaneous gas water heaters has been growing rapidly. Many consumers consider instantaneous gas water heaters superior to gas-storage and electric water heaters because they never run out of hot water. Instantaneous water heaters also take up less space.

5.1.2 Staying warm

The percentage of homes relying on gas for heating has been falling since 2010 in every state and territory except the ACT (Figure 5.3 on the next page). In part this can probably be explained by the rise in home air-conditioning. Air-conditioning systems (other than evaporative coolers) can also be used for heating in winter. In places such as Melbourne and Canberra which have hot summers and cold winters, it is likely that many households have air-conditioning and gas heating.

The need for residential air-conditioning is likely to grow as summer peak temperatures increase with climate change. About 60 per cent of

Figure 5.2: Gas water heating has become more popular since 2000
Proportion of households using gas and electricity to heat water

Notes: Gas totals include gas-boosted solar water-heaters, and electricity totals include electric-boosted solar water-heaters. All gas-boosted solar water heaters are assumed to use natural gas, because separate LPG data is not available. In Queensland and WA, the number of solar water heaters boosted by LPG may be significant, and a larger number of households use LPG for water-heating.

Source: Grattan analysis of Energy Consult (2021).

84. Hot water heating is the largest source of energy use and emissions in an Australian house. Gas water heaters were more efficient at heating water than electric-storage heaters, and cheaper to run. Because Australia's electricity supply was historically emissions-intense, gas water heaters also produced fewer greenhouse gas emissions than electric storage water heaters.

households surveyed in Victoria report intending to install reverse-cycle air-conditioning.[85]

5.1.3 Cooking

National data on the split between gas and electric cooking in households are not available. But we can get some idea of people's current preferences from other data.

There is some evidence in NSW that people seeking to buy a house are searching for homes with gas.[86] Given the low levels of gas heating in NSW, this may be driven by a preference for gas cooking.

One focus group in Melbourne showed that gas cooking was perceived as being faster and providing more control than electric cooking. The same group also showed that households liked having gas because it meant they could cook (and shower and stay warm) during power outages. Participants were also aware that Victoria's carbon-intense electricity supply made the environmental benefits of upgrading to electric smaller at present.[87]

Another survey in Victoria found that three-quarters preferred gas for cooking, and that the possible need to buy new cookware to go with an induction cook-top was a strong disincentive to upgrade.[88]

5.2 What explains Australians' choices?

Australians' choice of gas or electricity for hot water and heating is influenced by regulation, circumstances, information, and personal preferences.

Figure 5.3: Electric heating is more popular than gas in most states
Proportion of households using gas and electricity for space heating

Source: Grattan analysis of Energy Consult (2021).

85. JWS Research (2021, p. 48).
86. Domain (2023).
87. Based on market research conducted for a Victorian council.
88. JWS Research (2021, p. 30). Ceramic and aluminium cookware cannot be used with an induction cook-top without purchasing a converter disc. Converter discs cost about $50-to-$60.

5.2.1 Regulation affects choice

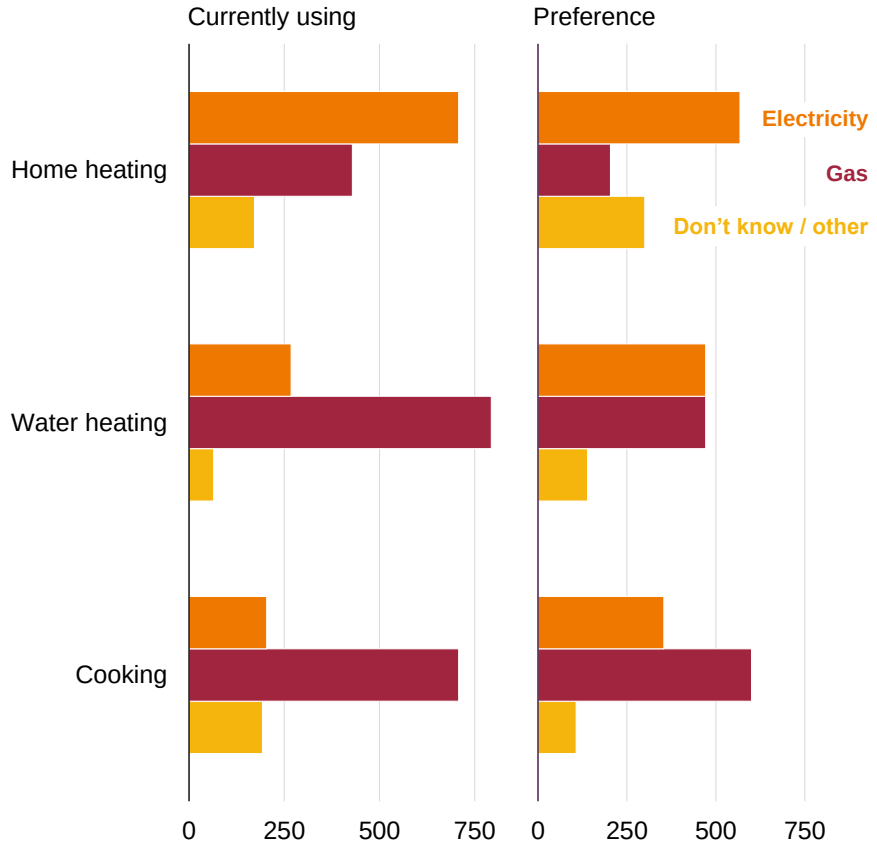
Heating systems and water heaters are part of the building fabric: they are there when someone moves into a house, and they remain behind when they move out. Until recently, it was mandatory for new homes in the ACT and Victoria to have a gas connection installed. This provided a strong nudge for home builders to install gas appliances, and locked large numbers of home owners into using gas. In NSW, planning regulations made it difficult to meet sustainability benchmarks for new homes with electric storage water heating, providing another nudge towards gas, because gas water heaters are much cheaper than solar.[89]

5.2.2 Urgency trumps preferences

Households report that they are open to changing from gas to electricity when appliances break (Figure 5.4). But these preferences don't always flow through to an actual change. About three-quarters of households surveyed in Victoria who have replaced a gas heating system recently report installing the same type of system.[90] Similarly for water heating (Figure 5.5 on the next page): the overwhelming majority of gas water heaters replaced in Victoria are replaced with gas water heaters when they break.

Replacing a broken water heater is understandably an urgent need, and replacing gas with gas is likely to frequently be the cheapest and easiest option. The lack of readily available advice in support of electrification is likely to be an additional influence.

Figure 5.4: What people use now may not reflect their preferences
Number of respondents



Notes: Survey of 1,072 households with mains gas in March 2023, asked 'Imagine that the main appliances/systems you use for home heating, cooling, cooking, and hot water broke within the next year and needed to be completely replaced. What would be your preferred source of energy for the replacement appliances/system you choose?' Respondents could choose all options for 'currently using' that applied to them.

Source: SEC Newgate (2023, pp. 28–29).

89. The NSW Building Sustainability Index (BASIX) gives the highest score to solar water heaters, then instantaneous gas water heaters, then gas storage water heaters: NSW Government (2023). A new home with an electric storage water heater is unlikely to achieve a pass score unless the home also has solar PV.
90. JWS Research (2021, p. 45).

5.2.3 A lower bill doesn't mean cheaper

Some people with gas at home think gas is cheaper than electricity because their gas bill is lower than their electricity bill.[91] This is natural, but based on a misunderstanding. Households use gas and electricity for different things, and when a comparison is made of the costs of doing the same task (for example, cooking a meal or heating a room), the electric option is usually cheaper. See Box 1 on page 9 for why this is the case.

5.2.4 Personal preferences

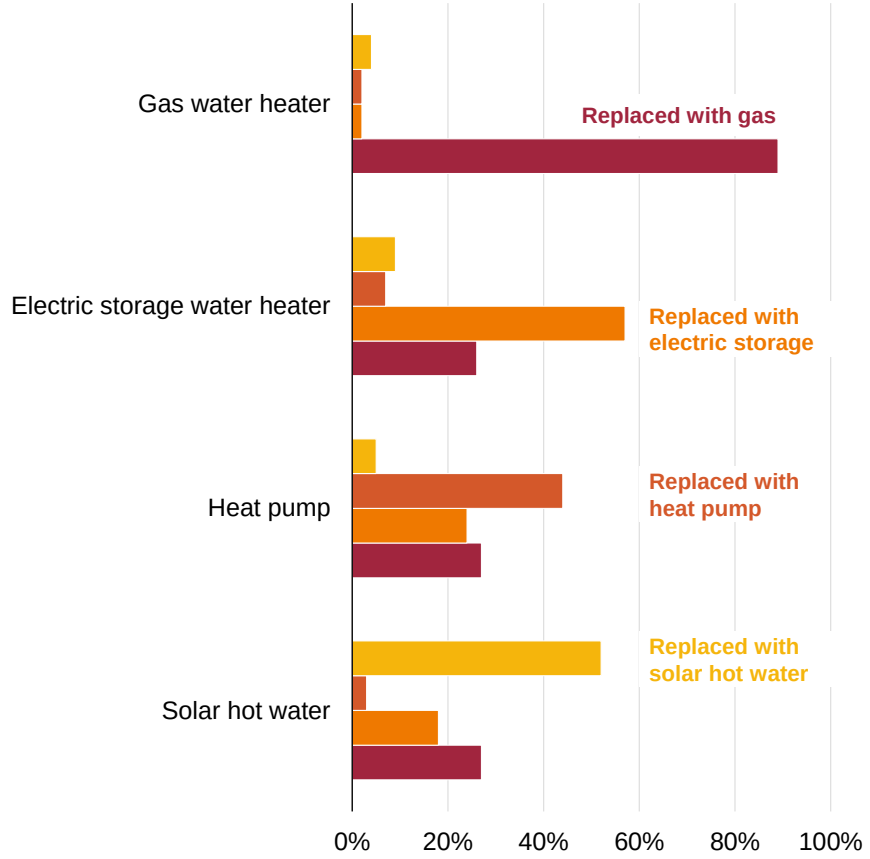
Whether someone uses electricity or gas at home can also be a matter of personal preference. This is particularly the case with cooking. Some cooking techniques and recipes have evolved alongside the use of gas to the point where using gas is perceived as integral to the flavour and texture of the dish.[92]

This may be why people are less likely to report being willing to replace a broken gas cook-top with an electric one (Figure 5.4 on the previous page). In a survey of 2,000 Victorians, 63 per cent reported a preference for gas cooking, and 73 per cent reported having replaced a broken gas cook-top with a new gas cook-top in the past five years. But in the same survey, 62 per cent reported being likely to consider an induction cook-top in the future.[93]

Personal preferences are also influenced by advertising and financial incentives. Since the earliest days of gas use in Australia, gas appliance suppliers and gas retailers have sought to influence

Figure 5.5: People tend to stick with what they know when they replace water heaters

Percentage of old water heaters replaced with new ones, by type



Notes: Survey of 1,500 owner-occupiers in Victoria with mains gas in August 2021, asked 'What type of hot water system do you have in your home' and 'What was your old hot water system, the one that you replaced most recently?'

Source: JWS Research (2021).

91. Based on market research conducted for a Victorian council.
92. Berger (2021).
93. JWS Research (2021, pp. 26, 32).

households to switch to gas, through practical demonstrations and financial incentives. These continue today.[94]

5.3 Governments should help shift people's preferences

A shift away from gas in homes is an essential part of response to climate change. But householders will only upgrade to all-electric if they see the benefits, for themselves and others.[95]

Setting a date for an end to residential gas use is the critical step to shifting people's preferences. The sooner a date is set, the longer people have to make choices that suit their particular circumstances. Ruling out hydrogen and biomethane as widespread substitutes (Section 1.4.1) would also provide households with certainty about their future options.

Australian governments have helped shift people's preferences through well-designed public policy in the past. From wearing seatbelts and applying sunscreen, to where and when it's acceptable to smoke or use water, government policies have shaped our current preferences, to improve the lives of Australians.

Policies that change people's preferences have often been characterised by five clear steps:

- Clear, targeted, long-term communications campaigns
- Removing regulatory barriers to preference changes
- Changing the costs and benefits
- Amplifying and reinforcing the preferred choice
- Enforcing the preferred choice through regulation once it becomes mainstream.

5.3.1 Communicate, communicate, communicate

To change people's preferences requires consistent communication over long periods. This is especially important when everyone needs to act and when the change is about technology.

The switch from analog to digital TV is a good example of successful communication to achieve a technology change.

The decision to move Australian television networks from analog to digital was made in 1998.[96] The switchover itself began in 2010, and was rolled out over three years. Online information for households was available from 2001, and a widespread communications campaign began in 2008. The campaign included explanations of why the switchover was taking place, the benefits to individuals of switching, detail on what households needed to do, and extra help for people who needed it.[97]

The ACT government has begun communicating with Canberra residents about the phase-out of residential gas use, 22 years ahead of the goal date. Campaign materials explain the context for the decisions, and the benefits for households. A clear timeline of intermediate dates is set out, encouraging households to start planning for upgrades. Households can develop a personalised plan, get help, and find out where to get subsidies and assistance.[98]

State governments will need to fund and implement similar campaigns, and the federal government should use its $1 billion Household Energy

94. See for example Goulburn Herald (1883), Cootamundra Herald (1936), EVO Energy (2019), Jemena (2023a).
95. Gordon et al (2022).
96. Parliament of Australia (1998).
97. Milman (2008).
98. ACT Government (2022b).

Upgrades scheme to communicate a message about the pathway to an all-electric home.

5.3.2 Red tape has been removed

There are no laws preventing households from upgrading from gas to all-electric.

The biggest regulatory 'nudge' towards gas – the requirement for new properties to have gas connections – has been removed by the Victorian and ACT governments.

All states and territories should ensure building and planning regulations continue to favour all-electric homes.

5.3.3 Make it easy and low-risk for people to upgrade

People will not upgrade to all-electric if they believe they will be less comfortable, or if they are buying an inferior product. Governments can help clear these hurdles.

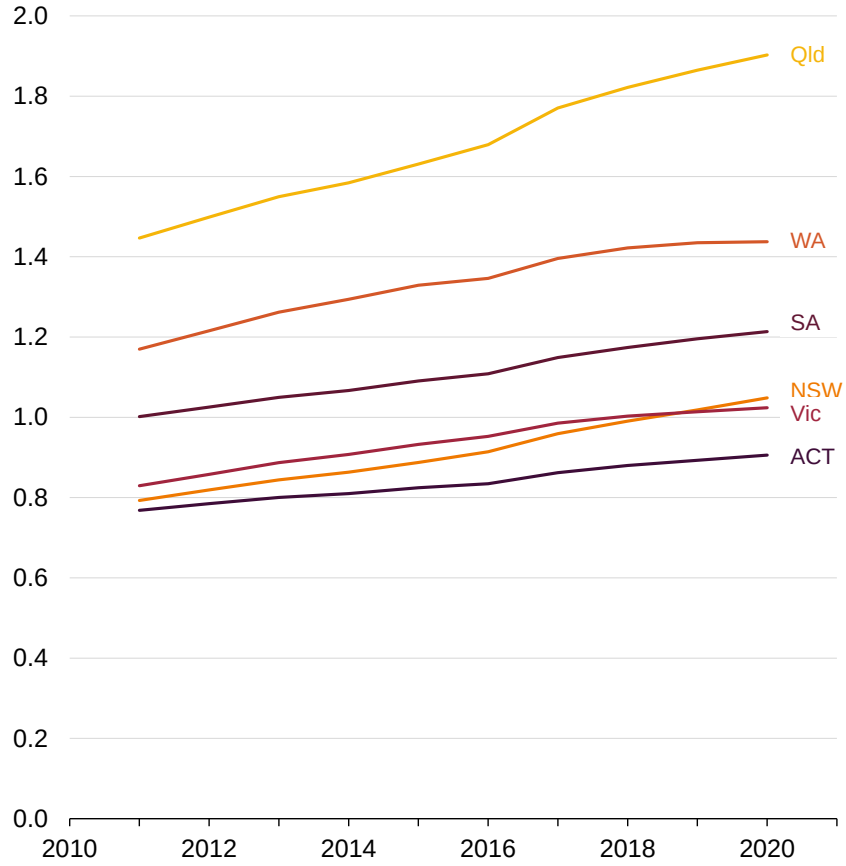
Try before you buy

Use of reverse-cycle air-conditioning in Australian homes has been growing over the past decade (Figure 5.6). State governments should use communication campaigns to encourage households to try using their reverse-cycle air-conditioners during winter to reduce or even eliminate use of their gas heaters.

Campaigns to encourage electric cooking could draw on the experience of the Ginninderry development in the ACT. This was the first Canberra suburb to be built without gas, and home-buyers had to be convinced that cooking on an induction stove was better than cooking with gas. The project developer enlisted local chefs to conduct cooking demonstrations in the display village. The proportion of potential home-buyers willing to consider buying an all-electric home rose from

Figure 5.6: Use of reverse-cycle air-conditioning has been growing in all states

Average number of air-conditioning units per household



Note: Includes ducted and split-system reverse-cycle air-conditoiners.

Source: Grattan analysis of Energy Consult (2021) and ABS (2019).

67 per cent to 88 per cent; and those who said they would definitely not consider an all-electric home fell from 10 per cent to 4 per cent.[99]

Regulate for quality and performance

The performance of home appliances is regulated through the *Greenhouse and Energy Minimum Standards (GEMS) Act 2012*, a national framework for appliance and equipment energy efficiency. It promotes the development and purchase of appliances and equipment that use less energy and create less emissions.

GEMS requires appliances to meet a minimum energy performance standard. This standard ratchets up over time, so that appliances are constantly becoming cheaper to run.

Of the key appliances for-all electric homes – heat-pump water heaters, reverse-cycle air-conditioners (RCACs), and induction cook-tops – only RCACs are regulated.

In Section 3.6.1 on page 25, we recommended GEMS be used to put gas and electric appliances on a level playing field. As part of this, governments should bring heat-pumps and induction cook-tops into the GEMS framework.

Electric heaters are not included in the GEMS framework either. As noted in Figure 2.1 on page 14, these heaters do not save consumers money when they replace gas, but they are very cheap to buy. Bringing them into the GEMS framework would obligate manufacturers to improve the performance of electric heaters or stop selling them.

5.4 The role of LPG

This report focuses on natural gas, delivered through the gas network. But about 750,000 Australian homes use bottled LPG for heating or water heating, and an unknown number use it for cooking. These homes are more common in Queensland and WA.[100] LPG is also used widely in all states in barbeques and patio heaters.

Switching from natural gas to LPG inside the home requires changing the burners in existing appliances, and other kitchen modifications. The result allows people to continue 'cooking with gas'.

It would be a mistake to replace widespread natural gas use with widespread LPG use. Using LPG produces 20 per cent more greenhouse gas emissions than using natural gas for the same task.[101] It's also less convenient: mostly it falls to the householder to monitor their gas bottle, notice when it is running low, and arrange the delivery of a fresh bottle.

Nevertheless, state governments might want to consider allowing some limited switching to LPG as an interim measure on the way to an all-electric residential sector. This may assuage concerns about forcing people to change how they cook, particularly among the elderly and first-generation migrants.

This option was given to residents of Esperance, WA. In 2022, the operator of the reticulated gas network (Infrastructure Capital Group) announced it would be shutting the network to its 400 residential, commercial, and government consumers. The consumers were given the choice of switching to LPG or electricity. About 9.5 per cent chose LPG.[102]

99. Ginninderry (2017, pp. 31–32).

100. Energy Consult (2021).
101. DCCEEW (2023).
102. These are preliminary findings from the Esperance Energy Transition Program.

6 We will need robust supply chains and a skilled-up workforce

As the world pivots to clean energy, there is huge and growing demand for key technologies and skilled labour to get the job done.

Australian governments can plan ahead to build strong supply chains of the key technologies for homes – heat pumps, induction cook-tops, and reverse-cycle air-conditioners for heating and cooling. Even if Australian companies emerge to make these appliances, we cannot afford to be locked out of global markets.

We also need enough electricians to switch five million dual-fuel homes to electricity. Yet we already have a shortage of electrical workers. Governments can help close the skills gap by supporting plumbers to get a limited electrical licence, and making re-skilling easier by providing low-interest loans for apprentices.

6.1 We need to build strong supply chains

Electrifying homes will require robust supply chains for electric appliances. Global demand for green appliances – such as heat pumps – is growing massively and rapidly. Leading heat pump manufacturers are investing $6 billion in expanding production.[103] The strain on supply chains will grow as countries vie for imports.[104] Unless it has a strategy, Australia could get locked out of supply chains.

Policy certainty is key to strengthening supply chains. The UK has created a target to strengthen its heat pump supply chain: installing 600,000 heat pumps a year from 2028.[105]

Some countries are addressing supply chain vulnerabilities by turbo-charging domestic manufacturing. The US government, for example, has committed A$372 million to developing heat pump manufacturing onshore.[106]

Australia should not necessarily follow the same path. Though we may mine the ores that produce the metals for key technologies, we lack a comparative advantage in mass-scale manufacturing, where labour costs bite.[107] Current Australian manufacturers of gas appliances such as ducted heating may find niche opportunities in an all-electric world.

Australia can't match the EU and US for subsidies. But we can benefit from the price reductions those bring about. There are already zero tariffs on the import of US-made, Japanese-made, and Chinese-made heat pumps, cook-tops, and reverse-cycle air-conditioners.[108] And on completion of negotiations on the EU free trade agreement, tariffs on appliances from the EU will probably drop from 5 per cent to zero.

Implementing the recommendations in previous chapters would build this policy certainty in Australia. Setting a gas phase-out date, banning new connections, subsidising social housing to go electric, and establishing tax write-off and low-interest loan schemes would form a landscape where the signal to suppliers is clear: the Australian market for electric appliances will continue to grow.

Regulating the performance of electric appliances, as proposed in Section 5.3.3 on the previous page, would ensure that the appliances we import are good quality. When a supply chain is stretched, quality may be the first compromise. Australia needs to make sure it is only buying efficient products.

103. IEA (2022).
104. Ibid.
105. Government of the United Kingdom (2023, p. 6).
106. Energy.gov (2023).
107. Wood et al (2022).
108. WTO (2023).

6.2 Avoiding workforce bottle-necks

Electrifying Australian homes will mean a surge in demand for electricians – or tradespeople with electrical licences. It will also mean a decline in demand for plumbers, who currently install and maintain gas appliances.

The challenge is thus two-fold: meet growing demand for electrical workers while also managing the displacement of workers in the plumbing industry.

6.2.1 Demand for already-stretched electricians will grow quickly

The 2021 National Skills Commission found a shortage of electricians in all states except Queensland.[109] In 2020, the Clean Energy Council found that 40 per cent of industry respondents had difficulties finding electricians.[110]

In the coming decades, demand for electricians will continue to grow. The number of electricians is expected to rise from 143,000 in 2021 to 157,000 in 2026.[111] Those extra 14,000 workers will be in high demand. Australia will need an additional 12,500 skilled workers for large-scale renewable energy projects, many of whom will be electricians.[112]

Add to this the large task of home electrification. There are 11 million gas appliances in homes across Australia.[113] At a minimum, there are 11 million hours of labor involved in replacing these with electric appliances.[114] Spread over the 27 years to 2050, this amounts to 1400 hours of labour per day – 175 electricians working full time. This is significant added demand for an already stretched workforce.

109. National Skills Commission (2021).
110. Clean Energy Council (2022).
111. Australian government (2021).
112. AEMO (2022b).
113. Energy Networks Australia (2021).
114. Grattan calculation based on ACIL Allen (2020).

6.2.2 Demand for gas-fitters will decline

In the short term, there remains strong demand for the 96,000 plumbers currently working in Australia. The workforce is expected to grow by 8.6 per cent by 2026. There are still thousands of homes being connected to the gas network each year, all requiring gas-fitters (Figure 2.5 on page 18).

In the longer term, there will be a significant workload to remove the 11 million existing gas appliances. But as households electrify, demand for gas-fitting work will inevitably fall away.

Plumbers could help fill the trades gap in electrical work. A restricted electrical licence should be added to the Certificate III in plumbing. And existing plumbers – who have a four-year apprenticeship under their belt – should be helped to extend their skills to include electrical work.

6.2.3 Include a mandatory restricted electrical licence in the plumbing qualification

To reflect the changing market, a Certificate III in plumbing should require a restricted electrical licence, starting immediately. This would allow plumbers to install appliances such as reverse-cycle air-conditioning units and heat pumps for hot water. This extra qualification would add eight days to an apprenticeship.[115]

Plumbers would benefit financially. A typical quote for the removal of a single gas appliance is $150 for one hour. Installation of a reverse-cycle air-conditioning unit will typically cost $400 for the same amount of time.[116]

115. Correspondence with the Plumbing and Pipe Trades Employees Union Vic and WA.
116. ACIL Allen (2020).

6.2.4 Help existing plumbers to up-skill

For the 96,000 existing plumbers, there should be a clear pathway to up-skilling. Some may want to do the eight-day training for a restricted electrical licence.[117]

Others may want to retrain as an electrician. One of the major barriers to doing so is the large pay-cut which comes with doing another apprenticeship. Apprenticeships for electricians are four years, and are paid at $530 per week in the first year, and $780 per week in the fourth year.[118] Assuming someone on an average plumber's salary wanted to retrain, they would be taking a pay cut of $45,000 in the first year alone. As the chief executive of the National Electrical and Communications Association, Oliver Judd, says: 'It's simply not feasible for a mature-aged worker with a family, paying rent or a mortgage, to drop back to junior apprentice wages.'[119]

Provide loans to mature-aged tradespeople in TAFE

The federal government should provide low-interest loans to electrical apprentices. It has done this before. In 2020 – during the pandemic – it provided a wage subsidy for electrical apprentices worth $1.2 billion. This package gave mature-aged workers a wage subsidy of up to $7,000-a-quarter for the first 12 months of their apprenticeship.[120]

This scheme has since been rolled back. The government should reinstate the policy, in the form of a loan similar to the HECS scheme for tertiary education.

Electricians – once certified – are well-paid. Median full-time earnings are $2,120 per week: 33 per cent higher than the all-jobs median of $1,593 per week.[121] And 86 per cent of electricians work full-time. For these reasons, they are likely to be good credit risks for lenders.

Running this scheme would enable plumbers – and people from any number of trades and industries – to retrain in the electrical trades more easily.

117. Correspondence with the Plumbing and Pipe Trades Employees Union Vic and WA.
118. Electrical Trades Union (2022).
119. Patty (2021).
120. Ministers' Media Centre (2022).
121. Australian government (2021).

7 System challenge: dealing with decline

A disorderly and unplanned push towards all-electric homes would risk inequitable distribution of network costs.

Once constructed, the cost of running the network is much the same regardless of the number of users. The network business could increase prices to maintain its revenue, and those consumers who can't leave due to financial or technical reasons will pay higher and higher bills. The alternative is for the network business to see decreasing revenue with no way to recover.

The risk of this 'death spiral' increases, the longer governments delay setting clear dates for an end to gas.

Widespread electrification means we may need more electricity network. The cost of this will be spread across all users too. Keeping that cost to a minimum requires a more thoughtful approach to how both electricity and gas network costs are regulated.

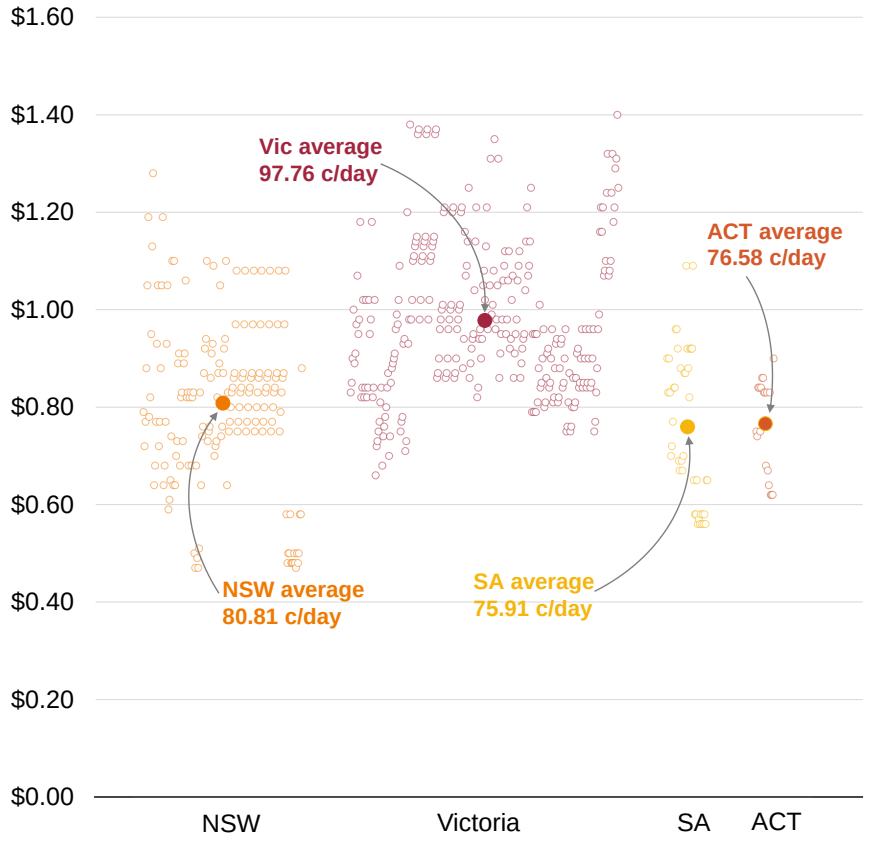
The challenge for governments is to manage a difficult transition safely and equitably.

Governments should take three immediate actions. They should regulate the process and cost of disconnecting from the gas network. They should revisit the use of time-of-use tariffs to flatten peak electricity demand, keeping electricity costs to a minimum. And they should make safety regulations fit-for-purpose for a network that is shrinking.

Beyond these, governments must drive further energy market reform. They must move towards a single regulatory framework with the consumer at the centre. And they need to decide who pays for widespread electrification, how much, and when.

Figure 7.1: Residential gas users pay about a dollar a day to use the gas network

Daily gas supply charges



Notes: Average not weighted by market share. Shows amount charged by gas retailer to gas customer, not amount charged by network business to gas retailer.

Source: Grattan analysis of data from Wattever (2023).

7.1 How gas networks operate

Two types of network are involved in bringing gas from gas fields to consumers. The transmission network moves large volumes of gas from gas fields to large consumers such as power stations, and to so-called 'city gates'. The city gate is where the transmission network meets the distribution network, which moves the gas to smaller end users such as homes, commercial buildings, and small industries.

In this report we concentrate on the gas distribution networks. Similar issues may arise for transmission networks, but not in the immediate future.

7.2 How gas networks are paid for

Distribution businesses are monopolies and are subject to economic regulation.[122] To determine how much gas users should pay to use the network, the regulator considers how much capital and operating expenditure a network business needs to serve existing customers. It also considers demand forecasts and a rate of return on investment. Gas network businesses are allowed to recoup capital investment over the expected lifespan of the assets – up to 80 years in some cases.

Gas network businesses cannot set prices higher than a weighted average price cap, determined by dividing their required revenues by forecast demand. The network business can then recoup these amounts from gas retailers, who in turn charge gas consumers. Prices are set at five-year intervals, striking a balance between certainty for gas consumers and flexibility for network businesses to adjust to changing demand.

Every gas user pays a daily supply charge, regardless of whether they used gas that day or not (Figure 7.1 on the previous page). In addition, each gas user pays a share of network costs, related to the volume of gas they use (Figure 7.2 on the following page).

7.3 What happens as gas use declines

Declining gas use and widespread upgrading to electricity has consequences for gas networks and consumers and for electricity networks.

7.3.1 The impact on gas networks

The pipeline network is a gas network business's core asset. Its value comes from the right to charge people for using it. If the gas network is growing, there are new gas users to help pay the remaining cost of existing assets, and for new assets built to serve the new users. If the network is shrinking, this is not the case.

As gas use declines, gas network owners face difficult decisions: how to recoup the costs of investments they have already made from fewer users, and when to write off assets that no longer have value.

This creates a challenge for the network owner. The amount they can ask users to pay is regulated via price caps. Fewer users means falling revenue, and falling revenue means the economic value of the network falls. Ultimately, the carrying value on the company's balance sheet must be written down, potentially to zero.

Until governments make a definitive statement about the future use of gas, it is difficult for network businesses to make this assessment.

Regulated asset businesses often carry a very high ratio of debt to equity, partly because investors have viewed these businesses as low-risk and banks are prepared to provide more debt due to the lower risk. But with the value of their major asset falling, shareholders won't put in any more money and neither will the banks. As the total asset value declines, the debt-to-equity ratio tips further towards debt.

122. Independent regulators set the revenue that the businesses can earn, strictly in most states and lightly in Queensland.

The point could be reached where the business is no longer earning sufficient revenue to service its debt, and its creditors effectively decide the business is bankrupt. A distressed gas company could then seek a bail-out from government, on the basis that without it, remaining gas consumers will not have gas. This raises the risk that consumers end up paying twice: once via higher gas bills as the network tries to adjust for falling revenue, and again as taxpayers to bail out a distressed network company.

7.3.2 The impact on gas consumers

One way that gas network businesses may choose to respond to falling demand is to ask to be allowed to charge more per user, to cover their costs. In the short term this may work, but in the longer term, gas users may respond by deciding to switch to electricity. As noted in Chapter 3, it is already cheaper for many households to make this switch.

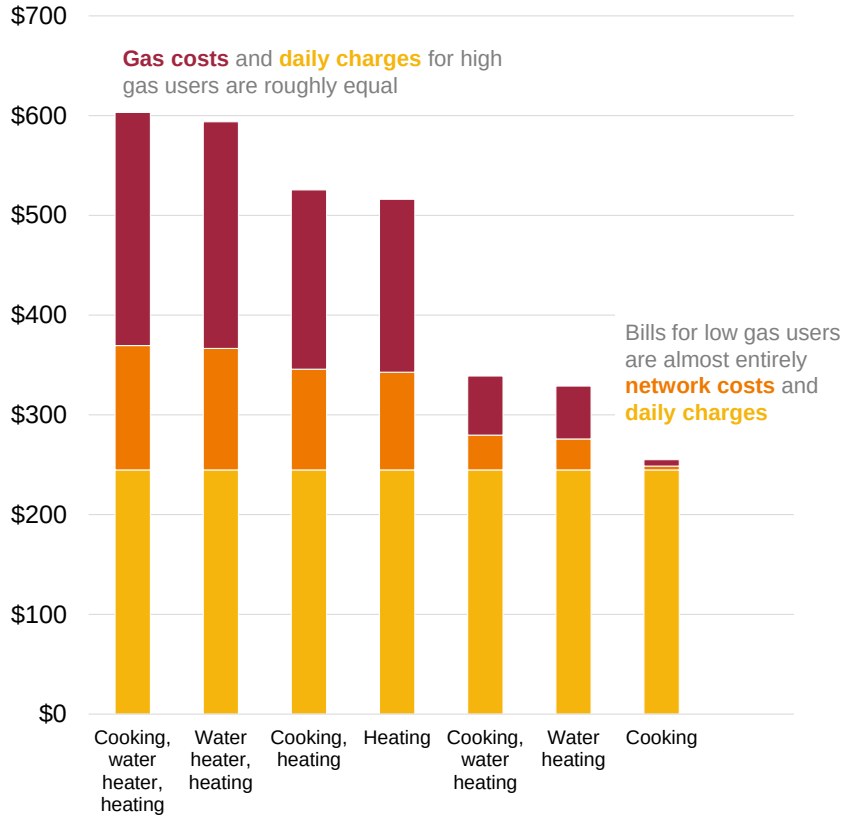
A cycle of higher prices driving consumers away and leading to even higher prices creates the conditions for a 'death spiral'. Eventually, if the death spiral isn't mitigated, it will be untenable for the network to continue functioning.

7.3.3 The impact on electricity networks

As more households upgrade from gas to electric appliances, they will use more electricity. If this increase is substantial, the electricity network – the poles and wires that deliver electricity to homes and businesses – will need to be upgraded. Like gas networks, electricity networks are regulated assets and the cost of using them is spread across all users.

In our 2020 report, *Flame out: the future of natural gas*, we estimated the cost of network upgrades required to support all homes becoming all-electric was $604 million for NSW and the ACT combined, $5.69

Figure 7.2: Most of the gas bill for households that don't use much gas is paying daily charges and other network costs
Breakdown of indicative annual gas bill, by household type



Note: Indicative gas bill for a home in the ACT.

Source: Grattan analysis using data from ACIL Allen (2020) and ActewAGL (2022).

billion for Victoria, and $101 million for South Australia.[123] This was an upper limit, based on simultaneous overnight replacement of every gas appliance. On the best information available today, this estimate now looks overly pessimistic.

Our calculation assumed there was no spare capacity in the current electricity grid. What we didn't account for is that for the vast majority of the year, actual demand for electricity is well below the maximum amount that the grid can supply. There is considerable headroom in the current network, particularly if tariffs are used to encourage consumers to move demand to off-peak times (running dishwashers overnight, for example, or timing when the water heater switches on).

We also assumed a like-for-like replacement of ducted gas heating with ducted reverse-cycle air-conditioning. This would be a very inefficient approach for households to take, and many homes already have reverse-cycle air-conditioning that they use for cooling. If households replace ducted gas heating with reverse-cycle air-conditioning (or just use the units they already have), the need for extra network will be less than our previous estimate.

This doesn't mean that no electricity grid upgrades will be required, although if the shift aligns with replacement, the cost will be spread over 20 years or more.

7.4 The regulatory challenge

The challenge for governments is to adjust the regulatory framework so it is fit to deliver a future gas network that is the right size (much smaller than today) and in the right places (largely outside residential areas). Regulating in the best interests of consumers will require determining how the costs of a managed decline of gas networks, and how any new investment in electricity networks, can be shared fairly between users, network owners, and governments.

A clear date for when the gas distribution network, or most of it, will be closed will make this determination much easier. An end date, and an end to new connections, makes clear the future costs of the network and the period over which these costs can be recovered. The earlier these decisions are made, the longer the time period over which costs can be spread, and the lower the costs to consumers.

Governments need to consider the distribution of all these costs: who should pay, when, and how.

7.4.1 What is fair for consumers?

Even though individual households may save money by upgrading from gas to all-electric appliances, the overall change across the system is not cost free. Those who leave early may end up imposing costs on electricity users, and will push up costs for remaining gas users. There is at least an equity argument that the latter is an unfair shift of the cost burden onto those remaining gas users. Those who remain will also be paying their share of any higher electricity costs.

A disorderly shift towards all-electric homes will mean costs will be distributed inequitably. Those who are able to upgrade will do so and start saving money. The households that are likely to stay on gas will be those where the occupants have less capacity to change: renters, low-income families, and those without easy access to cash.

In previous chapters, we made the case for governments to introduce policies to ensure these households can upgrade to electric appliances when their gas appliances reach end-of-life. But this will be a slow process, and in the meantime, these households are still using, and paying for, gas.

123. Wood and Dundas (2020).

Paying to stay, paying to leave

Gas consumers who leave the network must pay to have their gas disconnected or abolished. Disconnecting involves locking the meter and closing the household's gas account. Abolishing means removing the meter and the gas pipes between the meter and the main.

Disconnection charges are modest – ranging from an average of $38 in South Australia to $68 in the ACT.[124] The charges for abolishing are not, varying from about $750 in the ACT to more than $1,100 in NSW.[125]

Currently, a household that upgrades to all-electric appliances can ask the local gas network owner to disconnect them, or to abolish the connection. Some consumers report not being told about the cheaper disconnection option; others complain about feeling 'ripped off' by having to pay the fee for abolishing their connection.[126]

The gap between the charges for disconnecting and abolishing creates a potential safety risk. Even though the meter is locked, pipes on the property still may contain gas. If the property is sold, new owners may may be unaware of this hazard.

7.4.2 What is fair for networks?

Gas network businesses and the Australian Energy Regulator (AER) were slow to recognise the risk to gas networks from policy responses to climate change.

The Victorian government committed to a net-zero target of 2050 in 2017; the ACT government to a 2060 target in 2010, revised to 2050 in 2016, and 2045 in 2018.

Some networks have experimented with green gas alternatives, but these have been small, heavily subsidised projects and slow to get started. Until the most recent round of network access determinations, no network businesses had asked the AER to accelerate the depreciation of their assets, nor did any of them stop expanding.

However, gas network businesses in Victoria and the ACT did not have full choice in whether or not to expand their networks. Until recently, these governments required a gas connection to be provided to new homes and developments. As well, a government decision to backflip from encouraging or mandating expansion to banning new connections, and phasing out the sale of gas appliances (see Chapter 2), devalues the gas networks.

The National Gas Law includes a principle that 'a service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in providing reference services'.[127] The AER's view is that this does not mean such cost recovery is fully guaranteed under any circumstances.[128]

The businesses have been allowed to make a return on investments above the risk-free rate, in return for taking on some risk that they will not recoup every cent they spend. However, the risk premiums that have been allowed to network businesses may not appropriately reflect the future risks they face. This risk is crystallising now.

It is not unknown for government decisions made in the public interest to devalue privately-held assets, even to the point of stranding them. State government commitments to renewable electricity devalued coal-fired power plants, for example, and these assets are now being written down, closed, and decommissioned.

124. Grattan analysis using data from Wattever (2023)
125. EVO Energy (2023), Jemena (2023b)
126. Perkins (2023).
127. *National Gas (South Australia) Act* (2008).
128. Australian Energy Regulator (2021).

7.5 What has already been done about the emerging problem

The AER has already made accelerated depreciation available to gas network owners, which allows them to recoup more of their costs sooner. If the customer base remains static, accelerated depreciation increases network charges for all users. If the customer base declines, accelerated depreciation pushes increasing costs onto the consumers who are not willing or able to leave the network.

An early decision about an end date for residential gas use, and a ban on new connections, would reduce the amounts that consumers and shareholders have to pay via depreciation.

The AER has also acted to close the gap between the charges for disconnecting and abolishing for individual consumers. In Victoria, charges for abolishing will be regulated from 1 July 2023. Individual Victorian consumers requesting abolishment will pay a maximum of $220. The network business will recover the balance from its operating costs (that is, it will be spread across all consumers).

These temporary arrangements will help manage risk over the next five years. Beyond this, in the absence of clear policy direction from governments, the AER's regular process of determining costs and revenue for gas network businesses is not the best avenue to deal with safety and equity issues caused by widespread electrification.

7.5.1 Why accelerated depreciation is not enough

In the absence of clear policy direction from governments, the AER did the right thing by allowing accelerated depreciation. But while accelerated depreciation provides a little breathing space, it doesn't solve the problems outlined above in the long term.

Accelerated depreciation applies only to physical assets. If the number of gas users is shrinking, and networks are no longer expanding, operations and maintenance costs become a larger part of the network businesses' cost bases. As noted above, these costs don't change much with the number of users.

Accelerated depreciation only accelerates a death spiral. And because accelerated depreciation allows gas network businesses to make more revenue sooner, it tends to protect the interest of the businesses over that of consumers.

7.6 What should be done next

There is no point in governments accelerating the rate of upgrades from gas to all-electric homes if they do not also adjust the regulatory framework. The best interests of all consumers will be served only if regulation results in equitable and efficient distribution of costs.

Other countries have started grappling with these issues. The European Union is establishing a regulatory framework that supports the decarbonisation of the gas market, and greater integration between gas, electricity, and hydrogen markets and systems. It requires distribution networks to plan for decommissioning, and requires governments and network businesses to identify efficient cost allocation that protects consumers over the remaining asset life. It also limits repurposing the network to hydrogen: this is allowed only where there are no alternatives that are more cost-efficient and energy-efficient. Cross-subsidisation between current gas users and future hydrogen users is expressly prohibited.[129]

The issues raised above can't be dealt with incrementally, on a case-by-case-basis. The AER has done what it can within the constraints of the National Gas and National Electricity Laws. Australia's energy ministers now need to consider how they are going to regulate the gas and electricity networks through the energy

129. European Parliament (2023).

transition. There are actions they can take now, and there is a program of reform that they need to start working on now.

7.6.1 Regulate disconnecting or abolishing gas connections

At present, network businesses do not know if a disconnection is temporary, or whether it represents a gas consumer who has upgraded to all-electric and does not plan to return to the gas network.

The cost of decommissioning part of the gas network can be minimised if all the network in an area is removed at once. But because households will leave at different times, it could be more efficient to disconnect individual customers until removing the network can be done on one street or in one suburb.

The regulatory definitions for disconnecting or abolishing gas connections should be changed, to differentiate between:

- Temporary disconnections: disconnecting a home in anticipation that it will be reconnected. This would cover households being disconnected for not paying their bills, and disconnections to allow minor building works or repairs to be carried out safely.
- Permanent disconnections: disconnecting the house as a step towards permanently removing the gas network in a geographical area. This would be relevant where all gas appliances had been removed from the house. Because of the ban on new connections, it would not be possible to reconnect these houses later.
- Abolishing connections: immediately removing a gas connection. This would apply when households, for whatever reason, do not want to wait for the network to be removed from their suburb.

For permanent disconnections and abolished connections, the AER should extend the approach taken in Victoria to the next round of access arrangements for NSW, South Australia, and the ACT, and set a maximum fee for individual consumers. This would improve consistency between network areas, and make potential costs more transparent for consumers.

Setting a maximum fee for abolishing individual connections is only a temporary solution. As the number of customers leaving the network grows, recovering the costs above the maximum fee will put upward pressure on tariffs for remaining consumers.[130]

7.6.2 Manage electricity network costs by managing the peak

Reducing the cost of network upgrades to support greater home electrification can be achieved by paying attention to growth in peak demand. For all-electric homes, this means paying attention to winter heating loads.

The best way to minimise winter heating loads is to improve the thermal performance of houses. This means investing in ceiling insulation, draught-sealing, and better windows.[131] The Household Energy Upgrades Fund, announced in the 2023 federal Budget, is a step in this direction. In Chapter 4, we proposed that all rental houses should be required to have ceiling insulation, and in Chapter 3 we proposed that financing packages should cover things such as ceiling insulation. These proposals would not only make households more comfortable, they would minimise costs for all electricity users by preventing growth of peak demand.

Another way to reduce peak demand growth is to change the timing of water heating so that it does not occur at peak times. Improving the efficiency of heating systems and water-heaters through performance regulation (section 5.3.3 on page 39) would also help.

130. AER (2023a, p. 7).
131. Energy Efficiency Council (2023, pp. 59–60).

Time-of-use tariffs will also encourage the use of less electricity at peak times, reducing peak demand. This reduces the total amount of new network that may need to be built, and therefore means lower costs for all consumers.

7.6.3 Keep it safe

Safely operating a gas network with a declining user base and decreasing volumes of gas may be different to safely operating the current network.

State-based safety regulators should review and where necessary amend the regulatory frameworks for decommissioning gas infrastructure, to ensure they are fit-for-purpose and have explicit 'make safe' standards. In particular, they should work with with gas distribution businesses to develop safe options (other than abolishing connections) for removing large numbers of consumers from the network.

The federal government should make funding for home electrification available to states only when it is assured that appropriate safety regimes for decommissioning are in place.[132]

Network owners may also need to start planning for more decommissioning and removal of parts of the network. Decommissioning need not mean digging up every street and front yard. So long as there is no possibility of gas being in a section of network, it may be safer, easier, and cheaper to leave it in the ground. In this case, arrangements should be made for ownership to be transferred to whoever owns the land under which the infrastructure sits.

132. The Royal Commission into the Home Insulation Program (2014) established that the federal government has a duty to ensure that state and territory regulatory regimes are adequate to deal with the risks to personal safety and property if an injection of federal funding is likely to increase the nature and extent of demands on those regimes: Hanger (2014, p. 239).

In Victoria, the current review of the Gas Code of Practice may be an ideal forum for considering these issues and others raised in this chapter.

Keeping the network safe, and decommissioning, also have to be paid for. These costs will have to be recouped from a declining user base. Introducing a 'permanent disconnection' definition (section 7.6.1 on the preceding page) will allow for better planning for decommissioning, by increasing transparency around which users have really left the network.

The AER should also require network companies to include decommissioning plans in the information submitted for future access determinations, to ensure that planned costs are reasonable.

7.6.4 Produce a blueprint for market reform

Energy ministers need to consider three key energy market reforms that will support the move to an all-electric residential sector, while balancing safety, certainty for businesses, and equity for consumers.

First, 'best interest of consumers' should be redefined. Currently, the National Gas Law and the National Electricity Law treat gas consumers as entirely separate to electricity consumers. But every gas consumer is also an electricity consumer, and decisions made by and about gas consumers have ramifications for electricity consumers. There should be a single legal framework for energy, with the consumer at the centre.

Second, ministers need to ensure that the costs on the electricity network of widespread electrification are well-managed. This will include tariff and network pricing reform.

Third, the question that cannot be avoided is: who should pay? If consumers pay for the entire transition under the current framework, the transition will be inequitable. If networks pay the full cost, they will inevitably go broke.

The answer is probably some sort of grand bargain where the costs of the transition are shared among consumers, businesses, and taxpayers. But that won't emerge organically or by muddling through. The federal government can act as an honest broker in this process, and the planned Future Gas Strategy could be a good place to start.

8 Beyond homes

Upgrading homes to all-electric is only part of a larger transformation of Australia's energy use. Small businesses, commercial office towers, schools, hospitals, swimming pools, sports halls, and industry also use gas and will be affected by what happens to the gas network. Gas is also used to generate electricity.

Some small businesses use gas in similar ways to households, and face some of the same barriers. Commercial office towers are similar to multi-unit residential buildings. Public buildings and industry will have very different problems to solve.

This complexity shows why governments need to plan the journey away from gas. Setting the date for an end to gas is a critical first step. But knowing the destination is not enough: governments need roadmaps to get there.

8.1 Big gas users

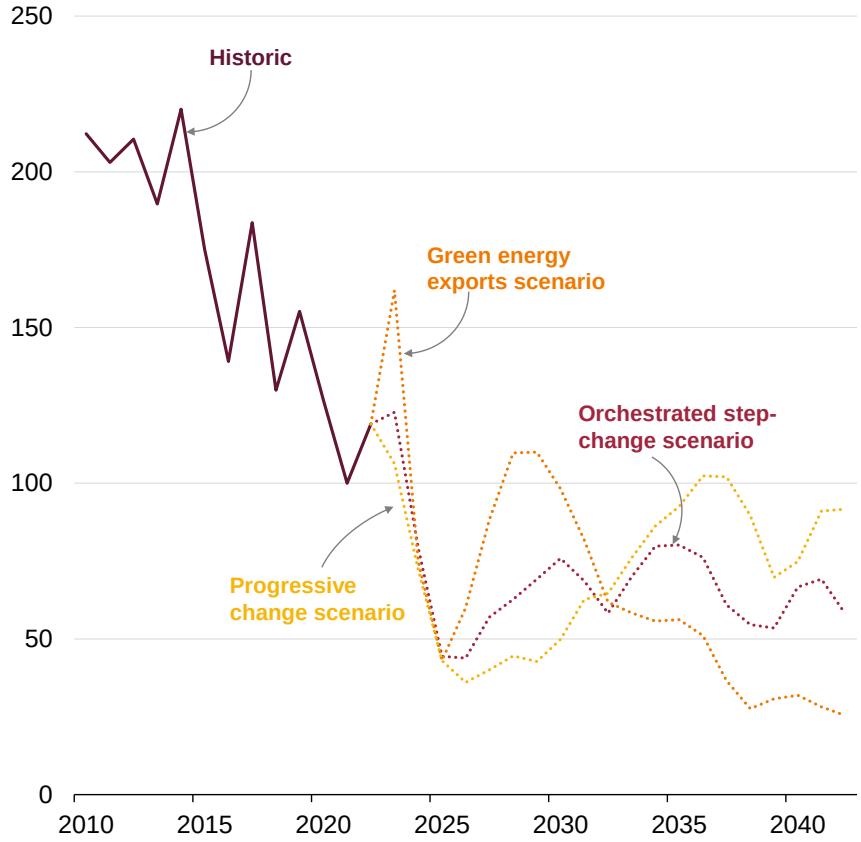
8.1.1 Electricity generators

Gas will have a continued, but diminishing, role in the electricity system. At present, gas generation seems the most economic option to meet the residual demand that solar, wind, and storage cannot.[133]

Electricity generators get their gas from from the transmission network, so the decline in the distribution network (Chapter 7) should not affect them.

Gas use in the national electricity market has peaked (Figure 8.1). Apart from a spike in gas use in 2023 in the 'Green energy exports' scenario (which seems unlikely at current gas prices), gas use declines

Figure 8.1: Gas use in the national electricity market has peaked
Annual gas consumption for electricity generation (PJ)



Source: AEMO (2023a).

133. Wood and Ha (2021).

in all scenarios. In the 'Orchestrated step-change' scenario, which is the central scenario used for planning purposes, gas use in 2042 is half of that in 2022.

8.1.2 Industrial users

Gas is used by industry for heat and for feedstock.

Where low-temperature heat is required (for example, food processing), electrification via heat-pumps is a viable and economic alternative.

For high-temperature heat, hydrogen or biogas may be alternatives, and potentially more innovative technology such as concentrating solar thermal.

Gas for feedstock cannot be replaced by electricity, because these processes rely on the carbon and hydrogen molecules in the gas, not the energy content. Alternative sources for these molecules are required.

Policies such as the Safeguard Mechanism provide an additional incentive for industrial users to reduce their gas use. But many industrial gas users are waiting for new technology to become commercial before they consider switching to new sources of energy or feedstock. Until that time, they will continue to need gas.

For a full discussion of the barriers to industrial decarbonisation and what governments should do, see Grattan's earlier reports *Towards net zero: Practical policies for reducing industrial emissions* and *The next industrial revolution: Transforming Australia to flourish in a net-zero world*.[134]

134. Wood et al (2021), Wood et al (2022).

8.2 Smaller gas users

8.2.1 Commercial buildings and small businesses

Some small commercial premises have very similar gas appliances to households. For example, a real estate agency might have a gas water heater, gas heating, and perhaps a cook-top in the staff kitchen, that are the same as would be found in a house.

Other small businesses will use gas appliances made for heavy commercial users. A cafe or restaurant would have commercial ovens and cook-tops, for example.

The barriers to moving to all-electric in a small business also differ. While small businesses typically rent their premises, they have more control over the fit-out of the premises than do residential tenants. This means they have more say over their appliances.

However, upgrading to all-electric may require changes to how staff do their jobs. A cafe owner would need to be sure their chefs could cook just as well on induction cook-tops as on gas burners, before making the switch.

As with households in multi-unit buildings, small businesses in multi-unit premises (such as shopping centres, arcades, or office parks) could be using shared appliances for hot water or heating. The same barriers discussed in Section 4.3 on page 30 will apply.

Some business users of gas might have low turnover and staff numbers, but use a lot of gas. Dry-cleaners and commercial laundries, for example, are heavy gas users. The appliances they use are not the same as residential appliances, and it may not yet be economical for them to switch to electric alternatives.

Commercial buildings that use gas are likely to have centralised hot water systems, and in some cases heating systems. Commercial buildings are already required to assess and disclose their greenhouse

gas emissions,[135] and many also participate in voluntary disclosure and rating schemes such as GreenStar. These are already driving greater awareness and change in the sector.

Governments are major tenants of commercial buildings. One way they can send a signal to the owners of these buildings to move away from using gas is by making all-electric a criterion for government leases.

8.2.2 Public buildings

There are no national data available on the extent of gas use in hospitals, schools, sports facilities, and other public buildings. But it is likely that it is heaviest in regions with extensive gas networks, such as the ACT and Victoria, and in regions with cold winters.

Without these data it is difficult to assess the way forward for public buildings. State governments should seek to fill this information gap.

8.3 What governments should do about the rest

Other sectors also need to shift away from using gas, but their pathway is less certain.

The best ways for governments to deal with this complexity is to start planning for a managed exit from gas. The need to do this is particularly critical in WA and Queensland, which have high industrial gas use. Industrial assets have long lives, and there are few chances to renew these assets before net-zero goal dates arrive. To switch them to biogas or hydrogen requires building up those industries to have sufficient fuel and feedstock available in time.

Planning needs to be done at the regional and local (rather than state) level. There may be some regions where it makes sense to develop local biogas and hydrogen supply to support clusters of industry. It might also make sense for some clusters of high-density commercial buildings to use biogas or hydrogen if there are barriers to electrification.

Some industrial consumers, with their own emission-reduction targets, or because they can see the changes ahead, are already developing biogas or hydrogen alternatives.

State governments also need to get their own affairs in order. They need plans for all-electric schools and hospitals. And they need to think through how to support local government to move to all-electric town halls, sports facilities, and swimming pools.

There are less than 27 years left before the national net-zero goal date of 2050. There are less than 22 years left for the ACT and Victoria. For politicians, this seems like a long time: about six terms of government. But in terms of asset lifetimes, and physical logistics, it is a very short time indeed.

135. The Commercial Building Disclosure Scheme requires sellers and lessors of office space of 1,000 square metres or more to obtain a Building Energy Efficiency Certificate before the building goes on the market for sale, lease, or sublease.

Appendix A: How we compared the costs of hydrogen, gas, and electricity

In Figure 1.4 on page 10, we calculated the cost of hydrogen as the average, maximum, and minimum for Australia from the following sources: Advisian (2021), DISER (2021), Bruce et al (2018), Longden et al (2020), and AEMO (2023b).

We took the cost of gas from Lewis Grey Advisory (2023), using a weighted average, maximum, and minimum for the east coast.

In Figure 1.5 on page 11, we calculated the cost of delivered hydrogen as the sum of:

- The cost of the hydrogen itself, as above.
- The cost of hydrogen transmission without storage, using the median value published by GPA Engineering (2022), assumed to be constant over time.
- The cost of hydrogen distribution. We assumed this to be similar to the current cost of gas distribution, and to reflect the haulage rates determined by the Australian Energy Regulator (see AER (2023a) for example). We assumed it to be constant over time.

The cost of delivered heat is the cost of delivered hydrogen divided by the efficiency of the boiler, taken from Cebon (2020).

The cost of delivered electricity is calculated as the sum of:

- The wholesale cost of electricity, taken from Oakley Greenwood (2022) and Aurora (2023).
- The cost of electricity transmission. We calculated this as the historic proportion of total network costs paid by household customers for transmission (from AEMC (2021)), multiplied by the average total network costs from the most recent Default Market Offers (AER (2023b)).
- The cost of electricity distribution. We calculated this as the historic proportion of total network costs paid by household customers for distribution (from AEMC (2021)), multiplied by the average total network costs from the most recent Default Market Offers (AER (2023b)).

The cost of delivered heat is the cost of delivered electricity multiplied by the co-efficient of performance of the heat pump, taken from Cebon (2020).

For all the above, we adjusted all dollar values for inflation using the Consumer Price Index.

Appendix B: How we calculated bill savings from upgrading to electric

B.1 Appliance configurations

In table B.1 on the following page, we assume gas households with two appliances have gas instantaneous hot water and gas cook-tops. These are replaced by induction cook-tops and heat-pump water heaters. We assume households with three appliances also have gas space heating. We assume households in Canberra and Melbourne have gas-ducted heaters, and households in other states use standalone gas furnaces. All-electric houses avoid gas connection fees, and we've included those savings in the annual running cost savings.

The costs of appliances include installation and are the same as those used in Figure 3.1 on page 21.

B.2 Running cost savings

We calculated savings using a 4 per cent real discount rate. Running costs assume all electricity is supplied from the grid, with none from rooftop solar. We calculated running costs using 2023 gas and electricity tariffs.

B.3 Usage

We estimated energy use per gas-using household using appliance installation rates in Energy Consult (2015). We converted gas use to electricity using coefficients of performance derived from Alternative Technology Association (2014), Alternative Technology Association (2018), and Livchak et al (2019-06-01), and temperature data from Bureau of Meteorology (2023).

We assumed dual-fuel houses with evaporative cooling use 300 kWh less per year than an all-electric house using reverse-cycle air-conditioning: Sustainability Victoria (2023).

Figure B.1: Savings from switching to electric appliances

	Gas configuration	Electric configuration	Capital cost savings	Annual running cost savings	Evaporative savings	Total annual running cost savings	NPV of savings over 10 years
Sydney	2 appliances	N/A	-$1,917	$479		$479	$1,970
Brisbane	2 appliances	N/A	-$1,917	$716		$716	$3,893
Perth	2 appliances	N/A	-$1,917	$216		$216	-$169
Adelaide	2 appliances	N/A	-$1,917	$682		$682	$3,613
Sydney	3 appliances	RCAC	$2,131	$635		$635	$7,284
Perth	3 appliances	RCAC	$2,131	$539		$539	$6,505
Adelaide	3 appliances	RCAC	$2,131	$827		$827	$8,837
Perth	3 appliances	Evaporative	$4,371	$539	-$90	$449	$8,013
Adelaide	3 appliances	Evaporative	$4,371	$827	-$107	$720	$10,208
Melbourne	3 appliances	RCAC	$1,993	$1,255		$1,255	$12,174
Canberra	3 appliances	RCAC	$1,993	$950		$950	$9,698
Melbourne	3 appliances	Evaporative	$4,233	$1,255	-$62	$1193	$13,908
Canberra	3 appliances	Evaporative	$4,233	$950	-$64	$886	$11,418

Notes: 'Evaporative savings' refers to the avoided cost of running an evaporative cooler. 'RCAC' refers to a reverse-cycle air-conditioner. 'NPV' means net present value.
Source: Grattan analysis of 2023 tariff data and retail data.

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