Evaluating a future beyond gas for homes and small businesses

About Concept Consulting Group

We have been providing useful, high-quality advice and analysis for more than 20 years. Our roots are in the electricity sector and our practice has grown from there. We have developed deep expertise across the wider energy sector, and in environmental and resource economics. We have also translated our skills to assignments in telecommunications and water infrastructure. Our directors have all held senior executive roles in the energy sector, and our team has a breadth of policy, regulatory, economic analysis, strategy, modelling, forecasting and reporting expertise.

Disclaimer

About this report

This report was commissioned by the New Zealand Green Building Council (NZGBC).

NZGBC is a not-for-profit membership organisation working to improve the quality and sustainability of New Zealand's built environment. For 20+ years, NZGBC has partnered with industry, government and communities to accelerate the delivery of healthier, lower-carbon and more resilient buildings and places. Through rating services such as Green Star, Homestar and HomeFit, NZGBC supports better building performance and advocates for policies and practices that create lasting environmental, social and economic value.

As New Zealand faces declining domestic gas supplies, changing energy economics and increasing pressure to reduce emissions, NZGBC commissioned this research to better understand the costs, benefits and broader implications of transitioning homes and small businesses away from fossil gas.

The purpose of this report is to contribute to informed public discussion and evidence-based decision making by providing an independent assessment of the economic, social and policy considerations associated with a transition to electric alternatives. The findings are intended to support policymakers, industry participants, businesses and households as they consider the future role of gas in New Zealand's energy system.

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Executive summary

New Zealand's gas fields are running out, and the cost of pipeline gas is set to keep rising while the cost of running a home on electricity keeps falling. For the great majority of households, switching away from gas is now one of the most profitable investments they can make – and doing so would also deliver billions of dollars in benefits to New Zealand, as well as protecting vital gas reserves for industries that find it hard to switch.

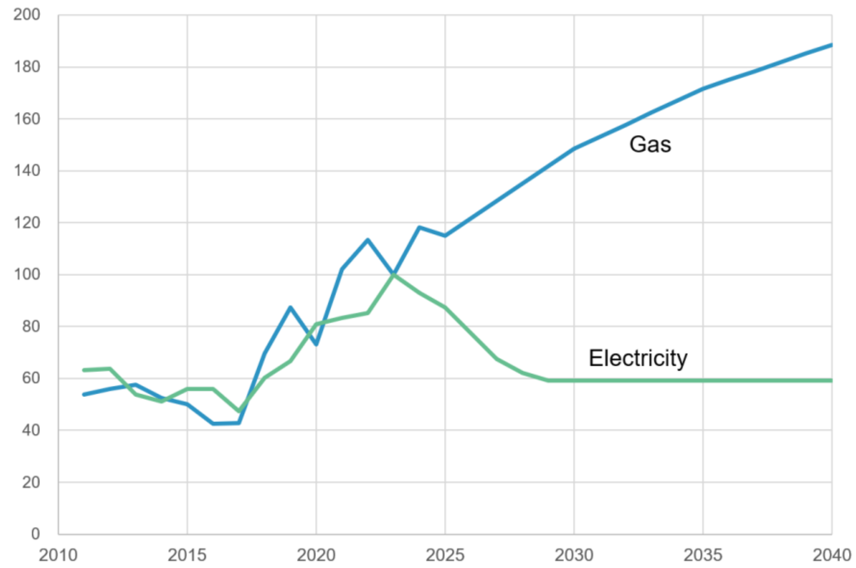
But most households cannot easily make this evaluation, and are not switching even where it clearly pays to.

Unlocking these benefits will therefore require active government involvement.

Households benefit from switching away from gas

The economics have shifted decisively in favour of electricity. Since the beginning of 2023 the average household gas bill has risen by ~36% in real terms to ~$1,655 a year, while electricity bills rose just ~5%. These trajectories are set to continue: on our central projection the cost of pipeline gas for home heating will rise ~30% over the next ten years – even if carbon prices do not rise – while the electricity cost of the same heating will fall ~17%.

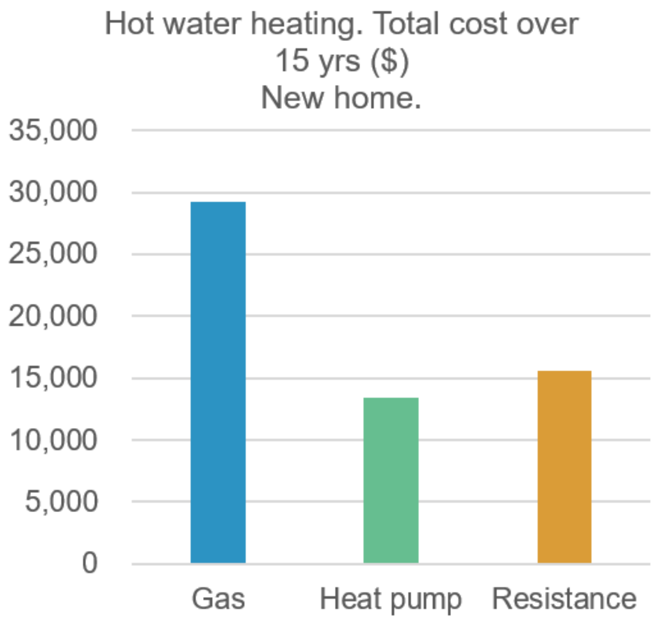
The following chart shows how wholesale prices have changed for gas and electricity relative to a 2023 baseline and our central projection for future price changes.



Three forces are pushing gas prices up. NZ's fields are running out, and the LNG or biomethane that could replace them costs around three times historical wholesale prices; carbon prices are more likely to rise than fall (Treasury's 2030 shadow price is $140/tCO2, versus ~$50 today); and as demand falls the largely fixed costs of the pipeline network must be recovered from fewer users – a 10% fall in demand requires a ~10% price rise, and residential demand is already falling ~8% a year. Meanwhile heat pumps keep improving – and now also provide summer cooling – whereas gas appliances do not.

For new-build homes, electricity is always the cheapest choice – a result that holds even under the most extreme (and, in our view, unrealistic) combination of low gas prices and high electricity prices:

- A heat pump saves a typical household ~$17,260 over fifteen years versus gas for space heating.
- A heat-pump water heater saves ~$15,900 over fifteen years versus gas.



For households that already have gas, it pays to switch away in the significant majority of cases. Switching a typical medium heat-load household to a heat pump delivers around a 17% return and increases household wealth by ~$9,000 over 15 years, with water heating delivering similar returns. If the gas appliance is close to needing replacement anyway, returns are higher still – up to ~36% for space heating and ~24% for water heating. Across the range of household circumstances the average return on switching is 20–50% – one of the most profitable investments a household can make.

The main exception is a small minority of cases – typically large homes with relatively new gas central heating that would also face high make-good and network-upgrade costs – where switching may not currently pay.

Switching delivers wider benefits to New Zealand

Home and small-business gas use is now a legacy technology: heat pumps have simply outcompeted it. On our central scenario, transitioning residential and commercial consumers away from gas by 2050 would deliver present-value savings of about $7.1bn. Even excluding the value of avoided carbon emissions and health costs, the saving is around $4.4bn – and a further ~$2.3bn in health benefits would flow from warmer, drier homes.

Beyond these direct savings, switching households away from gas would:

- free up NZ's scarce, declining gas for high-value industrial users many of whom currently have no ready alternative;
- improve the balance of payments by avoiding or reducing costly LNG imports, with home heating met instead by NZ-generated renewable electricity;
- support jobs, as replacing old gas appliances creates work for local trades; and

- help New Zealand meet its environmental targets and reduce the health burden – including respiratory harm from cooking with gas – on the health system.

Key messages for politicians

The benefits are real, but households cannot readily capture them on their own. Evaluating a switch means projecting future gas and electricity prices, assessing appliance loads and efficiencies, and running a discounted-cashflow analysis – and every switch requires an up-front cost. Faced with this, large numbers of households are not switching even where it would clearly benefit both them and New Zealand. As with retirement saving and health, government involvement is needed to secure good outcomes.

Victoria offers a proven, durable model – one that has avoided the policy reversals and 'culture wars' seen elsewhere:

- Signal the destination clearly, as Victoria does through its annually updated Gas Substitution Roadmap.
- Use progressive measures – building and appliance standards, and 'carrots' as well as 'sticks' – rather than blanket bans, starting with the low-hanging fruit of new-build.
- Protect renters and low-income households with measures aimed at the specific barriers they face. We estimate there are ~100,000 rental homes with either gas hot water or space heating.
- Avoid an absolutist approach: preserve gas, including LPG, for high-value, hard-to-electrify industry.
- Work with the trades early – Victoria's main misstep was rolling out incentives before tradesperson standards and training were in place, which let 'cowboy' installers in.

New Zealand's new ratepayer assistance scheme is a useful start, but more is needed to capture the full benefit:

- clearly signal the end goal, so households see switching as the 'right' choice;
- provide additional support – subsidies and rental standards – for low-income households and renters;
- use planning codes and building standards to make electric the default over time;
- work with tradies, including retraining and self-certification for qualified installers, with specific support for gas-fitters;
- keep the standards regime flexible as appliance technologies evolve; and
- address pipeline end-of-life cost recovery – the 'death spiral' – by recovering decommissioning costs now and regulating disconnection charges.

1 Introduction

After many years of natural gas providing reliable, affordable energy for New Zealand's businesses and homes, the last five years have been a torrid one for gas consumers. Following significant, and unexpected, drops in production from New Zealand's six main gas fields, gas prices have increased rapidly.

Looking forward, the outlook for New Zealand's gas consumers is highly uncertain:

- There is major uncertainty over the amount of gas that New Zealand's fields will be able to produce over the next couple of decades, and the associated wholesale prices. Options such as LNG and biomethane may provide additional supply, but with uncertainty over just how expensive these options will be and the impact on wholesale gas prices
- There is significant uncertainty over the future demand passing through the pipeline network, and thus the associated prices that will need to be recovered from such volumes to recover the fixed costs of operating the pipelines. The spectre of the so-called pipeline 'death spiral' hangs over gas consumers.[1]
- On top of this price uncertainty is supply security uncertainty: Industrial consumers are finding they are unable to contract for firm gas supply, as a significant amount of gas has been forward sold to Methanex till 2029 to an extent that producers are currently unable to offer firm supply contracts to all consumers who may want it, whatever the price.
- Lastly, there is uncertainty over the extent to which climate change considerations may affect New Zealand's gas consumers. Although current carbon prices in the Emissions Trading Scheme are low (~ \$50/tCO_2 at the time of writing) future national and international policy changes have the potential to significantly increase these prices.

This report presents analysis of the economics of pro-actively switching New Zealand's households away from pipeline gas to electricity – not only to deliver lower-cost energy to households, but also as a means of rationing remaining reserves for higher-value industrial gas consumers. It is structured in two main parts

- Part A provides some concise messaging from two perspectives
  - Firstly, from the consumer's perspective, detailing the costs and benefits to typical households from choosing electricity versus gas
  - Secondly, from the politician's perspective, highlighting the key policy choices that New Zealand faces with regards to gas
- Part B sets out the underlying analysis for those readers who want to dig deep into the detail to understand what is driving the outcomes and key policy implications.

[1] The 'death spiral' is where falling demand causes pipeline prices to rise, causing demand to fall further which causes further price rises, and eventually resulting in a runaway collapse of demand.

PART A: CHOICES FOR HOUSEHOLDS AND POLITICIANS

2 From a householder's perspective

2.1 The world has changed significantly in favour of electricity for heating and hot water

Gas prices for households have been rising significantly. Since the beginning of 2023 to the end of March 2026, the household gas bill has risen in real terms (i.e. stripping out the effect of general inflation) by ~36% to ~$1,655 per year on average. Over the same period residential electricity bills rose by ~5%.

Looking forward, their trajectories are also very different.

As set out in section 0, the 'wholesale' component of electricity prices (i.e. the generation component of electricity costs) is set to fall from current levels and, after an initial increase, long-term electricity network prices are also set to fall. In contrast:

- The wholesale component of gas prices (i.e. the costs of extracting the gas from the ground and injecting it into the pipelines) is set to rise due to a combination of:
  - increasing gas supply scarcity from NZ's fields running out. There is the possibility that this may be replaced by new sources of supply from LNG and/or biomethane. However, neither are cheap, with wholesale costs approximately three-times the historical wholesale prices that consumers used to face
  - carbon prices being more likely to rise, rather than fall. For example, the New Zealand Treasury's 2030 mid-point projection of the Shadow Price of carbon is $140, compared to the (at the time of writing) $50/tCO$_2$ current carbon price.
- The pipeline component of gas prices is also set to rise as falling gas demand requires higher prices to recover the largely fixed costs of pipelines from the remaining consumers. A 10% reduction in demand will require an ~10% increase in pipeline prices. In this respect, it is notable that residential demand has recently been falling at the rate of ~8% per annum.

Our central projection is that in ten years' time, even if carbon prices do not rise, the cost of pipeline gas for space and water heating for your home will have risen by ~30%, whereas the electricity cost of such heating services will have *fallen* by ~17%.

In addition to energy prices having this structural shift, there have been significant changes in space and water heating technologies. Heat pump costs and efficiencies have improved significantly over the past couple of decades – not just for space heating, but also for water heating – and are projected to continue to improve over the coming decades.[2] In contrast, no such improvements are projected for gas appliances.

The non-price 'quality' aspects of the gas and electric options have also changed:

- Space heating heat pumps also offer space cooling services in summer – something that is becoming increasingly valued as summer temperatures rise
- Modern water cylinders are mains-fed, resulting in exactly the same water pressure as for instant gas water heaters. Plus, externally located water cylinders at the side of a house (typically where an instant gas boiler would be located) can offer large quantities of hot water – more than enough for a household with teenagers! – without taking up interior space.

2.2 Electricity is the no-brainer choice of heating and hot water for new-build situations

Electricity is always the cheapest option for space and water heating in new-build situations. Choosing gas will guarantee you losing a lot of money. As set out in section 0, this result is robust even against the most extreme (and in our view, unbelievable) combination of low future gas prices and high future electricity prices.

As Table 1 shows, a household can save approximately $17,260 over fifteen years by choosing a heat pump for space heating in a new-build situation rather than pipeline gas. Although resistance electric heaters have a much lower up-front cost, their lower efficiency means they are a more expensive option than heat pumps over their lifetime.

Note: For gas, the up-front cost includes the cost of a gas connection, and the annual running costs assume some of the fixed charges for gas will be 'shared' by a gas water heater. If the house only has gas space heating, the annual running costs for gas will be greater.

Table 1: Space heating costs for typical medium-sized new-build house[3]

Option	Upfront cost ($)	15 yr average annual running cost ($/yr)	Total over 15 yrs ($)	Total benefit relative to gas ($)
Gas	10,160	1,220	28,460	
Heat pump	6,400	320	11,200	17,260
Resistance	1,260	990	16,110	12,350

GBC Misc_03

[2] https://build-up.ec.europa.eu/sites/default/files/content/irena_heat_pumps_costs_markets_2022.pdf

[3] Costs include GST – as do all the other tables in this section on household heating costs.

Why are electricity running costs so low?

Electricity running costs for heating are so much lower due to a combination of:

- Lower variable charges (ie, the c/kWh charge of being supplied with gas or electricity).
- Superior efficiencies – particularly in the case of heat pumps.
- Not including any fixed charges (i.e. the $/day charge) for electricity supply but including these charges for gas. This is because all households will need electricity anyway (for lighting, home electronics, etc), whereas consumers can avoid the fixed charges for gas by choosing electricity for their heating provision. The fixed charges for gas are material: a standard residential gas consumer in the Wellington region will currently pay approximately $840 per year, just in gas fixed charges.

Table 2 shows that households can save approximately $15,900 over fifteen years from choosing a heat pump for water heating in a new-build situation. As for space heating, the higher up-front costs of the heat pump are outweighed by the superior efficiency compared to a standard resistance electric water cylinder.

Table 2: Water heating costs for typical medium-sized new-build house

Option	Upfront cost ($)	15 yr average annual running cost ($/yr)	Total over 15 yrs ($)	Total benefit relative to gas ($)
Gas	6,740	1,500	29,240	
Heat pump	8,280	340	13,380	15,860
Resistance	3,180	830	15,630	13,610

GBC Misc_03

2.3 For households that already have gas, it pays to switch away from gas in the significant majority of case

The evaluation is slightly more complex for households that currently have gas for space or water heating:

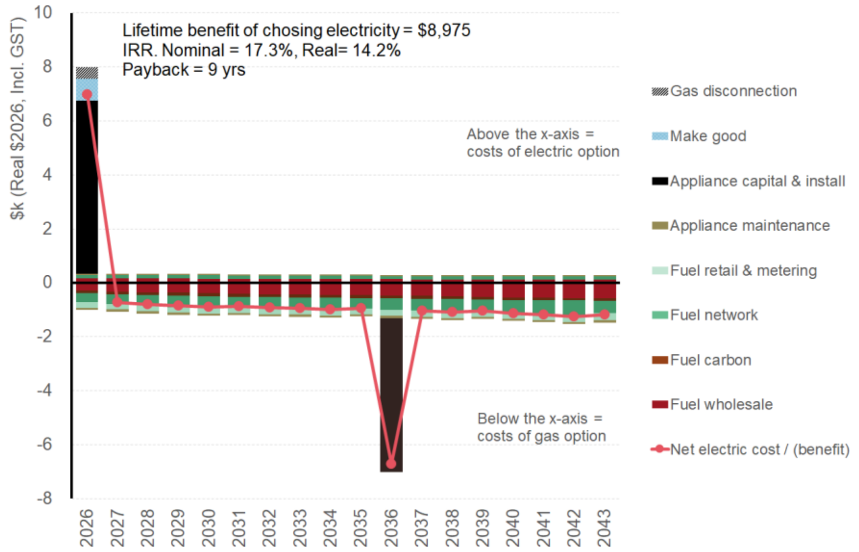
- The costs of their existing gas heater are 'sunk'. Therefore, only the future costs of replacing the gas appliance when it wears out should be considered. This future cost will effectively be a lot less for a gas appliance that could carry on operating for many years compared to one that will need replacing in the next year or so.
- There will likely be some 'make good' costs associated with removing an existing gas appliance (e.g. plastering and painting where a space heater has been removed). These vary according to household circumstances. If a house is being re-decorated anyway, the costs can be small.
- Some households (albeit only a small minority of very large households) may also incur the costs of increasing the

capacity of their network connection; going from one phase to two or three phase.

- Households will face a charge for disconnecting from the gas network

The pattern of cashflows is illustrated in Figure 1 which show the cash-flows for switching away from gas space heating to a heat pump for an average Medium heat-load household that would need to replace their gas heater in 10 years' time.

Figure 1: Cash-flow for switching away from gas <u>space heating</u> to a heat pump for an average Medium heat-load household that would need to replace their gas space heater in 10 years' time in Mid fuel price scenario



Initially, the household needs to spend ~$7,650 to purchase and install the heat pumps, undertake make-good repairs (some re-plastering and painting), and pay to disconnect from the gas network.[4]

Offsetting this, are ongoing fuel savings of ~$875 per year plus the avoided $5,715 cost of replacing a worn-out gas appliance with a new gas appliance in year 10. Overall, the investment delivers a healthy 17% return and will increase the household's wealth by ~$9,000 over the 15-year period of evaluation.

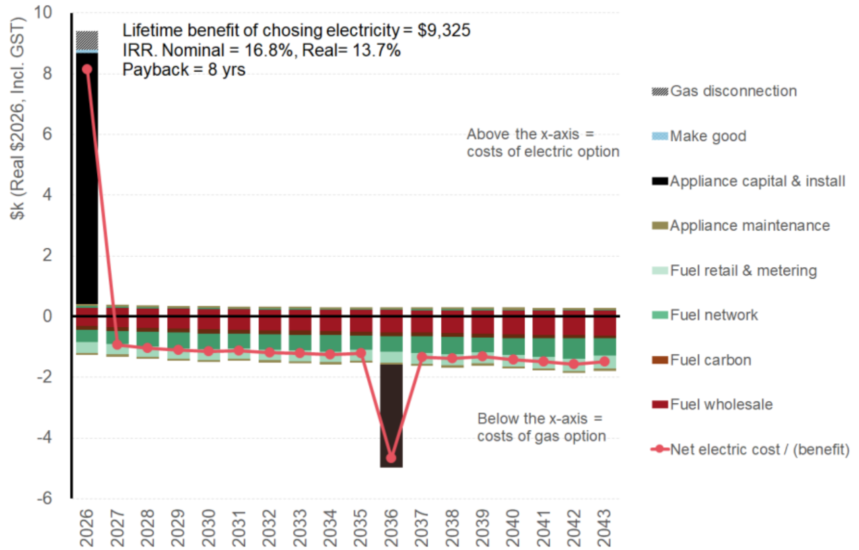
If a gas space heater is close to being needed to be replaced anyway, the savings are even greater – a 36% return if the gas heater would need replacing within one year. Likewise, if the household only has gas for space heating, the savings from switching away will be greater still.

That said, it should be noted that in a small minority of cases – typically large houses with gas central heating with a combination of: relatively new gas heating <u>and</u> which would incur significant make-good costs <u>and</u> significant network upgrade costs – it may not be currently cost-effective to switch away from gas. However, this is very much the minority of cases.

Figure 2 shows the same cashflow equation for a household who install a heat pump water heater, but would otherwise need to replace their gas water heater in year 10.

[4] This assumes some of the disconnection costs are shared with water heating.

Figure 2: Cash-flow for switching away from gas water heating to a heat pump for an average Medium heat-load household that would need to replace their gas space heater in 10 years' time in Mid fuel price scenario



This too delivers a similar level of net financial benefit and ~17% return – far better than paying off your mortgage or what could be expected from the stock market! Likewise, if the gas water heater is close to needing to being replaced anyway, the returns will be even greater – 24% if the gas heater needs replacing within one year.

Furthermore, unlike space heating, there are virtually no situations where it is not profitable to switch away from gas for water heating. This is because the make-good costs are much less (if replacing an instant gas water heater with an external electric cylinder, the make-good costs are negligible), and there should be no network upgrade costs as electric water heating can have ripple control.

Box 1: Should I wait until my appliance needs replacing?

If a gas appliance needs replacing anyway, it is almost always the case that it will be cost-effective to switch to an electric option. The average rate of return on the investment for the switch is estimated to be between 20% to 50% depending on customer circumstance. By far one of the most profitable investments any household could make!

If a gas appliance has several years of life left, a household could maximise their value by waiting until 'just before' it needs replacing. The scale of benefit from waiting is greatest if the gas appliance is relatively new, as the present value from postponing the up-front cost of the electricity option outweighs the lost benefit from not enjoying lower running costs earlier. If the gas appliance only has a few years left, the benefit from waiting is relatively small.

The big caveat to the 'wait-until-replacement-is-needed' strategy, is that it is not possible to predict exactly when a gas appliance will need replacing. If a gas appliance suddenly stops working, it is generally much quicker to replace it with another gas appliance than switch to electricity. Thus, unless households are prepared to wait the several days (potentially weeks) without heating or hot water while an electricity appliance is installed at short notice following a gas breakdown, it is worth pro-actively switching to electricity ahead of time, thereby avoiding any disruption.

Furthermore, as Figure 1 and Figure 2 have demonstrated, switching to electricity 'now' rather than waiting till the gas appliance anyway needs replacing 'later', is not a bad investment, and will almost certainly guarantee much higher returns than almost any other investment or paying off a mortgage. It is just that if you can fine tune the timing of switching to coincide with the timing when the gas appliance would anyway need replacing, you can achieve even greater value – subject to the risks of waiting too late.

Also, for households with more than gas appliance (eg, space and water heating), if there is anyway a need to replace one appliance, the economics of switching out the other appliance at the same time also substantially improve.

3 From a politician's perspective

3.1 Switching away from gas for households will deliver significant benefits to New Zealand

Burning gas in people's homes to provide space and water heating is now a legacy technology. The development of heat pumps means that, even without the issues with declining gas reserves and growing carbon costs, gas has been outcompeted by a new technology.

Switching away from gas for homes and small businesses will not only be lower cost for households, but deliver significant economic benefits to New Zealand as a whole through:

- avoiding unnecessary costs: an estimated $7bn present value
- freeing up declining NZ gas for high-value industrial users
- increasing jobs, as replacing old gas appliances with electric will deliver increased jobs for tradies.
- improving balance of payments through helping avoid, or reducing the need for, LNG imports, with home heating instead being provided by NZ-generated renewable electricity

Additionally, switching away from gas for homes will help New Zealand meet its environmental targets, and improve the lives of those householders with respiratory conditions adversely affected by cooking with gas – and reduce the associated burden on NZ's health system.

3.2 Realising these significant benefits will require government involvement

Although the benefits to households from switching to electricity are significant, the exact scale of benefit varies widely from household to household depending on circumstance – including in some (relatively uncommon) situations it not being cost-effective to switch. It is extremely hard for households to make this evaluation, requiring as it does the ability to:

- compile and evaluate the current *and projected future* prices for the different elements of electricity and gas supply

- assess the (household specific) gas and electric appliance heating loads and efficiencies
- evaluate any make-good costs for removing existing gas appliances and gas disconnection costs
- draw all the above together in a discounted cashflow analysis to evaluate whether the high up-front cost is justified by the ongoing reduced operating costs

Faced with this complexity, and the fact that switching away requires an initial up-front cost, large numbers of households are not switching when it would be cost-effective for most of them (and, by extension, New Zealand) to do so.

In the same way that governments help influence complex choices for issues such as retirement and health, government involvement is required to deliver good outcomes households home heating choices.

3.3 Victoria provides a good example of what (and sometimes what not) to do

Victoria has managed to achieve a durable policy framework that, unlike some overseas jurisdictions, has avoided policy flip-flops or been a casualty of the 'culture wars' around transitioning away from fossil fuels. The key factors behind this durability appear to be:

- Clearly signalling the strategic direction via the Gas Substitution Roadmap – an annually updated document that sets out a suite of initiatives to help homes and businesses transition away from gas
- Implementing a series of progressive measures rather than blanket heavy-handed bans
- Offering 'carrots' through financial incentive mechanisms, as well as prohibition 'sticks'. These incentives have been shown to reduce resistance to compliance and help normalise electrification. The level of financial incentive can change over time to reflect:
  - Progressively less of a need to overcome 'infant technology' barriers to new technology uptake
  - More explicit pricing of externalities such as carbon emissions in the price of gas
- Progressive building and appliance standards to improve the efficiency of energy use.
- Acknowledging that some end-uses are harder to electrify, or have more situation-specific issues than others – hence:
  - Starting with the low-hanging fruit of prohibiting new-build residential and commercial properties
  - Progressively extending to replacement of residential hot water
- Acknowledging that renters and low-income households face specific barriers to transitioning to cost-effective electric heating, and having additional measures specifically aimed at such barriers.

- Not taking an absolutist approach, in that prohibitions are not on LPG, and explicitly stating that much of the aim is to enable high-value, hard-to-electrify industry to continue to use gas.
- Working with the trades through measures to support trades up-skilling in the new heating technologies, with some additional specific focus for gas-fitters who face a long-term decline in work. Having tradies as advocates will deliver far better outcomes than if they are resistant to change
- Ensuring pipeline pricing doesn't create adverse incentives for consumers to electrify.

While most of these measures are not gas bans, they make continued reliance on gas less viable by:

- Improving building efficiency (shrinking heating demand)
- Making electric systems the default whole-of-home and commercial property solution
- Increasing the comparative cost and inconvenience of retaining gas

There have also been some problems with some aspects of the Victorian transition – in particular, initially not having sufficient standards and training for tradespeople in place ahead of programmes which used financial payments to incentivise uptake of technologies. This gave rise to early problems with some 'cowboy' installers who were implementing not fit-for-purpose heating systems or poorly-installed heating systems.

These issues have now significantly been overcome, including by allowing suitably qualified tradespeople to self-certify, and having a standards regimes that doesn't require higher-level legislative change (and thus can evolve promptly as technologies evolve).

3.4 The ratepayer assistance scheme is a useful start – but more needs to be done

The recently-introduced ratepayer assistance scheme will be a significant help in overcoming the barriers facing households. However, other key elements will be required to maximise the benefits to New Zealand:

- ***Clearly signal the end goal.*** Having a document such as Victoria's Gas Substitution Roadmaps will send a strong signal to households that switching away from gas is the 'right' choice.
- ***Provide additional support to address the specific barriers facing low-income households and renters.*** Subsidies for low-income households and standards for rented accommodation are likely to be the most effective tools in this respect.
- ***Use planning codes and building standards that, over time, progressively result in electric options being the default home heating option.***
- ***Work with tradies to support them in the transition.*** Key measures include: Training and re-certification programmes developed in conjunction with the relevant trade bodies - providing specific support for gas-fitters to re-train will be

particularly key. Enabling self-certification from suitably qualified tradespeople.

- *Ensure regulatory settings are correct.* Ensure the standards regime is sufficiently flexible to move with changing appliance technologies.
- *Address pipeline end-of-life cost recovery.* The so-called 'death spiral' creates some specific challenges, including rising prices for those consumers for whom it is harder to electrify, and the risk of unfunded costs for the continued operation of the pipelines in their final years and their eventual decommissioning. The Commerce Commission has started to address this with measures such as accelerated depreciation. But more changes are likely to be required including: explicitly starting to recover costs now for eventual decommissioning, and regulating consumer disconnection costs.

PART B: DETAILED ANALYSIS

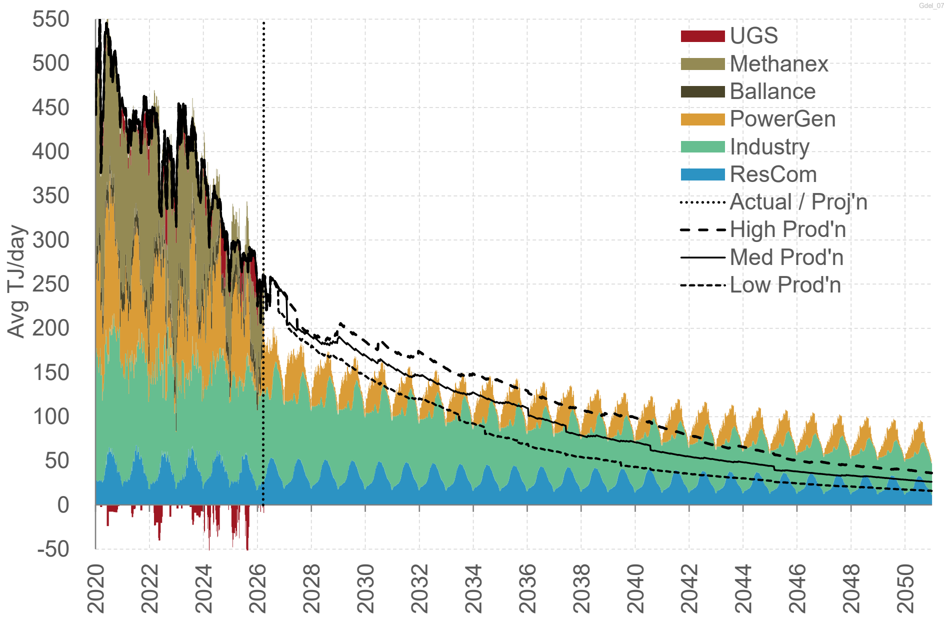
4 Setting the scene – where we stand today

4.1 New Zealand's existing gas fields are running out

Figure 3 below shows actual weekly demand and production up to March of this year, and then projects future demand and production on two bases:

- Demand is a simple projection of demand based on recent rates of gradual decline experienced over the past five years, with the exception of
  - power generation, which is based on a projection of likely displacement of gas-fired power generation from projected renewable build under a low carbon price scenario; and
  - petrochemicals (Methanex and Ballance) who are projected to exit soon (next year in the case of Methanex, an uncertain time in the future in the case of Ballance)
- Production is based on Concept's detailed modelling of potential drilling campaigns to deliver reserves and developable contingent resources.[5]

Figure 3: Weekly production and BAU demand projection



The immediate take-away from Figure 3 is that New Zealand is literally running out of gas, such that supply and demand will

[5] This projection is from our most recent gas market forecast which undertakes detailed physical and economic modelling of both the supply and demand sides of the gas and electricity markets. Demand and price projections are developed from almost 50 different scenario combinations of developable gas reserves, LNG prices and policy options, carbon prices, and biomethane prices. The gas market report is available on subscription from simonc@concept.co.nz

not balance at some point in the mid-30s if current rates of demand change were to continue.

4.2 What options does New Zealand have to manage this decline?

Faced with the inevitable decline of existing fields, New Zealand needs to determine which of the following options, or combination of options, is likely to deliver the best economic outcomes for New Zealand:

1) Exploring for, and developing new fields
2) Developing new sources of methane:
   a) Liquified Natural Gas (LNG) imported from overseas
   b) Biomethane developed from various New Zealand biological waste streams
3) Transitioning gas consumers to alternatives

While there is always the possibility for exploration to discover new fields that could be developed to fill the gap left by the decline in the existing fields, we estimate the chances of a material new field being developed – particularly in the Taranaki region[6] – as very low. This is because New Zealand is competing internationally for scarce exploration capital and, compared to other international prospects, New Zealand is considered unattractive due to the combination of:

- the Taranaki basin having relatively low prospects of discoveries of a significant size compared to international prospects
- little ability for cost-sharing between fields for bringing an offshore rig in; and
- high perceived sovereign risk.

In relation to this last point, even though the current coalition government has repealed the offshore exploration 'ban', there is the potential for a future government to re-introduce such a ban or other measures which would affect the profitability of petroleum producers.

Furthermore, even if a major new field was discovered, it would likely take five to ten years before it could be developed and brought into production.

Given this very low likelihood of significant new gas fields being developed, New Zealand must focus on the other two elements – determining whether it is cost-effective to develop LNG or biomethane as replacements, or whether to transition gas consumers to alternatives. The economics of these options is the principal focus of this report.

[6] We note that there is reportedly some overseas interest in gas prospects off the South Island. However, even if such fields were found, their location in the South Island would be of no use to North Island gas consumers as the economics of developing a pipeline connection to the North Island would be prohibitive. Rather, any such find would almost certainly export the gas as either LNG or in petrochemical form (eg, methanol or urea).

4.3 Who uses gas?

As Figure 4 and Figure 5 illustrate, gas is primarily used in five different sectors:

- Petrochemicals. Using gas as a feedstock to turn methane into either methanol for export, or urea for domestic fertiliser. Historically, this has been the biggest using segment. However, as set out in detail in section 0, the decline in gas production has precipitated a significant decline in petrochemical production.
- Power generation. Historically this covered baseload operation (ie, running 24/7) as well as peaking operation at times of particularly high demand or low renewable generation. However, as set out in section 0, significant build of renewable generation has resulted in gas-fired generators being displaced from baseload operation but they are still required for peaking operation, particularly for balancing hydro, wind, and solar variability, but also for meeting higher electricity demand in winter.
- Industrial (excluding petrochemicals). Using gas for manufacturing process heat – eg, making milk powder, drying wood products, or making steel. The majority is low to intermediate process heat using conventional boilers – what we refer to as 'boiler heat'. Some, however, is high-temperature process heat using furnaces, kilns, direct burners, and industrial ovens – what we collectively refer to as 'furnace heat'. Over the course of the past quarter century, industrial process heat gas demand has declined by about 20%.
- Commercial. Predominantly space heating, with some cooking and water heating for offices, shops, restaurants, hotels and other commercial businesses. As set out in section 0, there has been a steady decline in commercial demand over the past decade.
- Residential. Providing a mix of space heating, water heating, and some cooking for New Zealand homes. As set out in more detail in section 0, residential demand for gas has recently started to fall at a rate of ~8% per annum following years of steady growth.

Figure 4: Rolling 4-quarter gas demand

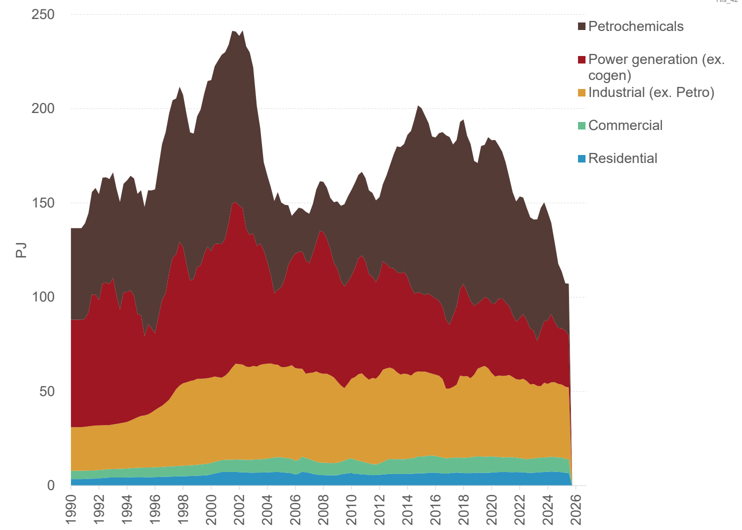


Figure 5: Rolling 4-quarter gas demand

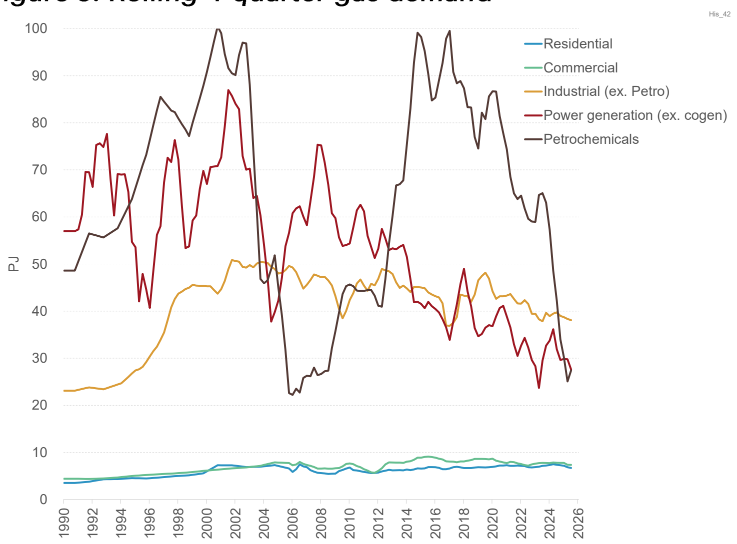
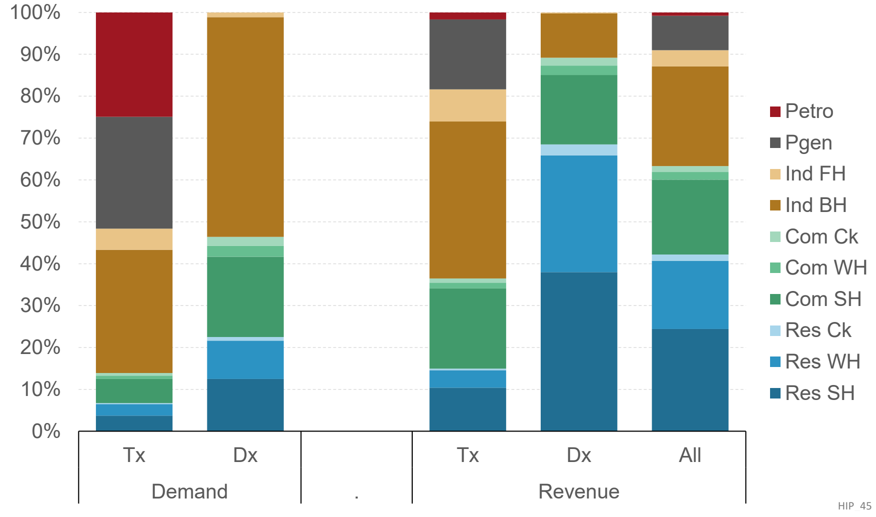


Figure 6 shows that, while residential and commercial consumers account for a small volume of overall demand for gas, they account for a much larger proportion of revenues for pipelines, with residential consumers accounting for almost 70% of distribution (Dx) pipeline revenue.

Figure 6: Estimated split of 2025 pipeline demand and revenues



Source: Concept analysis of EECA, MBIE, GIC, and Firstgas data

Accordingly, the future economic viability of pipelines is critically dependent on the extent to which residential consumers continue to use gas for space heating (SH) and water heating (WH) – the two principal uses of gas for households – with cooking (Ck) accounting for a much smaller share.

For transmission pipelines (Tx), the dominant contributor is industrial process heat, with boiler heat (BH) used for raising low or intermediate process heat in the form of hot water or steam accounting for the vast majority of this segment. High temperature furnace heat (FH) accounts for a much smaller component of this segment. That said, residential and commercial demand accounts for one-third of transmission pipeline revenues, so the fortunes of these two segments will have a material effect on the transmission pipeline charges for industrial consumers.

In contrast, although petrochemicals are large in volume terms, they account for a proportionately smaller proportion of transmission charges. This is due to the fact they are located extremely close to the gas fields, and thus Firstgas can only charge up to as much as it would cost for the petrochemical companies to develop private pipelines to bypass the Firstgas transmission network.

5 Assessing the economics of transitioning residential consumers away from gas

5.1 Introduction

This section addresses the economics of switching residential consumers away from gas to electricity. To test the robustness of conclusions around whether it is cost-effective to undertake such switching, it does this for different consumer situations and for a range of different scenarios for gas, electricity, and carbon prices.

Although the principal focus of this study is the economics of transitioning residential consumers, the latter half of this section also presents some analysis on where the economics of transitioning residential consumers stacks up relative to the economics of transitioning the other consumer segments – particularly non-petrochemical industrial consumers. This is to help ensure that any policies to pro-actively transition consumers away from gas are prioritising those consumer segments that are lowest cost to transition, but which may have material barriers to such transitions occurring.

5.2 Price scenarios

One of the big uncertainties facing consumers when making fuel choice decisions is what will be the price of fuel in the future. This is particularly given that both gas and electricity prices have exhibited recent big increases, and there is widespread concern around where prices could go in the future including due to uncertainty over future carbon prices.

Accordingly, for each of gas, electricity and carbon prices, we have developed three price scenarios: Low, Med, High. These are not our own predictions of where prices are likely to go, but the Low and High scenarios each represent a plausible range of where prices could go, with the Med scenario being broadly in the middle of the two extremes.

Figure 7 shows the gas price scenarios. The low is based on a hypothetical scenario where LNG is imported[7], but the cost of the LNG import terminal is subsidised through recovering the costs via a levy on electricity consumers. The high scenario is

[7] The imported LNG price is based on a oil-linked contract assuming a US$75/bbl oil price, a 15% slope for the LNG contract, an exchange rate of 0.65 US$/NZ$, and a further NZ$2.30 to cover shipping and LNG terminal opex costs.

based on a steady decline in gas reserves, and with gas prices slowly rising to the cost of an alternative – being LPG or diesel. Market-provided – ie, those unsubsidised by a levy – LNG prices would be higher than this, due to the high price of recovering the cost of the terminal over the volume of gas passing through the LNG terminal. The Med scenario is simply the mid-point of the Low and High scenarios.

Figure 7: Wholesale gas price scenarios (ex. carbon)

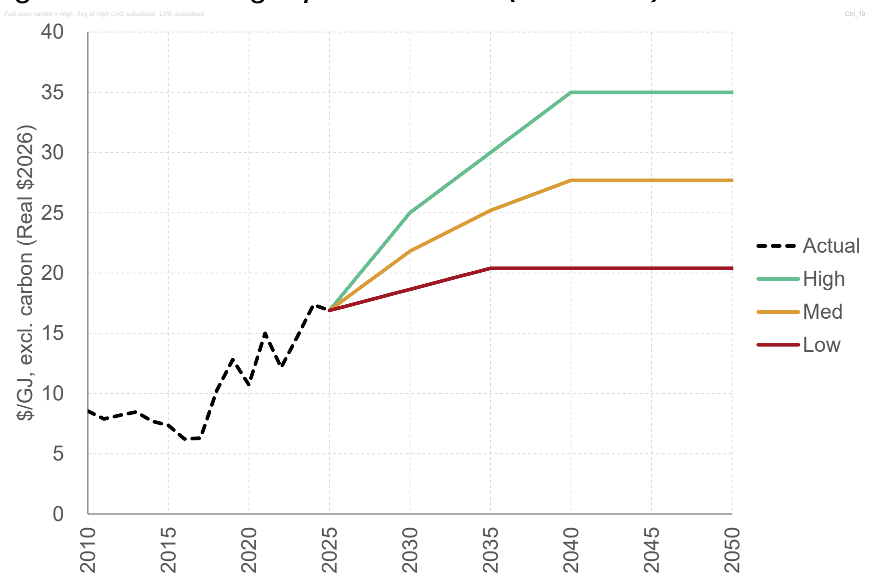


Figure 8 shows the wholesale electricity price scenarios. The Medium scenario is based on the current forward curve to 2029 as shown in Figure 9 below), and then simply flat-lines at the 2029 price beyond that time. The low scenario is a hypothetical scenario based on significant ongoing reductions in the cost of building wind, solar, and geothermal. The high scenario assumes a combination of high electricity demand, less significant reductions in the costs of renewables, and problems causing systemic delays in the construction of renewables (eg, due to consenting issues or global supply chain problems).

Figure 8: Wholesale electricity price scenarios

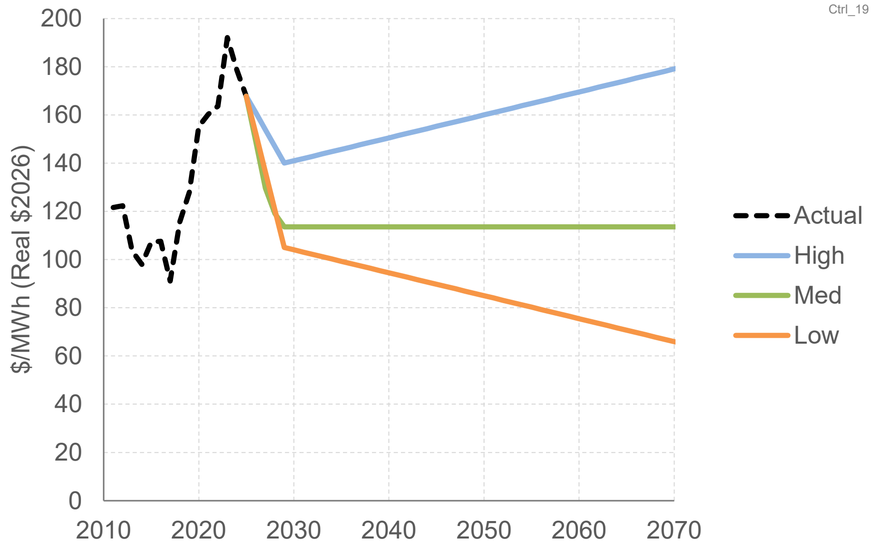
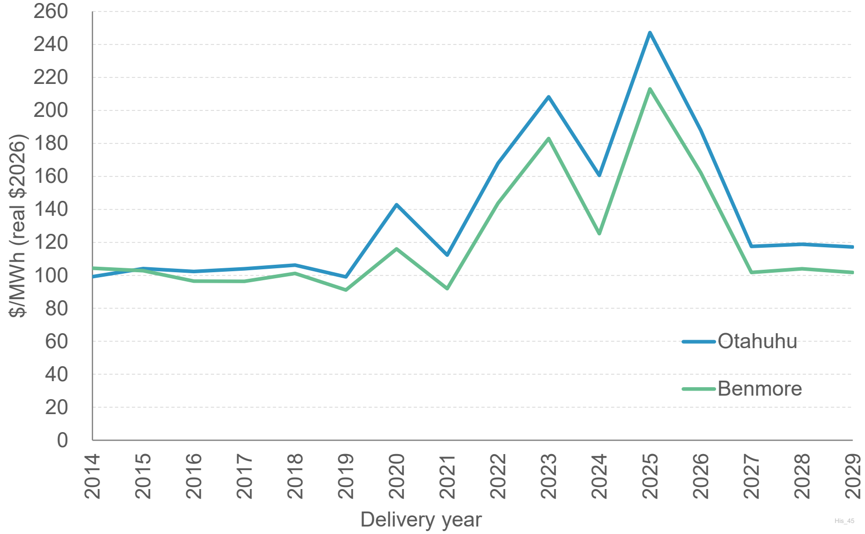
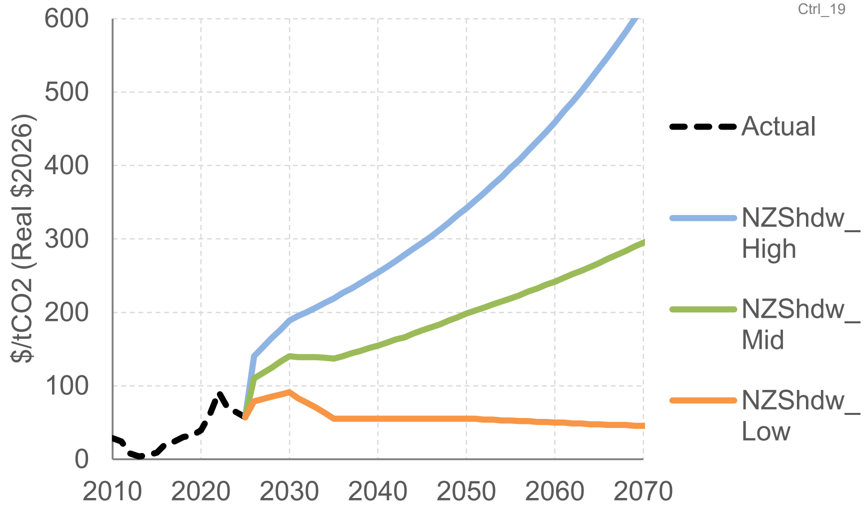


Figure 9: Historical and currently projected (as at 13 July) ASX contract prices



For carbon prices, we have used the High, Central, and Low scenarios set out by the New Zealand Treasury for the purposes of evaluating policies that give rise to emissions reductions.

Figure 10: Carbon price scenarios



The explanation given by the Treasury for the derivation of these approaches is set out in Box 2.

Box 2: Treasury derivation of carbon prices[8]

These emissions values reflect a "target-consistent approach". This means the values represent the expected marginal cost (or benefit) of actions that increase or decrease emissions and therefore move New Zealand further away or closer to the achievement of emissions targets. Specifically, the quantified values reflect the expected cost of finding an additional tonne of CO2-equivalent abatement at a given point in time (noting where emissions are reduced and these costs are avoided, this

[8] Source: https://www.treasury.govt.nz/publications/guide/cbax-tool-assessing-climate-change-environmental-impacts

is reflected as a benefit). This is distinct from a "social cost of carbon" which would represent the broader economic and social cost from releasing additional greenhouse gases into the atmosphere.

New Zealand has several emissions targets, which vary significantly in their focus - for example, whether they are solely domestic, all-gas or split gas. In addition, the future cost of finding additional abatement is highly uncertain due to several factors, including policy choices and available technologies. To capture this broad range of targets and focuses, alongside broader uncertainty, three scenarios are provided ('High', 'Central' and 'Low') rather than a single pathway.

The 'High' emissions pathway is based on estimates of the potential future whole-of-economy costs of emissions reductions required to reach New Zealand's domestic emissions targets, as reflected in the Climate Change Commission's 2023 Advice on the direction of policy for the Government's second emissions reduction plan.

The first five years of the 'Low' emissions pathway is based on Computable General Equilibrium (CGE) modelling commissioned by the Ministry for the Environment. These values represent the marginal cost of abatement over time, in a scenario in which both the second and third emissions budgets are met. We do not use the long-run marginal cost of forestry during these first five years, as it is assumed that there are some constraints on the amounts of additional forestry available as a source of removals during this time, due to the lag between forestry planting and sequestration. After the first five years, the 'Low' pathway assumes that additional removals from forestry become more available. It then transitions over five years to using the estimated long-run marginal cost of forestry as its underlying data source, as estimated by analysis by the Ministry for Primary Industries

The 'Central' emissions pathway is calculated as the mid-point of the 'High' and 'Low' pathways.

Rather than have nine different composite scenarios (being the combinations of each of the three price scenarios) we instead generally evaluate against two main scenarios:

- The mid scenario, being the Med values for all three parameters
- A 'Cheap-gas-expensive-electricity' scenario, which has Low values for the ex-carbon gas and carbon price parameters, and high values for the electricity price scenario. The purpose of this is to test the robustness of any conclusions about the cost-effectiveness of switching away from gas to an extreme scenario of low gas input costs.

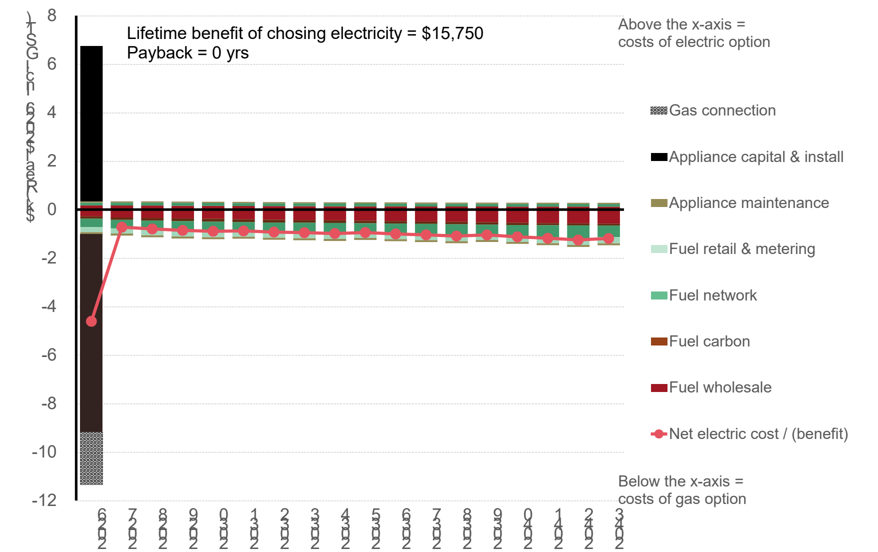
In addition, for some evaluations, we also use two composite scenarios which have mid values for non-carbon gas and electricity prices, but high or low carbon values. These are to test the effect of carbon prices on the cost-effectiveness of different fuel choices.

5.3 Residential new-build situations

Figure 11 below shows the projected cashflows for investing in a heat-pump rather than investing in gas space heating for an average new-build situation for a house with a medium heat load.

5.3.1 Space heating

Figure 11: Cashflow projection of investing in a heat pump rather than gas for an average medium-sized consumer new-build situation for mid composite price scenario



The costs appearing above the x-axis are the costs incurred from investing in the heat pump. These consist of:

- The up-front costs of
  - purchasing and installing the appliance
  - any electricity network upgrade costs (installing a second or third phase if required – very rarely required, as detailed further below, and thus not featuring in this example of a typical situation)
- The ongoing costs associated with using the heat pump:
  - Electricity supply costs (wholesale + network + retail cost-to-serve & metering)
  - Maintenance costs.

Appendix A sets out the specific assumptions for the up-front costs and the ongoing maintenance costs.

The costs appearing below the axis are those costs that would have been incurred from choosing gas. The categories are largely the mirror of the heat pump costs, except that they don't include electricity network upgrade costs, but do include gas connection costs.

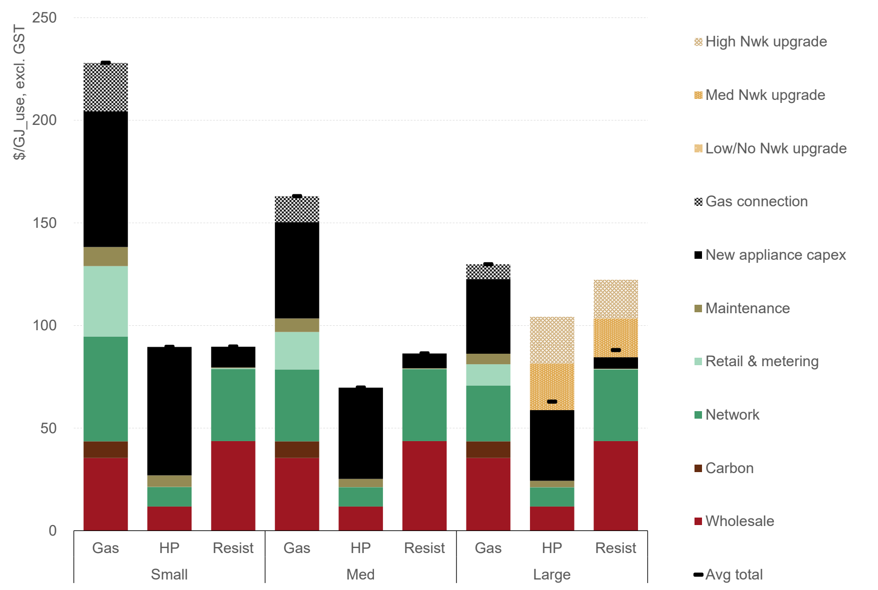
The red 'Net' line shows the net costs for each year of choosing a heat pump rather than gas. In this example, not only is the heat pump option cheaper on an ongoing basis, but it is also cheaper in terms of up-front costs. As such, the payback from choosing the heat pump is instantaneous, or '0 yrs' as shown in the figure. Overall, the household will enjoy a lifetime benefit of $15,750 from choosing electricity.[9]

While Figure 11 shows the pattern of costs and savings in an intuitive sense, it only shows it for one consumer situation. However, the relative economics of gas versus electricity can change depending on factors such as:

- The size of consumer's heat load;
- The extent to which a consumer may require an electricity network upgrade; and
- Which electric option is chosen – a heat pump or a standard resistance electric heater.

Figure 12 below enables such a comparison across all these different consumer situations in terms of installing gas versus electricity (either heat pump ('HP') or resistance ('Resist') electric heating) for household space heating, using the mid-point estimate for gas and electricity prices.

Figure 12: New-build residential space-heating economics using Mid fuel price scenario



The graph shows the average *lifetime* cost per GJ of providing *useful* heat.

The italicisation of 'lifetime' and 'useful' is because, to enable true like-for-like comparisons between options, it is necessary to take account of the fact that:

- the cost of heating a home is comprised of some costs that occur as up-front lump sums (eg, the cost of installing an appliance, or connecting to the gas network), some which

[9] Future differences in operating costs between the two options are evaluated over fifteen years, and using a 5% discount rate to bring aggregate such future differences to a present value.

occur as regular fixed costs (eg, network, and retail & metering), and some that vary with the amount of heat provided (eg, fuel (which is marked as 'wholesale' in this graph), carbon, and some network costs);

- there are variations in the amount of heat required for different households; and
- there are variations in the efficiency (a.k.a. coefficient of performance, or 'COP'[10]) of the appliances used to provide such heat.

These aspects mean it is necessary to:

- amortise the capital costs over the lifetime of the up-front lump sums to arrive at a $/yr cost recovery requirement
- spread any annual capital recovery or fixed costs over the annual GJ of useful heat required by the household situation
- factor the cost of the variable fuel, carbon, and network charges by the appliance COP.
- weight the variable costs by the expected discount-weighted average of such costs over the lifetime of the investment. For example, if it is expected that wholesale prices are going to rise over the next twenty years, it is necessary to calculate the average price over the twenty years, but with the early years weighted more than later years using an appropriate discount rate.[11]

The graph also highlights there are many different elements to the cost of heating a home:

- The wholesale fuel costs. This is the non-carbon cost of gas or the wholesale electricity generation cost. The reason there is such a difference between the heat pump and resistance heating options despite both using the same-priced electricity is because the COPs are so different.
- The carbon cost. For electricity, this is effectively incorporated within the wholesale cost, but is split out for gas.
- Network costs.
  - For gas, this includes both the variable charge and the recovery of fixed charges. The recovery of fixed charges gives rise to the network cost of gas being higher for households with small heating loads compared to large heating loads, because in small heating loads the fixed costs are being spread over a relatively small amount of useful heat.
  - For electricity, only the variable charges are included. This is because a home will require electricity (and incur

[10] Efficiency is often referred to as 'coefficient of performance' (COP). A typical gas heater has a COP of approximately 78% (in real world use conditions), a resistance space heater has a COP of 100%, whereas a space heating heat pump has a COP of approximately 360% - Ie, because it is heating the home using the ambient heat from outside, it produces 3.6 times the amount of useful heat than it consumes as electricity.

[11] For this analysis a 5% real discount rate has been used, being a reasonable reflection of most household's real cost of capital.

the associated fixed charges) irrespective of their heating choice, whereas gas is an entirely discretionary fuel.

- Retail & metering costs are largely recovered via fixed charges – hence the variation for gas consumers between households with small and large heating loads. Furthermore, such costs are not incurred for electricity heating choices because, like network charges, homes will anyway require electricity, irrespective of their heating choice.
- The maintenance costs associated with servicing the heating appliance. While this is likely to be incurred every five to ten years, the cost shown is the annual average, spread over the useful heating load.
- The up-front capital costs of purchasing and installing the appliance. Although the up-front costs of installing an appliance for a household with a small heating load will be less than for a large heating load, such costs do not scale directly with the size of heating load. This results in the cost per GJ of useful heat being larger for households with small heating requirements than those with large heating requirements.
- The costs of connecting the house to the gas network. Again, there is no similar cost associated with connecting to the electricity network, as the house will anyway require electricity.
- Potential electricity network upgrade costs – ie, moving from the typical one-phase connection to a two-phase connection. Very few houses will require such an upgrade – hence it only appears for the large heating load situation, and even then, only a minority of such large heating load households will require such an upgrade. Furthermore, there can be some variation in the cost incurred if an upgrade is required. This gives rise to the variation between low to high network cost upgrades.

The dashed mark 'Avg total' shows the weighted average total costs incurred across the different housing situations. In the case of new-build space heating, this takes account of the likelihood of a house requiring a network upgrade.

The key takeaways from Figure 12 are:

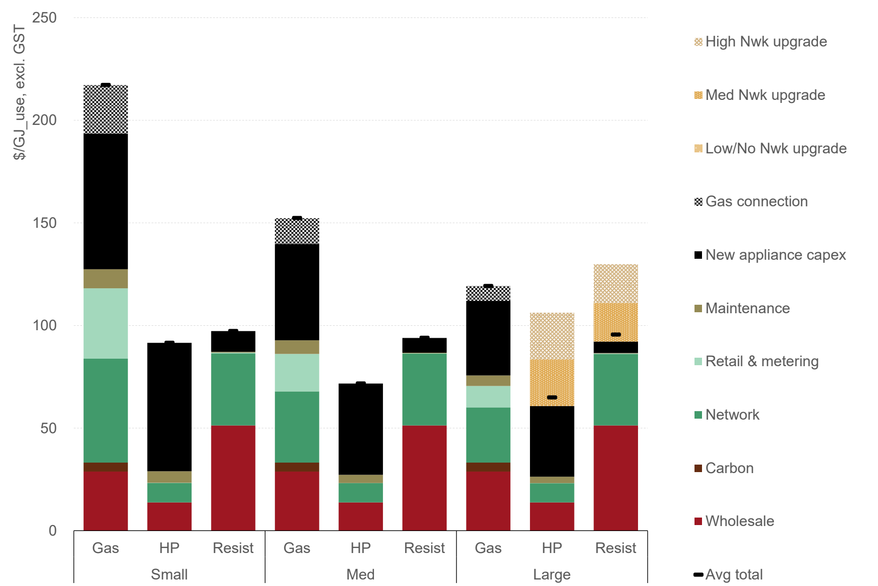
- Electricity is always cheaper for home space heating in new-build situations against our mid-point fuel scenarios by quite some margin.
- The size of heating load has an effect on both the absolute cost per GJ of useful heat and the relative costs of the different options. This is due to the effect of spreading up-front capex and ongoing fixed costs over varying amounts of useful heating requirement. While this doesn't affect the choice between gas and electricity, it does mean that for small heating loads the optimal choice may be a simple resistance heater as the benefit of the low capital cost of a resistance heater outweighs the disbenefit of its worse efficiency compared to a heat pump.

It is also worth noting that the substantially lower variable costs of a heat pump (ie, the wholesale + network costs for the heat pump, compared to the wholesale + carbon + ~50% of the network costs for gas) may deliver additional benefits in that lower-income households face less of a direct cost from heating their homes to higher temperatures. Research undertaken by EECA shows that warmer homes have been shown to deliver substantial health benefits – the value of which aren't shown in this analysis.

To test how robust this conclusion is to possible variations in future fuel prices Figure 13 shows the same type of evaluation as for Figure 12 but using the Cheap-gas-expensive-electricity scenario.

Again, electricity is the cheapest option across all consumer situations, even against this fuel price projection that (in our view, unrealistically) favours gas.

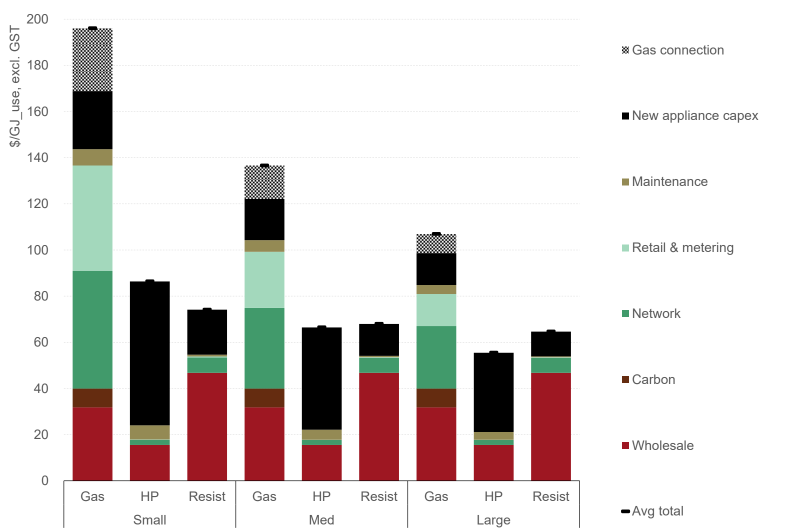
Figure 13: New-build residential space-heating economics using Cheap-gas-expensive-electricity fuel price scenario



5.3.2 Water heating

Figure 14 shows the same comparison as for Figure 12 but for water heating in new-build residential situations.

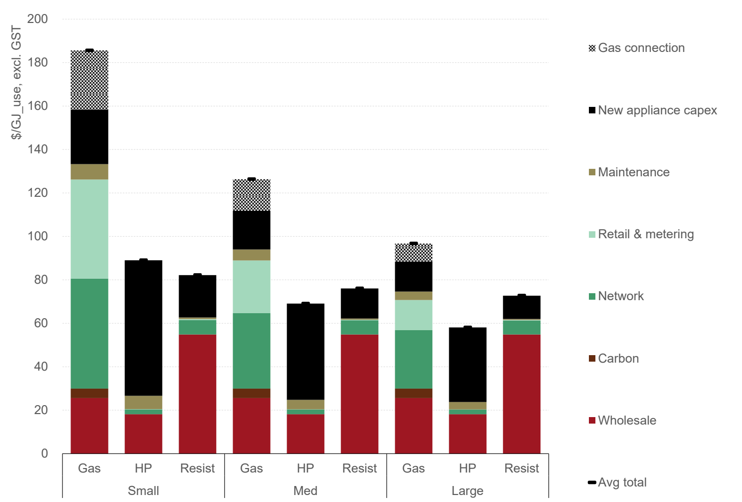
Figure 14: New-build residential water heating economics using Mid fuel price scenario



This shows a very similar picture to that for space heating, in that gas is always the most expensive option. The most significant difference compared to space heating is that there shouldn't be any electricity network upgrade costs associated with installing electric water heating options as hot water cylinders can be controlled via ripple (or next-generation) control, significantly reducing the load on the network at times of system peak.

And Figure 15 below shows that this conclusion about electricity being cheaper than gas for new-build water heating situations holds true even against the cheap-gas-expensive-electricity fuel price scenario.

Figure 15: New-build residential water-heating economics using Cheap-gas-expensive-electricity fuel price scenario



5.3.3 Summary residential new-build economics

The fact that electricity is substantially cheaper than gas for both space and water heating is likely a significant factor behind the significant drop in the number of new gas connections: falling by over 50% in three years.[12]

It is important to note that this shift in the economics of home heating in favour of electricity has been happening anyway, even before the decline in New Zealand's gas fields made the economics even more compelling. This has been due to electricity technology change:

- Significant reductions in the cost, and improvements in performance, of heat pumps over the past couple of decades have transformed the economics of electricity space heating. Furthermore, heat pumps are not just cheaper at heating homes but also provide additional benefits through being able to provide air conditioning in the summer – something that is increasingly sought after as summer temperatures rise.
- Heat pumps are also starting to emerge as cost-effective options for water heating as rapidly growing global uptake is causing costs to fall and efficiencies to improve at a faster rate now than space heating heat pumps.
- Electric water heating now delivers equivalent service quality to instant gas water heating (one of the main selling points of gas water heating in the past): mains pressure cylinders deliver showers at exactly the same flow rate as instant gas water heaters, and large externally located water cylinders provide more than sufficient water for large households without taking up interior space. In the case of houses switching from gas to electricity (addressed below) in most cases external water cylinders can be located at the side of the house where the instant gas water heater is attached, significantly minimizing any plumbing costs associated with such a switch.

Electricity technology change has also radically transformed the carbon emissions associated with switching. Fifteen or more years ago, increased electricity demand was largely met by increased gas and coal-fired generation resulting in minimal emissions savings, particularly for space heating. That is no longer the case, with increased electricity demand being almost entirely met by renewable generation.

5.4 Households switching from gas to electricity

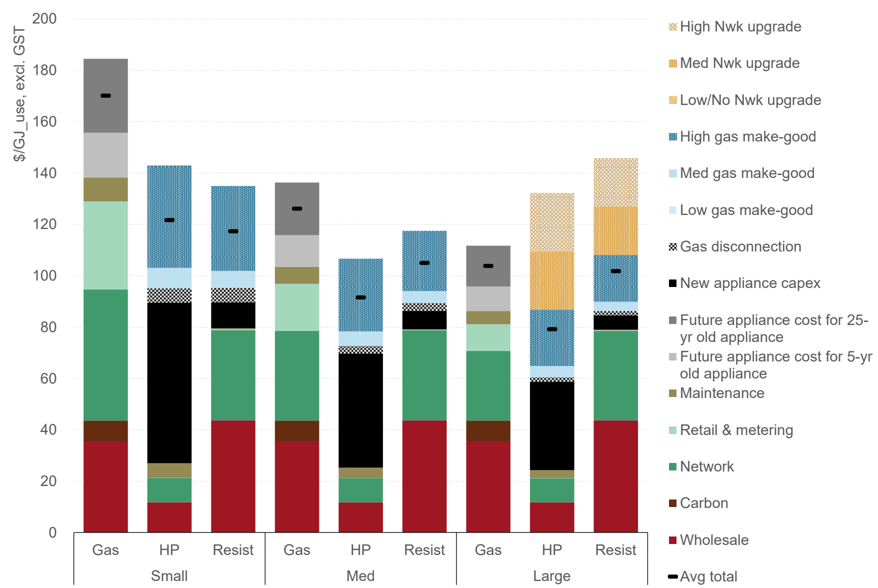
While electricity is the 'no brainer' choice for new-build situations, the situation is rather more nuanced for households with existing gas heating appliances. Figure 16 and Figure 17 below show the cost of switching away to electricity or sticking with gas for households with existing gas appliances for space heating and water heating, respectively.

As is apparent from the greater number of items in the charts, there are more factors to consider for this evaluation:

[12] New connections in 2021 were 7,963, but in 2024 they had fallen to 3,675. (Source: Commerce Commission disclosures)

- Consumers with existing gas appliances don't need to purchase a new gas appliance, whereas switching to electric heating will incur the full cost of the new appliance. However, gas appliances do wear out and will eventually need replacing. Accordingly, the chart shows the present value of the future cost of a household replacing a worn-out gas appliance with another gas appliance for two situations: A household with a five-year-old gas appliance, and one with a twenty-five-year-old appliance. As can be seen, the present value of the future cost of replacing a relatively new appliance is a lot less than for an old appliance which will soon need replacing anyway. In addition to discounting the future cost, it is assumed that replacing a worn-out gas appliance with another gas appliance will result in a 20% saving in the cost compared to a new-build situation.
- Removing a gas appliance will likely require some 'make-good' costs, such as plastering and painting where a gas heater used to be. There is likely to be significant variation between such costs, hence the high / medium / low values. These costs are likely to be minor for water heating but more significant for space heating. The median values are based on a detailed Australian study of such costs.[13]
- Households will likely incur a cost to disconnect from the gas network. For this evaluation we have conservatively assumed $750. We note that overseas jurisdictions have started to introduce measures to cap these costs (eg, as set out in section 0 later, Victoria has capped gas disconnection costs at ~A$235, compared to the ~A$1,000 to $2,500 consumers were charged previously).

Figure 16: Switch-away costs for residential space heating for Mid fuel price scenario



[13] *"Cost of switching from gas to electric appliances in the home – A report for the Gas Appliance Manufacturer's Association of Australia"*, Frontier Economics, 24 June 2022

Figure 17: Switch-away costs for residential <u>water heating</u> for Mid fuel price scenario

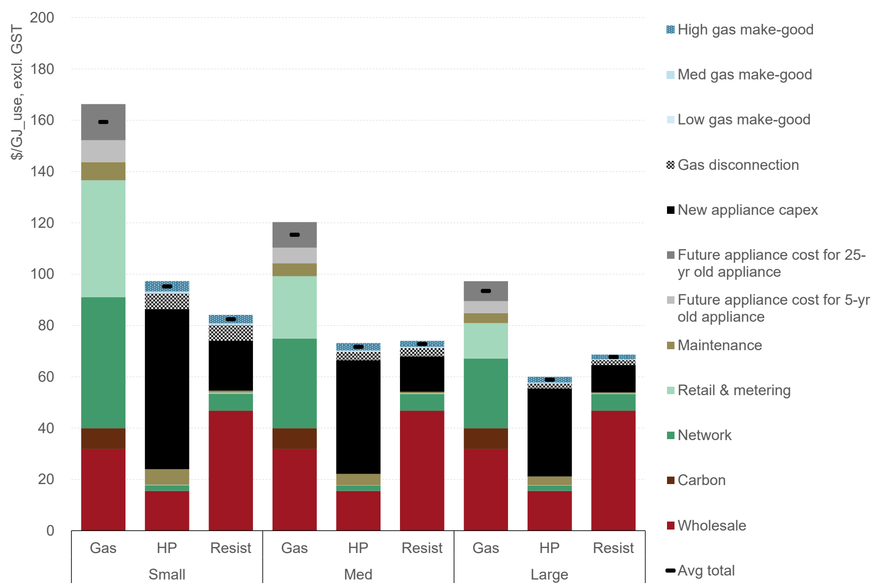


Figure 18: Switch-away costs for residential <u>space heating</u> for Cheap-gas-expensive-electricity fuel price scenario

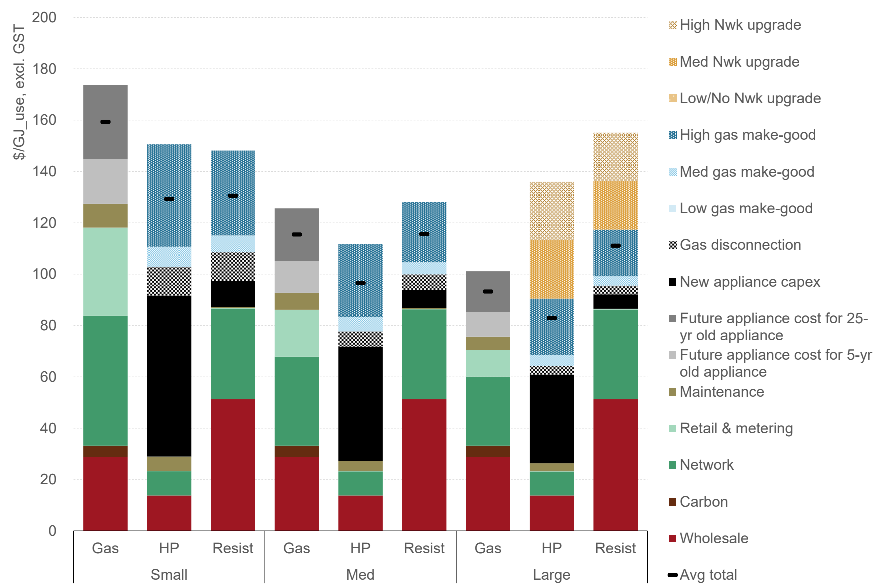
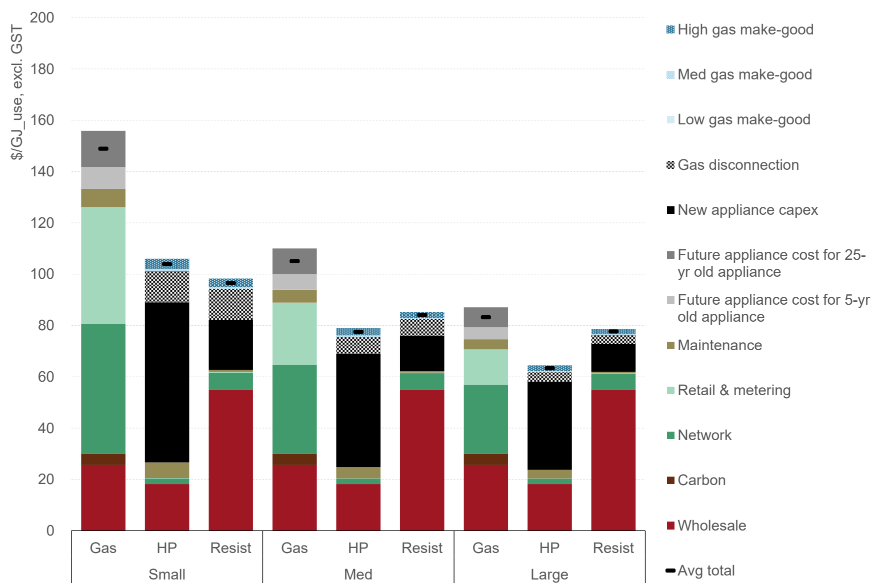


Figure 18 and Figure 19 below show the same evaluations for space and water heating for the Cheap-gas-expensive electricity fuel price scenarios.

Figure 19: Switch-away costs for residential water heating for Cheap-gas-expensive-electricity fuel price scenario



The key take-away from the results shown in Figure 16 to Figure 19 is that the majority of households who currently use gas can make material savings by switching away to electricity.

That said, there are some households for whom the economics of switching away from gas to electricity currently do not stack up. This applies to those households with a combination of:

- A fairly new gas appliance that won't need replacing for at least another fifteen years
- High make-good costs from removing the existing gas appliance – this is mostly an issue for space heating in some housing situations
- High network upgrade costs – this is only an issue for space heating in a small number of houses with large heating loads.

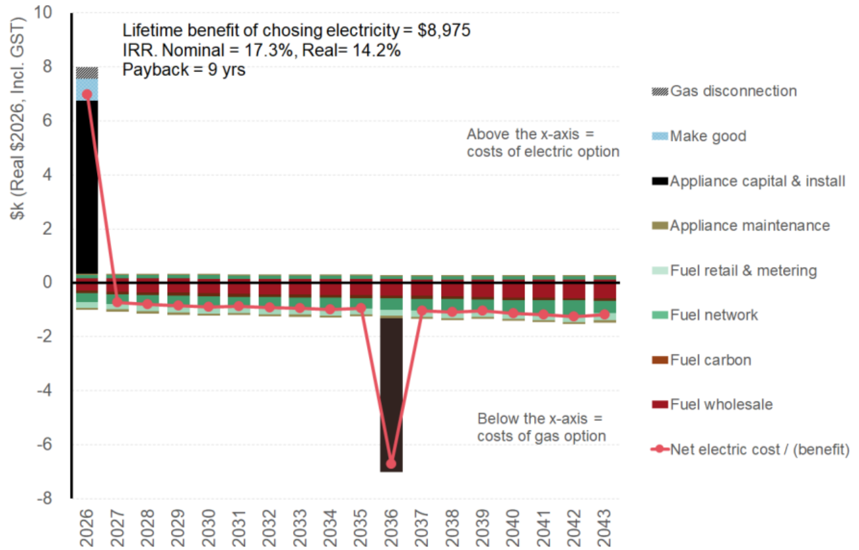
However, these housing situations are very much in the minority.

5.4.1 Why then, are we not seeing mass switching away from gas to electric heating?

One significant reason that we aren't seeing mass switching away is that a major element of the electricity option cost is the up-front costs of installing the appliance and incurring any gas disconnection costs. On a pure cash-flow basis, the electric option will result in significantly higher costs for the first year, and take several years for the investment to pay back.

This is illustrated in Figure 20 which show the cash-flows for switching away from gas space heating to a heat pump for an average Medium heat-load household that would need to replace their gas heater in 10 years' time.

Figure 20: Cash-flow for switching away from gas space heating to a heat pump for an average Medium heat-load household that would need to replace their gas space heater in 10 years' time in Mid fuel price scenario

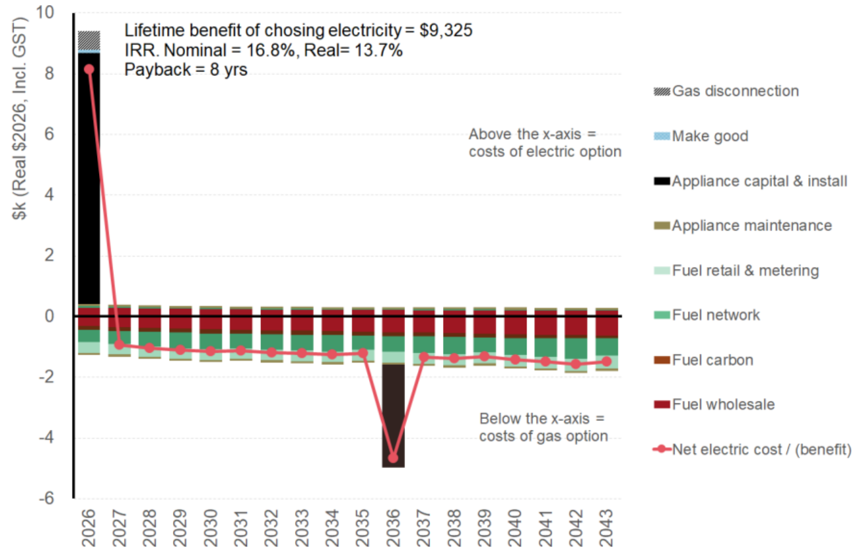


Initially, the household needs to spend ~$7,650 to purchase and install the heat pumps, undertake make-good repairs (some re-plastering and painting), and pay to disconnect from the gas network.[14]

Offsetting this, are ongoing fuel savings of ~$875 per year plus the avoided $5,715 cost of replacing a worn-out gas appliance with a new gas appliance in year 10.

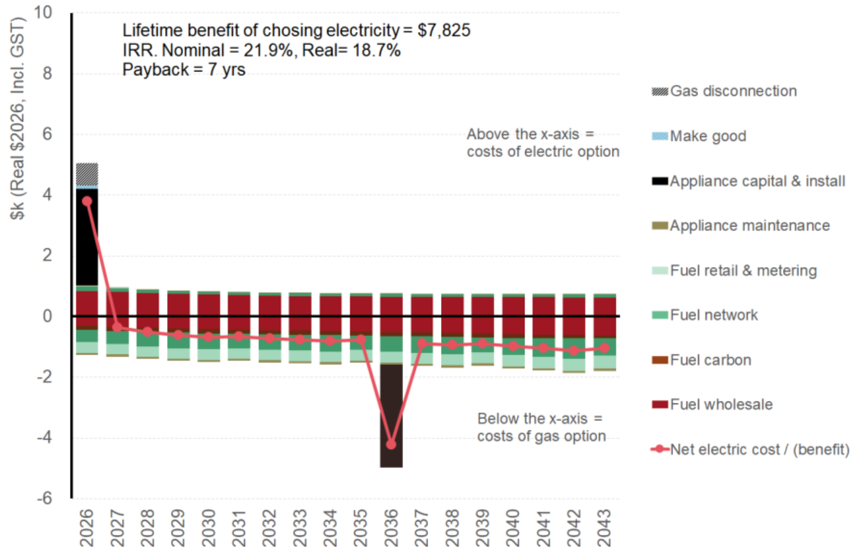
Figure 21 shows the same cashflow equation for a household who install a heat pump water heater, but would otherwise need to replace their gas water heater in year 10, with Figure 22 showing the same situation but installing a standard electric cylinder rather than a heat pump.

Figure 21: Cash-flow for switching away from gas water heating to a heat pump for an average Medium heat-load household that would need to replace their gas space heater in 10 years' time in Mid fuel price scenario



[14] This assumes some of the disconnection costs are shared with water heating.

Figure 22: Cash-flow for switching away from gas water heating to a standard resistance cylinder for an average Medium heat-load household that would need to replace their gas space heater in 10 years' time in Mid fuel price scenario



These water heating examples also show significant benefits for the household switching away from gas to an electric water heating option.[15]

[15] The water heating example shows the slightly counter-intuitive result of the option of installing a standard resistance electric cylinder delivering a higher IRR but lower lifetime benefit compared to the heat pump option. This is because the standard cylinder has lower up-front costs, but higher on-going costs – ie, the trade-off between up-front cost versus longer-term benefit is different. The lifetime benefit number (which is the present value of the current and future costs and benefits) is the one that indicates which one is best. Thus, assuming the cost-of-capital of the household is broadly similar to the 5% discount rate used for the present value calculation (ie, similar to current mortgage rates), the heat pump option would deliver the greatest benefit to a household's wealth over the fifteen years used for the evaluation. If the household had a smaller water heating load – ie, the value of the ongoing running costs would be relatively less, than a standard resistance electric cylinder would be best – as indicated by Figure 17, previously.

However, for all these examples, most households will find it hard to estimate the present value of the future replacement cost of a worn-out gas appliance.

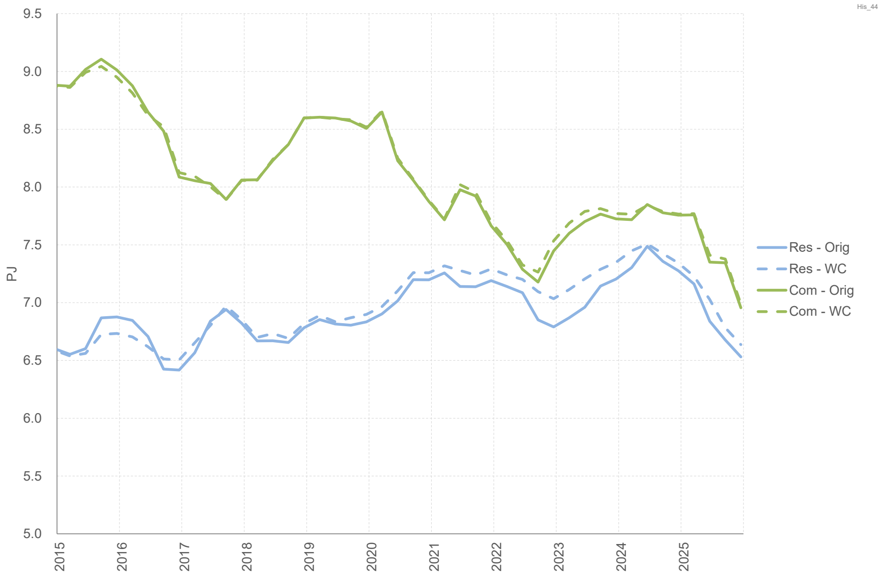
Similarly, there is poor information available as to the expected future wholesale and network prices of gas and electricity. And, even if there were such information, most households would be unable to perform the discounted cash flow calculations to enable like-for-like comparisons.

Thus, even though switching away from gas to electric is likely to be one of the most profitable investments households can make (as illustrated by the ~17 to 20% rates of return in the above illustrations – far exceeding paying off mortgages or investing in term deposits or the average returns from the stock market), most households don't have the skills to evaluate such an investment: Most people don't look at life through the lens of a discounted cashflow spreadsheet!

That said, this dynamic of gas being fundamentally uneconomic for new-build situations and significant savings being available for a growing number of existing gas users, appears to be reflected in recent observed outcomes. Thus, both residential gas volumes and customer numbers have started to fall and are projected to fall further.

MBIE stats shown in Figure 23 below show that annual residential demand has fallen from a high of 7.5 PJ for the twelve months ending Jun-24 to 6.53 PJ for the twelve months ending Dec-25 – an annualised rate of reduction of 8.7% per year, or 7.9% on a weather-corrected basis.[16]

Figure 23: Gas sold to residential and commercial consumers – rolling 4-quarter total[17]



However, during that same period, the number of gas ICPs registered as being active only fell by an annualised rate of 0.8% per year.[18] The pipeline companies in their most recent projections provided to the Commerce Commission indicate that they expect customer ICP numbers to fall by 8.2% from 2024 through to 2033.[19] While this annualised rate of reduction of 0.9% per year is consistent with the reported rate of change in active ICPs over the past eighteen months, it is much lower than the observed rate of reduction in the PJ volume of sales to residential consumers.

It is not clear why there is such a big discrepancy between the change in reported PJ volume reported sold by retailers to residential consumers and the reported change in the number of active ICPs. While it is possible that the average amount of gas used by individual households has fallen – whether due to energy efficiency, or just switching out one gas appliance rather than all heating appliances – the scale of discrepancy between the PJ volume and ICP customer numbers is too great for this to be the main explanation. Rather, it is likely that some households that have switched away from gas may still have their properties reported as active ICPs.

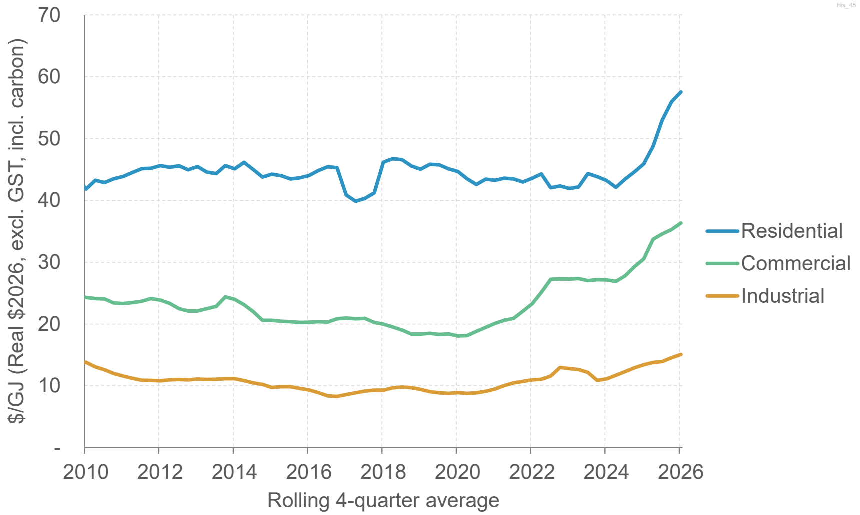
Some of this recent reduction in residential gas demand is likely due to increases in the price of gas.

Figure 24 shows that on an average cost per delivered GJ basis, real prices for residential consumers have risen over the past eighteen months from a prior stable long-term average of ~$50/GJ to $64/GJ.

[16] Weather correction has been undertaken by Concept based on the observed historical relationship between demand in a quarter and temperature.
[17] WC = Weather-corrected. Orig = Original, or non-weather-corrected.
[18] Analysis of data downloaded from https://www.gasindustry.co.nz/data/switching/

[19] Source: https://www.comcom.govt.nz/assets/Documents/2026-gas-default-price-quality-path/Concept-Consulting-Gas-demand-projections-to-feed-into-the-default-price-quality-path-DPP-regulation-of-gas-distribution-businesses-22-August-2025-v2.pdf

Figure 24: Rolling 4-quarter average gas prices

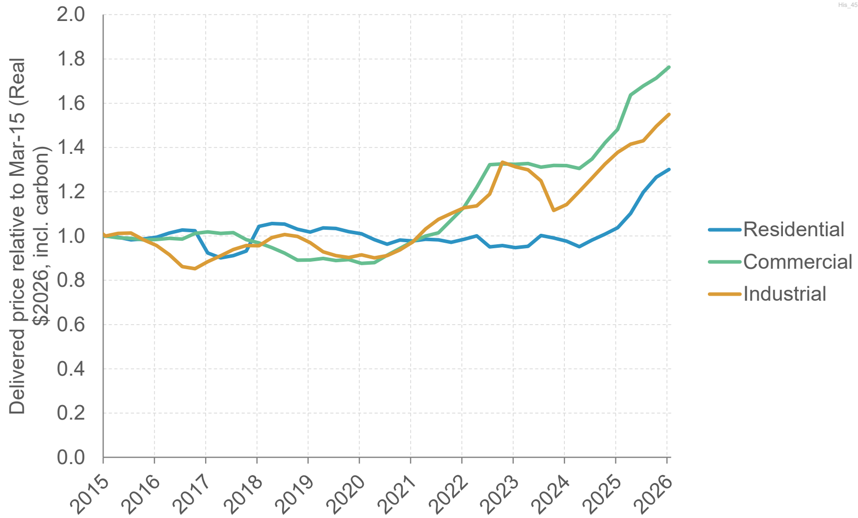


Source: Concept analysis of MBIE stats

Figure 25 shows that, in relative terms, commercial and industrial consumers have faced even greater % rises in the cost of gas.

Thus, while residential consumers' prices have risen by 25% since the beginning of 2020, industrial consumers' prices have risen by 64% and commercial consumers' by 96%.

Figure 25: Change in consumer gas prices relative to Jan-20



Some of this is due to the rise in wholesale gas prices due to the growing gas scarcity situation. Our evaluation is that the effect of the growing price of wholesale gas has yet to fully flow through to residential consumer prices, with retailers wary of incurring the political wrath that would likely follow a very rapid large increase in prices to households.

Some of this is due to an increase in pipeline charges. This is partly due to some price increases under the price control mechanism administered by the Commerce Commission.

Rising pipeline charges may also partly be due to falling volumes of gas. If consumer volumes fall by 10%, all other things being equal, prices for the remaining consumers will need to rise by ~10%. This is because almost the entirety of pipeline costs are not driven by the GJ volume of gas flowing down the pipes but, to all intents and purposes, are fixed. Recovering a fixed cost from a smaller volume of gas requires higher prices for that gas.

Box 3: Should I wait until my appliance needs replacing?

If a gas appliance needs replacing anyway, it is almost always the case that it will be cost-effective to switch to an electric option. The average rate of return on the investment for the switch is estimated to be between 20% to 50% depending on customer circumstance. By far one of the most profitable investments any household could make!

If a gas appliance has several years of life left, a household could maximise their value by waiting until 'just before' it needs replacing. The scale of benefit from waiting is greatest if the gas appliance is relatively new, as the present value from postponing the up-front cost of the electricity option outweighs the lost benefit from not enjoying lower running costs earlier. If the gas appliance only has a few years left, the benefit from waiting is relatively small.

The big caveat to the 'wait-until-replacement-is-needed' strategy, is that it is not possible to predict exactly when a gas appliance will need replacing. If a gas appliance suddenly stops working, it is generally much quicker to replace it with another gas appliance than switch to electricity. Thus, unless households are prepared to wait the several days (potentially weeks) without heating or hot water while an electricity appliance is installed at short notice following a gas breakdown, it is worth pro-actively switching to electricity ahead of time, thereby avoiding any disruption.

Furthermore, as Figure 20 to Figure 22 have demonstrated, switching to electricity 'now' rather than waiting till the gas appliance anyway needs replacing 'later', is not a bad investment, and will almost certainly guarantee much higher returns than almost any other investment or paying off a mortgage. It is just that if you can fine tune the timing of switching to coincide with the timing when the gas appliance would anyway need replacing, you can achieve even greater value – subject to the risks of waiting too late.

Also, for households with more than gas appliance (eg, space and water heating), if there is anyway a need to replace one appliance, the economics of switching out the other appliance at the same time also substantially improve.

5.4.2 Eventually, it will be economic for all residential consumers to switch away from gas

This dynamic of falling pipeline demand raising pipeline prices for remaining consumers which triggers even more consumers to swich away from gas is known as the 'death spiral'. Managing this is one of the biggest challenges associated with the transition away from gas.

Our projections show the effect of this in the cashflow projections in Figure 20 and Figure 21 previously, with the running costs of gas starting to rise towards the back end of the projection. In fifteen years' time, our projection is for the pipeline and retail+metering costs to have increased by 50% - largely due to shrinking demand increasing the price for remaining consumers.[20] At the moment, a standard residential consumer in the Wellington region will pay approximately $840 per year, just in gas fixed charges. By 2040, this fixed charge component is projected to have risen to almost $1,300 per year in real terms.

The effect of this price rise will be to increase the proportion of gas consumers for whom it is cost-effective to switch away. As the consumer base progressively shrinks, eventually it will be economic for all residential gas consumers to switch away.

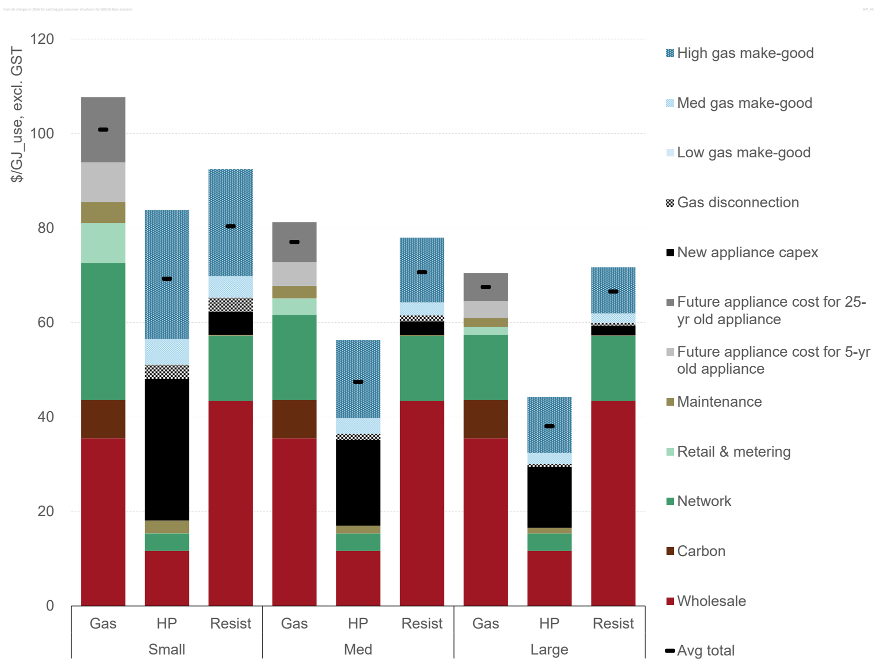
6 Economics of gas versus alternative for other consumer segments

6.1 Commercial consumers

EECA's energy end-use data identifies that the significant majority of gas used for commercial consumers (offices, hotels, restaurants, shops, etc.) is for space heating.

Figure 26 shows the estimated economics of switching away from gas for commercial consumers for space heating.

Figure 26: Economics of switching commercial space heating



Although similar to that for residential households switching away for space heating, the economics of switching to electricity appear to be even more favourable for commercial consumers than residential consumers.

This is likely due to the economies of scale in delivering energy services, and thus the proportionally greater extent to which variable costs affect the relative economics of gas versus

[20] This effect is greatest for the pipeline component, but there is also a similar (albeit proportionately smaller) element for retail cost-to-serve in that there are some fixed costs associated with providing energy consumers with retail services.

electric for commercial consumers relative to residential consumers. The high efficiency of heat pumps will thus have proportionally greater effect than in the case of residential situations.

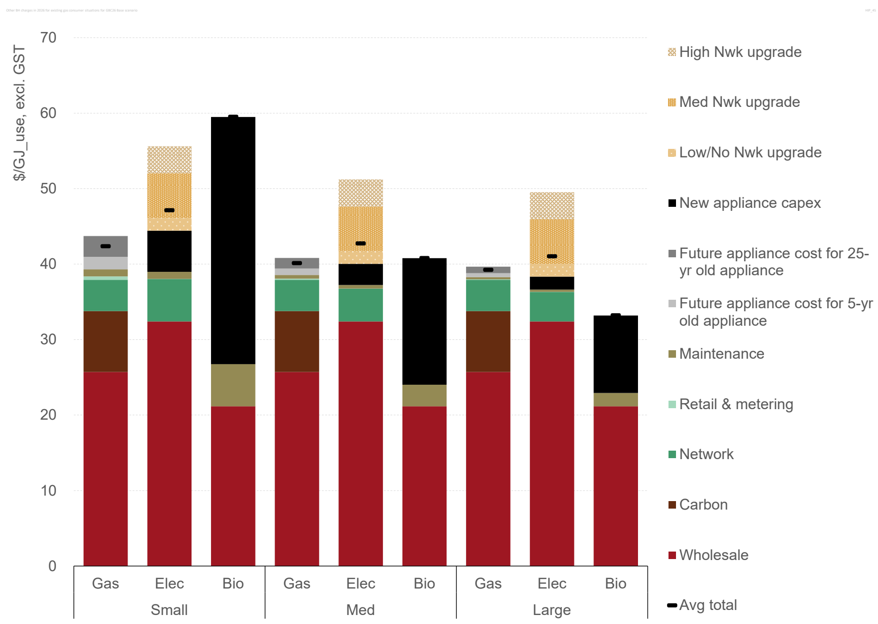
That said, it is likely that there is greater variation in commercial consumers' situations than in residential situations.

The relative economics of electricity versus gas, coupled with the fact that commercial consumers have faced the greatest proportional increase in gas costs (as indicated in Figure 25 previously), may significantly explain why commercial demand has fallen more significantly than residential demand over the past decade (as indicated by Figure 23 previously).

6.2 Industrial consumers

While the economics of switching away from gas for residential and small commercial consumers are compelling, the same is currently not true for many industrial consumers. Figure 27 shows the evaluation for switching away from piped gas to electricity for industrial consumers for the Mid fuel price scenario.

Figure 27: Economics of switching for an industrial boiler heat consumer for Mid fuel price scenario



One key difference between the economics of gas for industrial consumers and residential consumers, is that the wholesale + carbon cost dominates the cost for such users. This is because industrial users have very high load factors for their operation – typically using their boilers for ~65% of the time. This contrasts with ~10% load factors for households using their heating appliance. Coupled with significant economies of scale, this makes the appliance capital and maintenance costs of industrial boilers significantly less on a $ per GJ of useful heat basis compared with industrial heaters.

Similarly, significant economies of scale and high utilisation results in much lower pipeline costs.

This dynamic makes it more generally costly for industrial users to switch from gas to alternatives:

- While high temperature heat pumps are available for some industrial heating requirements, in most cases there will still be a significant requirement for raising primary heat in a way that can't be satisfied by a heat pump. Using a standard electric boiler (the 'Elec' option shown in Figure 27) results in a high wholesale cost of electricity.
- While electro boilers are themselves relatively low-cost options, in many cases switching to an electric option will require a significant and costly network upgrade.
- Biomass is a cheaper fuel relative to electricity – although there can be material variation depending on site-specific factors such as distance from the source of biomass – but the costs of the boilers themselves are significantly more expensive. Furthermore, biomass supply requires supply chains that have yet to fully mature, creating a 'chicken-and-egg' barrier to large scale uptake: An industrial consumer will be unwilling to make an investment in a biomass boiler unless they have confidence that there will be long-term supply of biomass. Conversely, a biomass supplier will be unwilling to make the long-term commitment to enable such supply unless they have confidence of a long-term market for their biomass. That said, this infant technology barrier is starting to be overcome, with scale being developed in a number of regions.

Current low carbon prices are suppressing the signal for cost-effective industrial switching

Although Figure 27 indicates that switching to biomass boilers is lower cost than continuing with gas for large industrial boiler heat loads (subject to the caveat around significant variation in biomass prices), that is for the situation with our mid fuel prices scenario. While these are not unreasonable for the ex-carbon wholesale gas and electricity prices, the carbon price projection is significantly higher than current prices that are emerging from the secondary market for units in the New Zealand Emissions Trading Scheme.

Figure 28 shows how the economics change if industrial consumers face the low carbon price scenario (which is still ~ 40% higher than current ETS prices) and Figure 29 shows the economics for the high carbon price scenario.

Figure 28: Economics of switching for an industrial boiler heat consumer for Mid-fuel-low-carbon price scenario

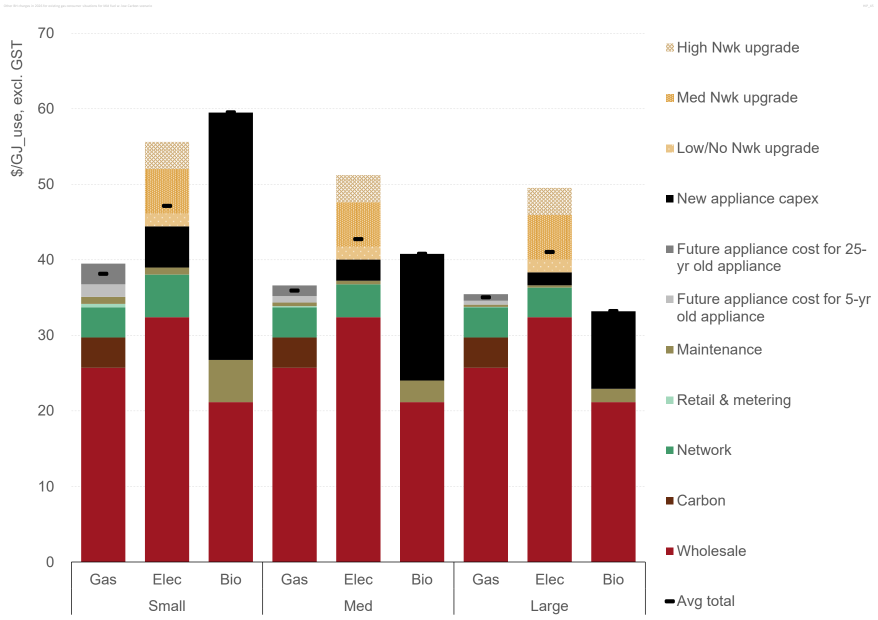
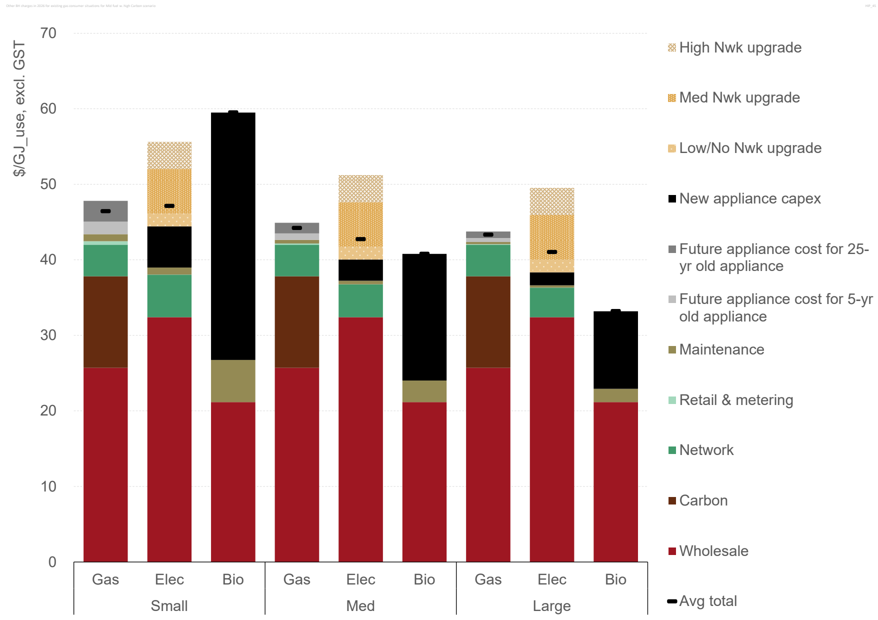


Figure 29: Economics of switching for an industrial boiler heat consumer for Mid-fuel-high-carbon price scenario



As can be seen, with low carbon prices, the economics of large boiler loads switching from gas become marginal, whereas in the high scenario the economics of switching to biomass for large boiler heat loads become compelling.

Given that the Treasury's high carbon price scenario is what the Climate Change Commission projects as being the marginal cost of meeting our emissions reduction target, it is the best reflection of the price signal New Zealand should be sending its emitters to deliver the least-cost transition – at least in a way that doesn't result in large parts of our sheep-and-beef farmland being covered in pine trees.

If, as is currently the case, New Zealand doesn't send such a price signal, we are likely to get worse economic outcomes.

Furthermore, it should be noted that the high carbon price scenario is that which is consistent with the current legislated emissions reduction target: net-zero emissions (excluding biogenic methane) by 2050 and beyond. However, the Climate Change Commission's latest advice is that to be consistent with New Zealand's international commitments to limit climate change, New Zealand should adopt a target of net *negative* 20 $MtCO_2e$ by 2050 *including* international transport emissions. The marginal abatement cost with such a target would necessarily be higher than is currently reflected in the High carbon price scenario.

6.3 Power generation

Figure 30 to Figure 32 below show the outcomes projected in Concept's central scenario using its ENZ model. Note:

- The values for the years 1990 to 2025 are actual historical outcomes, with those for 2026+ being those projected in the model.
- The 'jagged' nature of many of the historical outcomes significantly reflects the variation in hydrology between the years. The values for the projected years reflect the mean outcomes across all potential weather years.

Figure 30: Base scenario generation

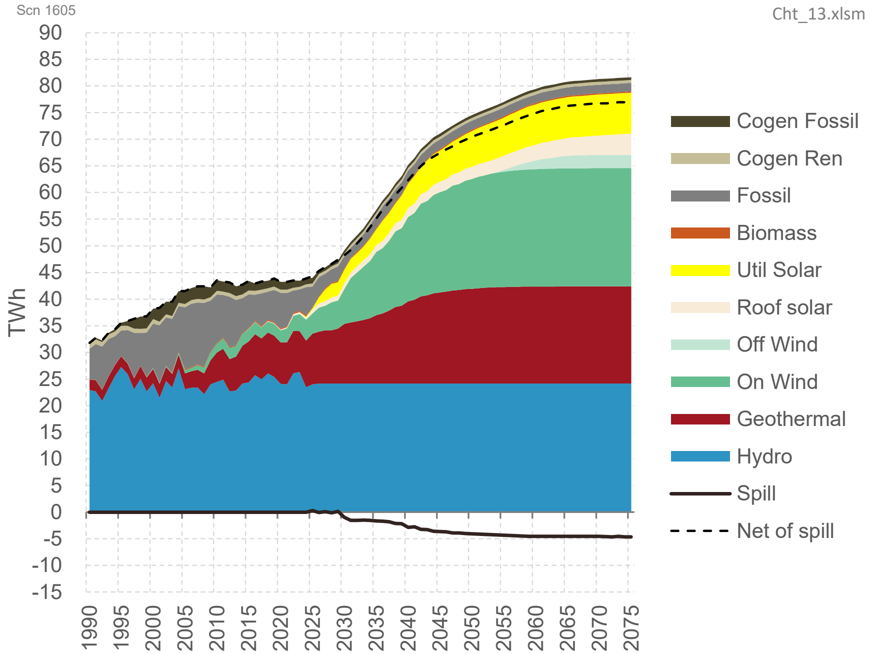


Figure 30 shows that renewable build has been, and is projected to continue to, displace the need for thermal generation from baseload duty and some (but not all) flexible 'peaking' duties

Figure 31: Base scenario % renewable generation

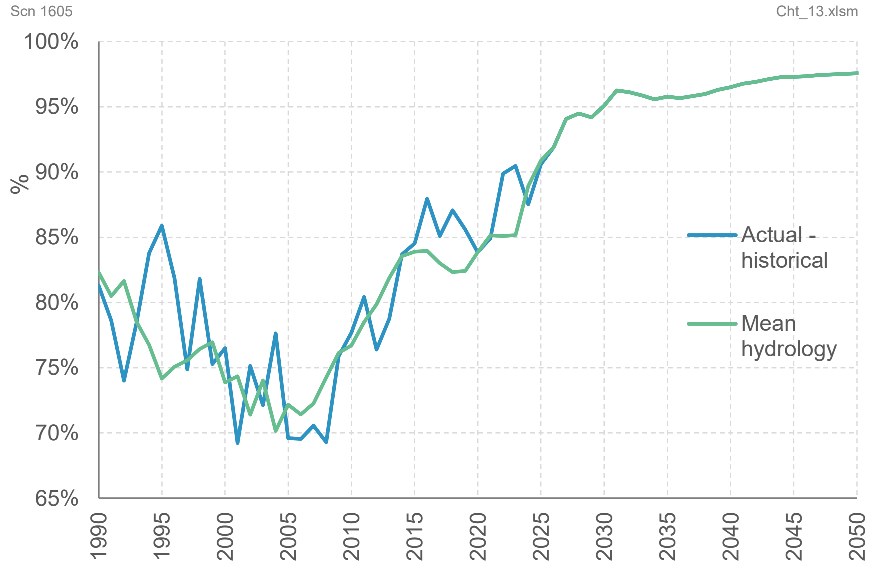


Figure 31 shows that the decline in thermal generation out to 2035 is a continuation of the trend that started in 2005 of increasing % renewable generation as renewable stations are built at a rate that is faster than demand growth. By 2032 in this base scenario, the system reaches ~96.5% renewable generation. Beyond 2035 the % renewables only very marginally increases. This is because the last 2-3% of thermal generation is performing a low-capacity factor peaking role, largely to balance renewable variability, and it is very costly to over-build renewable generation and batteries to an extent that significantly displaces thermal generation from this type of duty – particularly the long-duration, seasonal and dry-year duty for which batteries are completely un-economic options. Higher % renewable generation (ie, ~99%) is not achieved because of the assumption of $50/tCO2 carbon prices (ie, assuming no reform of the ETS) in this Base scenario.

Figure 32: Base scenario fossil generation

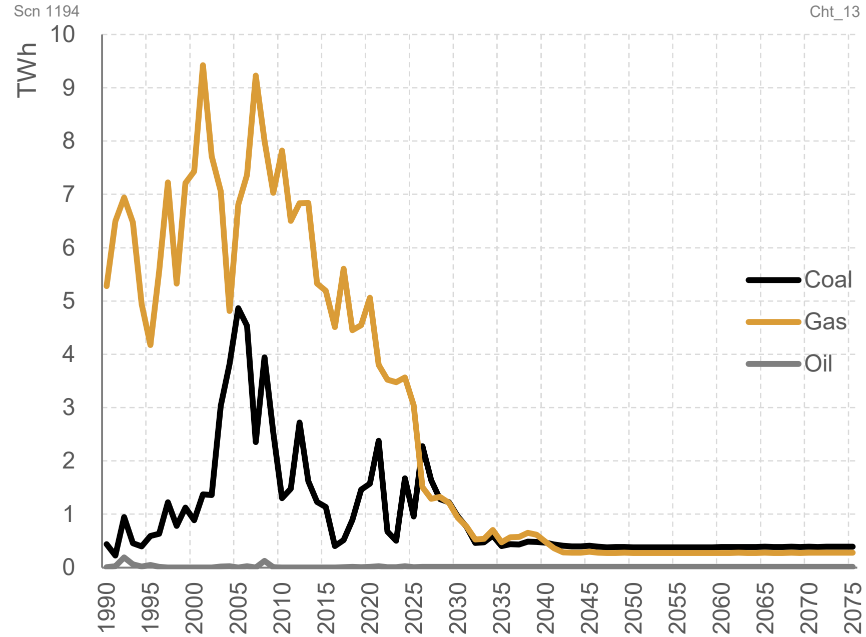


Figure 32 shows that some of the reduced need for gas for power generation is due to the use of coal at the Huntly Rankine station displacing gas-fired power generation – both from OCGT peaker plants and from being burned in the (dual fuel) Huntly Rankine station itself.

Note: The above graphs show average outcomes across a range of 'weather years' – ie, for each future year, the outcome is the average across dry years and wet years. In dry years a lot more thermal generation and fuel is required, and vice versa in wet years.

The analysis in our separate gas market study[21] demonstrates that this varying need is met by a combination of underground gas storage, coal stockpiles, industrial gas flexibility – particularly from the Ballance petrochemical plant which is projected to take over from such duty when Methanex exits – and industrial electricity flexibility (from the likes of the Tiwai smelter).

6.4 Petrochemicals

Petrochemicals manufacture largely occurs in parts of the world where gas is relatively cheap, particularly where there is limited ability to export gas through pipelines or LNG. In other words. it is a sector that has predominantly developed as a means of monetising gas that would otherwise be stranded – particularly gas that is produced in association with oil production. As a result, global petrochemical prices tend to be driven by the economics of production in places with such surplus gas situations. The ability to pay for gas to produce petrochemicals is therefore relatively low.

This dynamic drove the development of New Zealand's petrochemical sector in the 1970s and 1980s and the subsequent decades.

Now, however, New Zealand no longer has a situation where there is surplus gas above what is the demand for New Zealand's non-petrochemical uses of gas.

The economics of petrochemical manufacture mean it would be fundamentally uneconomic for them to pay the very high prices associated with LNG or biomethane.

Therefore, unless there is a major new gas discovery in New Zealand that can be developed within the next five or so years, the key question is 'when' not 'if' petrochemical manufacture will cease in New Zealand.

Methanex has closed two of its three methanol production trains and has been operating its third at part load. There is a very real likelihood that this train will also close in twelve months, as the deliverability from the fields it has contracted from (Pohokura and Maui) is likely to fall below the ~50 TJ/day that is the methanol train's technical minimum. This is likely to be at or around the end of this year as that is the date that OMV has announced it will likely cease production at the Maui field due to production levels falling below the level necessary to cover the ongoing costs of operation.

While the Ballance urea manufacturing train has managed to keep operating, it has been unable to secure a long-term contract, and has kept operating on a hand-to-mouth basis, purchasing surplus gas on a short-term basis while the demand for gas-fired generation is low. It is uncertain how long Ballance will be able to continue operating. Its much smaller size than Methanex mean it could continue operating for more years yet –

[21] "Outlook for the New Zealand gas market". Available on subscription. Contact simonc@concept.co.nz for details.

particularly if other gas users continue to transition away – and such operation would allow gas producers to bring forward the monetisation of their gas and associated liquids production. However, this would also have the effect of bringing forward the eventual time when New Zealand runs out of gas from its existing fields. This highlights the key 'rationing' challenge facing New Zealand: although there is a negative economic impact from stopping petrochemical manufacture, there is a significant and growing counter-balancing benefit in that this will free up gas for higher-value uses of gas (eg, industrial process heat) and postpone the time when these industrial consumers will need to switch to more expensive fuels.

A key question for 'NZ Inc' is whether this rationing dynamic is happening in a way that maximally allocates scarce petroleum resources to the highest value uses.

7 Are there other benefits or costs of transitioning residential consumers?

The previous sub-sections have identified that switching residential and commercial gas demand to electricity is likely to deliver a positive economic benefit, even without a cost of carbon. This sub-section assesses some of the other aspects that may deliver additional benefits, or have been put forward by some stakeholders as delivering costs.

7.1 Transitioning mass-market consumers will deliver supply security benefits

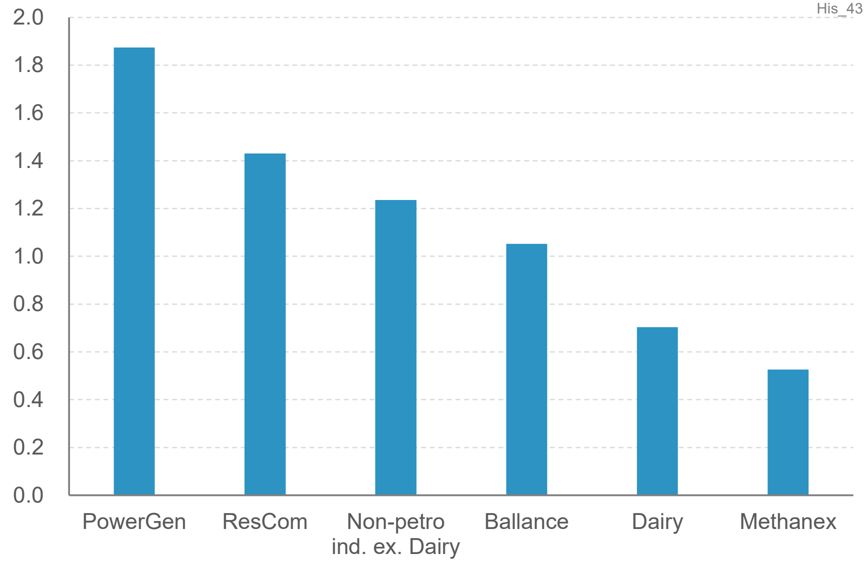
Transitioning mass-market consumers will deliver the benefit of rationing scarce gas for the higher-value industrial consumers – giving more time for those industrial consumers for whom it is more costly to transition.

There is not just a long-term dimension to this, but a shorter-term dimension relating to winter system security. In this respect, some industrial consumers are currently finding it hard to be offered firm supply contracts at any price. As our latest market forecast report demonstrates in some detail, this is significantly due to the 'contractability' problems associated with re-allocating the gas entitlements that Methanex has contracted for until 2029 to higher value uses.

While addressing such issues is beyond the scope of this report to GBC, it is worth noting that the inability for gas producers to offer firm contracts during this period significantly relates to the balance of supply-demand deliverability during 'dry' winter periods – ie winters where hydro generation is low.

In this respect, Figure 33 demonstrates that while power generation is indeed the biggest proportional segment of demand driving the need for winter peaking gas, residential and commercial demand is also a proportionally significant driver.

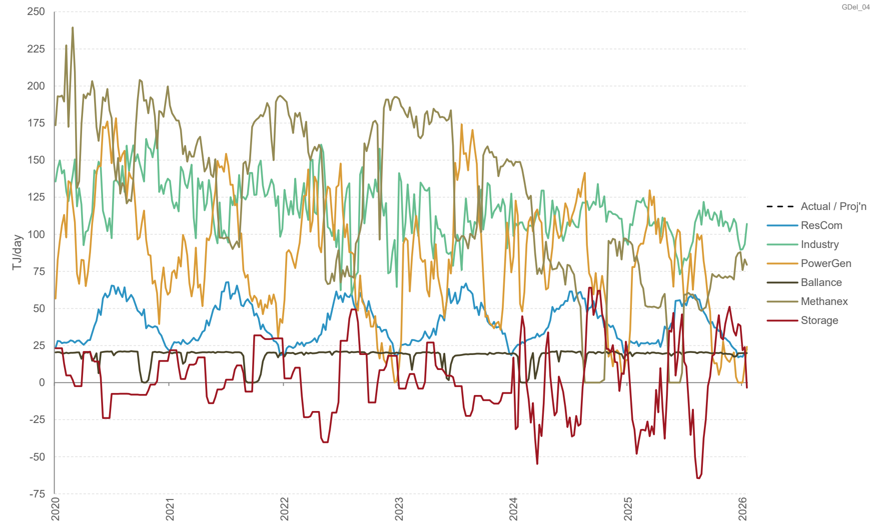
Figure 33: Relative weekly demand during peak system demand period in year[22]



Source: Concept analysis using daily gate data from 2020 to 2025

The strong winter-focussed shape of residential and commercial demand can also be seen in Figure 34.

Figure 34: Historical weekly demand



Source: Concept analysis using daily gate data from 2020 to 2025

Helping residential and commercial demand transition away is therefore not only economically optimal, but will also deliver one of the biggest supply-security 'bangs-for-buck'.

[22] This graph shows the average weekly demand for each segment during the peak system demand week each year, relative to the average weekly demand for that segment across the whole of each year. For example, a value of 2 would mean that the segment's weekly demand during the system's peak demand week is twice as much as the segment's average weekly demand across the year.

7.2 Gas doesn't offer resilience benefits for households and businesses

As the frequency of adverse climate events such as cyclone Gabrielle increases, the costs of energy interruption is becoming increasingly front-of-mind for the public and policy makers.

Some have suggested that having gas heating offers resilience in the event of an electricity outage. However, the vast majority of gas appliances in homes and business in New Zealand need electricity to work, so there is no such resilience benefit.[23]

7.3 It is important not to confuse interruption cost with economic cost

One of the confusions about considering the different values of gas for consumer groups is that different consumer groups are assigned a 'value of lost load' (VOLL) which is used for determining which parts of the network will be progressively shut off in the event of a critical contingency such as the unexpected sudden loss of a major source of gas supply.

One of the highest value groups (after the likes of hospitals) are residential consumers. Most large industrial consumers will be shut off ahead of residential suburbs, despite the analysis above and in section 0 below showing that the economic value for using gas is far greater for industrial consumers than residential consumers.

This is because VOLL measures a cost of interruption, whereas the economic evaluations in this report assess the economics of switching from gas to alternatives. Residential consumers have a higher cost of interruption because:

- There can be human welfare issues if interruption occurs during winter and homes are using gas for space heating;
- It costs an enormous amount to turn the gas back on for a residential area after the main pipeline gate has been turned off. This is because it is necessary for safety reasons to send pipeline staff round to *every property* to check that no gas appliances have been left on before the gas is able to be restored to the whole area.

7.4 Switching away from gas also offers health benefits

EECA has recently published a major study that identifies there are material human health costs associated with the air pollution from indoor combustion from gas cookers.[24] This study, consistent with a growing international body of evidence

[23] Some appliances that are 40-50+ years' old may be of a type that don't need electricity to operate. However, there are very few such appliances left in New Zealand.

[24] *"Indoor Combustion in New Zealand Homes: Health Effects and Costs"*. Report prepared by Emission Impossible Ltd and Resource Economics for Energy Efficiency & Conservation Authority, September 2025. Available here: https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/EIL-Indoor-Combustion-Study.pdf

on this issue, identified that gas cookers are responsible for several hundred premature deaths each year, along with close to a thousand hospitalisations and several thousand increased incidences of asthma.

Although the costs are heavily skewed to a relatively small segment of the population (those who are vulnerable to respiratory conditions, particularly among the elderly and infants), the consequences for this small segment can be very severe. The values ascribed for avoiding such adverse outcomes are consistent with the values used in other areas of society whether such as spending on health care, road safety, and the like.

Heat pumps also potentially deliver benefits arising from warmer, drier homes due to the ongoing costs of space heating heat pumps being roughly one-quarter of the ongoing costs of gas space heating. Past studies have identified between a 5:1 and 2:1 health-benefit : energy-measure-cost ratio for investments in insulation and clean heating solutions that lower households' fuel bills.[25]

[25] See, for example, https://ourarchive.otago.ac.nz/esploro/outputs/report/Healthy-Home-Initiative-Five-year-outcome/9926792153101891 and https://www.eeca.govt.nz/assets/EECA-Resources/Motu-Warmer-Kiwi-Homes-evaluation-Dec-2022.pdf

8 How much is supplying mass-market consumers with gas costing New Zealand?

8.1 Transitioning residential and commercial consumers will deliver billions in cost savings

The key conclusions set out in section 0 were:

- Electricity is always cheaper than gas for all residential new-build situations – even against the (in our view, unrealistic) scenario of low gas and carbon prices and high wholesale electricity costs.
- Electricity is cheaper than gas for switching away for most residential and commercial situations that currently use gas – even against the cheap-gas-expensive-electricity scenario
- In addition to such switching delivering economic value to NZ in its own right, this would deliver additional value by rationing the scarce remaining gas from our existing fields for industrial consumers for whom the economic value of using gas is much greater.

To estimate the overall cost to New Zealand of continuing with gas for residential and commercial consumers, we undertook additional modelling of the value of the avoided costs that would be enjoyed by transitioning such consumers away from gas by 2050, rather than continuing with gas and, in doing so, relying on additional sources of supply, such as from LNG.

On a present value basis, using the Mid price scenario, the savings from transitioning away residential and commercial gas consumers to electricity by 2050 were estimated to be $7.1bn, of which $1.4bn was due to avoided carbon emissions valued at the mid carbon price scenario, and $1.3bn was the adverse human health costs from households continuing with gas cookers using EECA's recent report[26] on the human health consequences of indoor combustion indicates as a basis for this cost.

Ie, even excluding these emissions-related costs, transitioning residential and commercial consumers away from gas will deliver approximately $4.4bn in value to New Zealand.

Furthermore, this benefit does not include:

- The health benefits of warmer, drier homes due to the ongoing costs of space heating heat pumps being roughly one-quarter of the ongoing costs of gas space heating. Past studies have identified between a two-times and five-times health benefit for every $1 spent on reducing energy costs through investments in insulation and clean heating solutions that lower household's fuel bills. If we assume a $1 health-benefit per $1 of reduced space heating energy-cost, this translates to a present value health benefit of approximately $2.3bn.

[26] *"Indoor Combustion in New Zealand Homes: Health Effects and Costs"*, Sep 2025, Emission Impossible Ltd and Resource Economics for EECA

- The benefits of enabling high-value industrial consumers to continue with gas for longer before they need to transition to higher-cost alternative fuels.

8.2 Proactive transitioning of industrial consumers will also deliver benefits, including for those who need to transition to *fossil* fuels

Although prioritising switching for residential and commercial consumers will eke out New Zealand's gas for higher-value industrial consumers, this is not a permanent solution as our domestic gas reserves are finite. Accordingly, measures to support industrial consumers to transition – starting with those whose ability to do so is greatest – will be an important complementary measure.

EECA has being doing good work on this front in relation to measures to support electrification and the development of solid biomass solutions for industrial process heat. Expanding these programmes are likely to deliver additional value – particularly while carbon prices are below the level required to deliver an emissions reduction that isn't predominantly driven by planting trees on former sheep & beef farms.

However, there are likely some industrial users for whom transitioning to electricity or biomass is not practicable.

Foremost among these are the petrochemical producers Methanex and Ballance who primarily use gas as a *feedstock* for making either methanol or urea. At some point, it is hard to see that both such producers can continue in New Zealand due to declining gas production. Such exit is likely to be soon in the case of Methanex, but potentially quite a few years' away in the case of Ballance. However, it would be fundamentally uneconomic to develop an LNG import facility to enable such producers to continue.[27]

Other industrial gas consumers for whom electricity or biomass may not be practicable are those who use gas to provide furnace heat. However, there need not be de-industrialisation from these industrial consumers completely exiting New Zealand. Our analysis (in our separate gas market forecast report) indicates that an LNG terminal is not the solution (imposing costs on New Zealand that far outweigh the benefits to this industrial segment), but instead helping such consumers transition to LPG (ie, liquid petroleum gas, not liquefied natural gas) or diesel would be far more cost-effective – even in a future of much higher carbon prices.

However, at the moment, there are no programmes to support such consumers to prepare for such a transition, and a broader

[27] Petrochemicals are predominantly developed in countries with gas surpluses to monetise gas that would otherwise be 'stranded'. The international price of such petrochemicals therefore reflects this. In contrast, LNG import prices reflect situations of gas scarcity in such importing countries. This gives rise to a situation where, if LNG were imported into a country that produces petrochemicals, gas would be imported at a price that is higher than the value of the petrochemical product that was made from gas.

policy position from many quarters that seems to focus purely on renewables and ignores the (relatively small in total size) industrial segments for whom renewables are unlikely to be practicable options in the next few decades. Not only would exit from New Zealand from these segments be bad for New Zealand's economy, but there is a high likelihood that global emissions would not fall (and could even rise), as New Zealand production of these internationally traded commodities is replaced by overseas fossil-fuelled production – an outcome often referred to as 'carbon leakage' in the context of measures to reduce emissions in a country that have the unintended consequence of shifting production to overseas countries with similar or higher emissions.

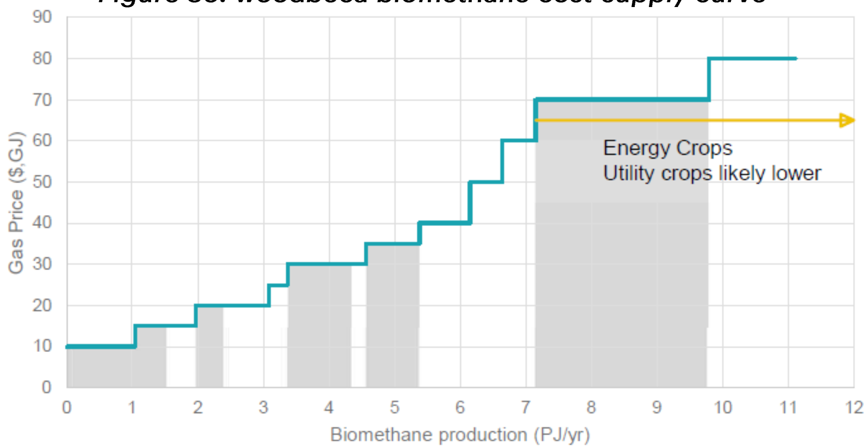
Without recognising the challenges facing these hard-to-electrify sectors, and without measures to support their eventual transition to alternatives such as LPG or diesel, concerns about de-industrialisation – concerns we consider justified – could undermine the durability of policy frameworks that support those transitions to low-emissions technologies that are cost-effective. Instead, policy flip-flops (eg, from 100% renewables to LNG) imperil the steady investment signals required to deliver a transition that is both cost-effective and delivers the needed emissions reductions.

8.3 Might biomethane be an alternative transition route?

Some commentators, particularly the gas pipeline companies(!), suggest biomethane as an alternative way to manage the decline in New Zealand's gas fields, and a reason for consumers not to switch away from gas.

Concept undertook modelling as part of our more detailed gas market report[28], to establish the extent to which this could be the case. As an input, we used the NZ biomethane cost-supply curve developed by woodbeca for the Gas Industry Company[29], reproduced as Figure 35 below.

Figure 35: woodbeca biomethane cost-supply curve



Note: grey columns indicated the quantities based on the case studies

[28] "Outlook for the New Zealand gas market". Available on subscription. Contact simonc@concept.co.nz for details.

[29] Source: https://www.gasindustry.co.nz/assets/CoverDocument/Gas-Transition-Plan-Biogas-Research-Report-February-2023.pdf

Our gas choice model was run in a way that biomethane was taken up to the extent that it is cost-effective to do so. Thus, as the wholesale price of gas rises, the model progressively develops biomethane consistent with the biomethane cost-supply curve illustrated in Figure 35.

Eg, if wholesale gas prices rise to $25/GJ, an amount of biomethane is assumed to be developed consistent with the $25/GJ point on the cost-supply curve (taking account of the relative carbon intensities of the two fuels and the assumed carbon price for the scenario).

However, due to the relatively high cost of biomethane, this resulted in only a relatively modest uptakes of biomethane with almost no discernible effect on the time when consumers transition away from pipeline gas.

What if biomethane were cheap and plentiful?

To test whether much larger, cheaper biomethane supply would change the outcomes, we ran a scenario with twice the available volume at 75% of the price. We regard these as optimistic assumptions — not least because biomethane costs are mostly feedstock costs, so it lacks the scope for the big technology-driven cost reductions other renewables have enjoyed.

Tellingly, the volumes of Auckland food waste collected for the Reporoa anaerobic digestion plant — which feeds the gas pipeline network — are materially below projections, hurting the scheme's economics.

Nonetheless, despite these (in our view) optimistic assumptions, this results in only marginally higher amounts of biomethane uptake that only marginally prolongs pipeline gas use.

What if biomethane were cheap and plentiful and carbon emissions expensive?

Because biomethane is proposed as a decarbonisation pathway, we ran a scenario combining the Cheap Biomethane assumptions with the energy sector facing carbon prices at Treasury's recommended high estimate for the shadow price of carbon. The logic: if biomethane is a cost-effective way to decarbonise, a high carbon price should overcome any barrier created by carbon prices being too low.

However, exposing market participants to a high carbon price results in a much more rapid transition away from pipeline gas to alternatives such as electricity and (solid) biomass, and there is relatively little biomethane uptake.

This is because, even at double the available biomethane, the volume is still small relative to pipeline-gas demand. The high carbon price on the fossil component of pipeline gas outweighs any benefit from the lower-emission biomethane component, so switching accelerates.

The only sector with higher gas demand under the high carbon price is petrochemicals. This is gas sold to Ballance, which the Industrial Allocation mechanism shields from the high carbon price. Because non-petrochemical consumers switch away faster, more gas is freed up for petrochemical production.

Biomethane summary

Given its small physical potential and high cost, it is hard to see biomethane delivering a sustainable long-term future for pipeline gas — and certainly not one that lowers energy costs for New Zealand's gas consumers.

If cost-effective opportunities to develop biomethane and inject it into pipelines arise over the next couple of decades, all well and good — though our provisional view is that alternative uses for the bio-feedstock will often be more cost-effective. For example:

- cogeneration of biogas at landfills or waste-water treatment plants,
- composting rather than anaerobic digestion for waste organic matter, and
- if circumstances make anaerobic digestion more cost-effective than composting, direct use of the biogas in an industrial gas facility rather than upgrading the biogas to biomethane to inject into a pipeline.

But telling consumers that biomethane will let them keep using pipeline gas for the foreseeable future — without spelling out the likely price and emissions consequences — would:

a) likely result in distortion of consumer decisions giving rise to poor economic outcomes (ie, not switching to alternatives as early as they would otherwise have done); and

b) arguably, be misleading to consumers.

9 Overseas gas transition policy learnings

New Zealand is not the only country faced with the challenge of whether or how to transition away from gas.

Several overseas jurisdictions have started to implement policies to move their economies away from gas. For some this is primarily due to climate change concerns and the need to transition off fossil fuels to reduce their emissions. For others, problems of diminishing supply, similar to those that New Zealand is facing, are becoming primary drivers.

This section reviews some of the approaches taken by these overseas jurisdictions. It seeks to distil the key learnings around what works, and what doesn't, for achieving a least-cost gas transition. It primarily reviews the experience of Victoria whose drivers are very similar to those of New Zealand, but who has implemented a suite of policy tools whose successes and failures are particularly relevant for New Zealand.

After reviewing the Victorian experience, the section pulls out a few other useful learnings from overseas jurisdictions that are also implementing gas transition policies.

9.1 Victoria

The Victorian Government has outlined a multiyear gas substitution road map to move the state off reticulated gas.[30] The original roadmap was set out in 2022, with updates published every year since.

9.1.1 Policy rationale

The key reasons set out in the roadmap for pro-actively moving away from reticulated gas are centred primarily on declining supply, cost, and climate considerations:

- Declining local supply. The Bass Strait gas fields that have supplied Victoria cheaply for decades are depleting. Continuing to rely on gas would mean increasingly expensive imported or interstate gas.
- Cost of living and energy bills. Gas prices have risen sharply and are projected to keep rising as east coast supply tightens, while electric appliances (particularly reverse-cycle air conditioners (ie, what Kiwis call heat pumps) and heat pump hot water systems) are significantly cheaper to run.
- Emissions reduction. Gas use in homes and businesses accounts for a substantial share of Victoria's emissions so decarbonising buildings is essential to hitting its legislated net-zero by 2045 target.

[30] https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap

There is also a strong stated economic rationale of first transitioning those consumer segments where it is cost-effective to do so (particularly residential and commercial) to ration remaining local gas resources for industrial and agricultural users for whom transitioning away from gas is more costly.

9.1.2 Policy mechanisms

Victoria's gas phase-out relies on a complementary policy stack, not a single mechanism:

- Strategic direction via the Gas Substitution Roadmap
- Progressive regulatory prohibitions on gas use
  - Planning reforms that block new gas connections
  - All-electric building mandates
  - End-of-life appliance replacement rules
- Financial incentives for electrification
- Market reforms of pipeline charges
- A dedicated agency to deliver support programmes

Together, these mechanisms are intended to deliver structural decline in gas use over time, while managing political risk, energy affordability, and supply security.

Strategic direction via the Gas Substitution Roadmap

The Gas Substitution Roadmap (GSR), anchors Victoria's gas transition. It provides the overarching policy logic and approach, being a sequenced, regulatory-led transition focused on electrification of buildings, appliance replacement at end-of-life, and targeted financial and planning reforms, while preserving gas supply for harder to abate industrial uses.

Its annual update cycle allows for it to evolve to meet changing circumstances as well as adjust elements that aren't working as well as intended.

Progressive regulatory prohibitions on gas use

The Victorian government has started a staged approach to prohibiting gas use, starting initially with prohibitions on gas for new residential developments, and then progressively extending the prohibitions to cover commercial buildings and also replacements of end-of-life gas appliances.

It has used a mix of planning controls and building and appliance regulations.

- Since 1 January 2024, new residential dwellings, apartments, and residential subdivisions that require a planning permit can no longer connect to the gas network. This was implemented via Amendment VC250 to the Victoria Planning Provisions. These do not generally block gas connections for commercial or industrial developments.
- From 1 January 2027, all new homes and most new commercial buildings must be constructed as all-electric. Gas appliances for heating, hot water, or cooking are not permitted in these buildings. These requirements are formalised through the Building and Plumbing Amendment Regulations 2025. Industrial, manufacturing, and

agricultural buildings are excluded, reflecting economic and technical constraints.

- From 1 March 2027, when a residential gas hot water system reaches end of life and cannot be repaired, it must be replaced with an electric system (typically a heat pump). Working appliances can continue to operate; repairs are allowed until no longer feasible
  - For owner-occupiers, this requirement currently applies only to hot water, not space heating or cooking. Although the government originally proposed the requirement should also apply to space heaters, it removed that requirement after consultation, where concerns were raised about the greater retrofit costs for space heating compared to water heating and concerns around timing and breakdown stress.[31]
  - Rental housing is subject to more stringent electrification mandates: Landlords must replace end-of-life gas hot water systems *and* gas space heaters with electric alternatives
- Minimum Energy Performance Standards applied to rental properties have been used as a mechanism to strengthen the incentives to electrify, using lease transitions as a regulatory trigger:
  - At the start of a new lease or conversion to a periodic tenancy, rental providers must ensure:
    - Energy-efficient electric cooling in the main living area. As these are reverse-cycle air conditioners, they also can provide space heating in the winter – obviating the need for gas space heating
    - Minimum ceiling insulation (R5.0 where none exists)
    - Upgraded draught sealing
    - Efficient water fixtures
  - By July 2030, efficient electric cooling must be installed in all rental properties, regardless of lease status.

Financial incentives and subsidy programs

Regulation is paired with financial support programmes:

- Victorian Energy Upgrades (VEU) certificates subsidise electric appliances such as heat pumps and reverse cycle air conditioners. This is additional to the federal small-scale technology certificates (STCs) created under the Commonwealth Renewable Energy Target (RET) scheme.

[31] The original proposal required immediate replacement when a heater failed—often mid-winter. This raised practical concerns for space heating: No time to plan or shop; Tradespeople unfamiliar with electric heating solutions; Risk of households being left without heat during cold periods Hot-water failures were perceived as more manageable: Easier temporary solutions; Less seasonal urgency; Shorter installation times.

- Solar Victoria rebates further lower upfront costs, with enhanced payments for Australian-made heat pumps

Gas pricing and connection cost reforms

The Australian Energy Regulator (which regulates all the Eastern States, not just Victoria) has also adjusted market signals:

- New gas connections increasingly require up-front payment of full connection costs.

A dedicated agency: Solar Victoria

Solar Victoria is the Victorian Government agency responsible for designing and administering household and small-business clean-energy incentive programs, with a central role in supporting electrification, rooftop solar, and battery uptake across the state.

While initially focussed on solar panel installation and subsidies, its role has expanded to support the Gas Substitution Roadmap through:

- Continuation of rebates for Solar
- Rebates for Hot Water electrification
- Education and upskilling for trades impacted in the transition
- 0% interest loans for Batteries

9.1.3 Key learnings from Victoria

Financial incentives can result in poor outcomes if not complemented by an appropriate standards and training framework

Subsidy and certificate scheme design is prone to gaming. Australia's small-scale technology certificate (STC) framework, calculated under AS/NZS 4234, has been subject to "designing to the test". Manufacturers discovered that lower heating set points improve the coefficient of performance (COP) and thus qualify for more certificates — but at the cost of under-heating tanks for consumers. Similarly, in Victoria's commercial scheme, manufacturers inflated the maximum theoretical hot water load to claim larger rebates by raising set points, narrowing deadbands, and deploying resistance elements. A key corrective would be to increase the minimum delivery temperature (e.g. from 45°C to 50°C) or to introduce site-specific scaling factors — for instance, basing the certificate partly on the thermal capacity of the unit being decommissioned — to better align deemed savings with actual usage.

Overly generous subsidies create perverse incentives. When early rebates covered the full cost of systems, consumers were less discerning about product quality, and aggressive door-to-door and telemarketing sales practices emerged. Victoria and NSW responded by progressively increasing customer co-payments, imposing minimum five-year warranty requirements on all components, and banning telemarketing and door-knocking for these schemes.

Energy efficiency and demand response objectives can conflict. A higher set point and larger deadband (e.g. 70°C/10K) would store more daytime-heated water through the evening peak but reduce COP. More sophisticated demand-response strategies — triggered by spot-price data via WiFi-enabled systems or timing windows — can reconcile these objectives. A demand-response certificate scheme is being developed in Australia to incentivise manufacturers to design water heaters with demand response in mind.

Installation quality must be addressed upfront. Victoria learned early that hot water heat pump (HWHP) installations require attention to factors absent from traditional systems — airflow angles, noise, sunlight exposure. Solar Victoria responded by mandating installer training, requiring photographic documentation of each installation, and checking compliance against a jointly developed checklist before paying rebates. Where new technologies outpace updates to the National Construction Code, performance-based compliance solutions provide a legitimate interim pathway, though well-designed standards and training should progressively reduce the need for them.

Workforce transition needs structured support

While the transition will result in an overall increase in work and jobs for tradespeople, in some areas (gas-fitting) it will eventually result in a significant reduction in work.

Critically, reskilling programs should allow existing tradespeople — especially those whose gas-fitting work will decline — to move into heat pump technologies without completing an entirely new apprenticeship. Victoria is exploring a restricted HWHP licence as a practical pathway. The transition may be eased where plumbers already hold both gas and water licences, giving them a foundation in the core skills required. Meaningful coordination across traditionally separate disciplines (plumbing, gas fitting, electrical, refrigeration) would likely require a specialised licensing category backed by multidisciplinary training.

Hot Water Heat Pumps and newer electric appliances often include more complex electronics and installation requirements, especially to achieve much of the promised savings value. To support the plumbers and gas fitters for this new type of work and appliance, Master Plumbers and Plumbing Industry Climate Action Centre (PICAC) are providing training funded by Solar Victoria. This is both on installation of the new appliances, as well as business support to realise the opportunities available to them through the transition. These training programmes have been crucial to gas fitters being able to transition without needing to undertake a new apprenticeship.

The implementation of the gas ban legislation in Victoria placed the adherence responsibilities on to the plumbers primarily, and builders. The gas ban specifically ruled out the giving of permits to new buildings with gas connections, which impacts building surveyors. They also banned specifically the installation of gas appliances, gas water heaters, and gas connections. Banning the installation/connection of gas appliances means that it is plumbers who will be the most legally impacted by the ban, as opposed to other people involved in the gas supply chain.

Initially the ban wasn't well received, as there was no prior industry consultation, even though the plumbers have the responsibility to implement the ban. After receiving push back, in the next phases there was more industry consultation on the GTR.

While the ban impacts other industries, the responsibility and penalty falls on the plumber meaning they are the one needing to encourage compliance. The concern expressed by Master Plumbers, PICAC, and others, was that this places a large compliance responsibility risk on a small group with minimal proposed support or other options. The responsibility also meant the plumber needed to clarify whether the property was eligible for exemption as well.

The Victorian government didn't have any specific way to mitigate this, but contacted the Master Plumbers and PICAC, which lead to the government supported training of plumbers with funding from Solar Victoria. This specific engagement based on the Regulatory Impact Statement submissions led to increased support for the road map that wasn't there before.

Split Incentives

Victoria has been working hard to manage the split incentives issue between renters and rental providers. Victoria has had a minimum energy efficiency standard for homes since 2023, which is to help aid the transition. For addressing split incentives, they are introducing rental specific minimum energy standards (detailed on page 59 above) to ensure those properties aren't left behind.

These standards are designed to improve rental homes while keeping costs manageable for rental providers. They have staggered the implementation so that the costs can be spread over time.

Victoria is also managing split incentives by offering rental providers rebates. Victorian Energy Upgrades program provides discounts for upgrading appliances to be energy efficient, specifically space heating and cooling, and water heating appliances While these are available for all people in Victoria, using the rebates can be initiated by the tenant or the landlord. If the tenant initiates, then they are supported in getting written consent from the landlord. Solar Victoria is also offering landlords solar installation discounts to decrease cost of installing solar on their rental properties.

Low-Income Households

Victoria has a high dependence on gas as a source of energy, meaning that low-income households have a high-risk of being left behind in the energy transition. To enable an equitable transition significant support has been given to low-income households to ensure they don't get left behind and are supported. Low-Income households are most likely to have a harder time electrifying, and so these options are opened to them through Solar Victoria's rebates for solar and hot water electrification.

Social and Community Housing

Social and community housing was not included as part of the rental programmes to support the transition in the most recent Victoria Gas Substitution Roadmap.

The Energy Efficiency in Social Housing program has been funding full electrifications and upgrades. It was introduced in the first road map, and as of the most recent update in 2025 is now $209.4 million program. The first phase has focused on electrification and upgrade of appliances. The second phase, which is currently underway, will focus on disconnecting properties from the gas network where possible.

9.1.4 Eastern Australia[32]

Of relevance to Victoria are the broader measures implemented by the Australian Energy Market Commission. The AEMC has now introduced new rules for managing the gas phasedown element of the energy transition in its economic regulation of pipelines. This is driven by its projected 80% fall in distribution-connected residential and commercial demand over the next 20 years. The new rules include:

- An outcome based, clear definition on the difference between gas meter disconnection and service abolishment
- New gas connections bear the full cost upfront of connecting to gas
- Gas abolishment costs are borne by the consumer
- Gas abolishment costs are standardised
- Requirement for retailers to provide and make accessible service options for abolishing and disconnecting from gas networks.

The AEMC is also currently consulting on changes to their pricing methodology for gas companies. The proposed changes are:

- Increasing the forecasting timeframe from 5 years to 10 years, with the pricing methodology being weighted to the forecasts and based less on current actuals
- Altering the Capital Cost Recovery Tools
  - These include using accelerated depreciation for some assets, compensation for inflation, the circumstances under which capital becomes redundant, and how redundant capital provisions can be re-used
- Amending Capex and Opex definitions to focus on a potentially decreasing customer pool, instead of a focus on growing the current customer pool
- Amending reference tariffs to accommodate different transition scenarios
  - The service provider and regulator need to consider customer impacts beyond the 5-year time frame in setting tariffs

[32] Source: AEMC National Gas Amendment Rule

9.2 Other Jurisdictions with Gas Phasedown

Jurisdiction	Rationale	New Builds	Existing Builds
Victoria	Supply Concerns Climate Consumer Cost	No new Connections	Ban Space and Water heating
City of Esperance (South Australia)	Supply Concerns	No new connections possible	All builds electric or LPG
Scotland	Supply Concerns Climate Consumer Cost	Building regulations efficiency standards	
United Kingdom	Supply Concerns Climate	Ban space and water heating	
Netherlands	Climate Supply Concerns	No new connections	
Zürich	Climate Supply Concerns	Removal of gas distribution networks	Subsidised transition to renewable sources
Denmark	Climate	Building regulations energy efficiency	
New York State	Climate Public Health	No New Connections	

Vancouver	Climate	Space and Water Heating	
Austria	Climate	Space and Water Heating	Subsidised phase-out
Norway	Climate	No new connections	Ban on space and water heating
France	Climate	Space and Water heating	All need replacing

Some interesting international case studies

The Cost of a Disorderly Transition - Esperance

In 2021, Esperance Gas Distribution Company announced it would cease trading by March 2022, as the network was no longer economically viable. A state-funded transition plan of $10.4M (~$27,700 per customer) successfully moved approximately 400 customers to electrification or LPG. Key challenges included tight timelines, post-COVID trade shortages, and low initial customer engagement, which was addressed through cold calls and door-knocking.

Similar issues but a different method - Scotland

Scotland's 2024 New Build Heat Standard prohibits high-emission heating systems in new builds, driven by declining North Sea gas supply, net-zero targets, and fuel poverty concerns. Initial implementation faced low public awareness and financial barriers, with recommendations to strengthen incentives and improve communication of existing support programmes.

Phasedown through building regulations - Denmark

Denmark has phased out gas through progressively stricter building energy efficiency standards rather than outright bans. Since 2018, regulations have made gas heating, hot water, and cooking effectively non-compliant, with the rules extending from new builds to all renovations. Industry reception has been broadly positive, with 2025 updates criticised for not going far enough to meet policy goals.

9.3 Key Learnings from overseas

Victoria has managed to achieve a durable policy framework that, unlike some overseas jurisdictions, has avoided policy flip-flops or been a casualty of the 'culture wars' around transitioning away from fossil fuels. The key factors behind this durability appear to be:

- Clearly signalling the strategic direction via the Gas Substitution Roadmap
- Implementing a series of progressive measures rather than blanket heavy-handed bans
- Offering 'carrots' through financial incentive mechanisms, as well as prohibition 'sticks'. These incentives have been shown to reduce resistance to compliance and help normalise electrification. The level of financial incentive can change over time to reflect:
  - Progressively less of a need to overcome 'infant technology' barriers to new technology uptake
  - More explicit pricing of externalities such as carbon emissions in the price of gas
- Progressive building and appliance standards to improve the efficiency of energy use.
- Acknowledging that some end-uses are harder to electrify, or have more situation-specific issues than others – hence:
  - Starting with the low-hanging fruit of prohibiting new-build residential and commercial properties

- Progressively extending to replacement of residential hot water

- Acknowledging that renters and low-income households face specific barriers to transitioning to cost-effective electric heating, and having additional measures specifically aimed at such barriers.
- Not taking an absolutist approach, in that prohibitions are not on LPG, and explicitly stating that much of the aim is to enable high-value, hard-to-electrify industry to continue to use gas.
- Working with the trades through measures to support trades up-skilling in the new heating technologies, with some additional specific focus for gas-fitters who face a long-term decline in work. Having tradies as advocates will deliver far better outcomes than if they are resistant to change
- Ensuring pipeline pricing doesn't create adverse incentives for consumers to electrify.

While most of these measures are not gas bans, they make continued reliance on gas less viable by:

- Improving building efficiency (shrinking heating demand)
- Making electric systems the default whole-of-home and commercial property solution
- Increasing the comparative cost and inconvenience of retaining gas

There have also been some problems with some aspects of the Victorian transition – in particular not having sufficient standards and training for tradespeople in place ahead of programmes which used financial payments to incentivise uptake of technologies. This gave rise to early problems with some 'cowboy' installers who were implementing not fit-for-purpose heating systems or poorly-installed heating systems.

A key challenge for countries seeking to use financial carrots to help incentivise uptake of technologies is to have such standards and training support in place, but doing so in a way which is not too slow to implement and is able to keep pace with changes in technologies. Allowing suitably qualified tradespeople to self-certify, and standards regimes that don't require higher-level legislative change, are both means to address these aspects. Alignment with Australian standards where possible is another key element in this respect.

Thank you to reviewers of this report:

- Alan Brent, Professor of Sustainable Energy Systems, Te Herenga Waka Victoria University of Wellington
- Christian Hood, Chief Advisor at New Zealand Climate Foundation | Whakatere i te Āhuarangi.

APPENDICES

A Residential appliance and other cost assumptions

Table 3 and Table 4 below set out the GST-inclusive cost assumptions for residential space heating and water heating, respectively.

Table 3: Cost assumptions for residential space heating[33]

Costs varying by appliance and consumer size					
			Gas	HP	Resist
Capital & Installation ($)		Small	6,125	4,800	925
		Med	8,150	6,400	1,250
		Large	11,100	8,700	1,700
Maintenance ($/yr)		Small	60	40	0
		Med	80	50	0
		Large	110	70	0
Electricity-specific costs varying with size and situation					
			Small	Med	Large
	Prop'n of consumers		33%	33%	33%
Network upgrade ($)					
	85%	Low	0	0	0
	12%	Med	0	0	5,000
	3%	High	0	0	10,000
Make good ($)					
	5.0%	Low	0	0	0
	47.5%	Med	610	814	1,106
	47.5%	High	3,062	4,085	5,550

HIP_45 Res SH GBC26 Base

Table 4: Cost assumptions for residential water heating

Costs varying by appliance and consumer size					
			Gas	HP	Resist
Capital & Installation ($)		Small	2,825	6,200	2,400
		Med	3,775	8,275	3,200
		Large	5,125	11,225	4,325
Maintenance ($/yr)		Small	60	50	10
		Med	80	70	10
		Large	100	90	10
Electricity-specific costs varying with size and situation					
			Small	Med	Large
	Prop'n of consumers		33%	33%	33%
Network upgrade ($)					
	85%	Low	0	0	0
	12%	Med	0	0	0
	3%	High	0	0	0
Make good ($)					
	5.0%	Low	0	0	0
	47.5%	Med	81	107	146
	47.5%	High	404	539	732

HIP_45 Res WH GBC26 Base

The ex-GST gas connection costs for new-build situations are assumed to be $3,800 per connection, and gas disconnection costs for households switching away from gas are assumed to be $750 per connection.

Households needing to replace an end-of-life gas appliance with another gas appliance are assumed to save 30% of the capital and installation costs compared to a new-build situation.

[33] HP = Heat pump. Resist = Resistance electric heater